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Utilisation of Concept Attainment Strategy in Enhancing Higher Order Thinking Skills of Grade 9 Mathematics Learners

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Abstract— This study explored the Utilisation of the Concept Attainment Strategy in Enhancing the Higher-order Thinking Skills of Grade 9 mathematics learners. One hundred twenty-two students were divided into two groups: one using this approach and the other receiving traditional instruction. Pre-test results showed low performance in both groups, with no significant difference. Post-test outcomes indicated improvements in both groups, with the experimental group achieving significantly more substantial gains. The results suggest that the experimental group effectively aids in the development of critical as well as creative thinking skills of the learners through creating concepts from the given examples. The use of examples to construct an idea has a positive effect on the learners' higher-order thinking skills. The study recommends that teachers intensify their critical and problem-solving skills by attending workshops, training, and seminars to bridge the gap and improve the higher-order thinking skills of the learners. Continued research is needed to evaluate its long-term impact and adaptability across various learning contexts.

Keywords: Utilisation of Concept Attainment Strategy, Higher Order Thinking Skills, Grade 9 Mathematics Learners.

I. INTRODUCTION

The concept attainment strategy uses an inductive approach that studies examples and distinguishes them from nonexamples. The concept of attainment has a clear and systematic way of engaging the learners (Kaviani, 2023). Jerome Bruner proposed the concept attainment strategy. It focuses on developing comprehension of words and ideas associated with a concept rather than on its name or what the concept is called. It allows learners to compare and differentiate examples and understand the idea. The learners apply the applications to real-life situations (Boulware & Crow, 2008).

Learning using the concept attainment model positively influences students' critical thinking abilities. There is an increase in students' essential mathematical skills of thinking that obtain learning through concept attainment (Angraini et al., (2021). In addition, Watson (2024) defines critical thinking as higher-order thinking skills or HOTS and those attained by rote memorisation as low-order thinking. Higherorder thinking skills include synthesising, analysing, reasoning, comprehending, applying, and evaluating.

To know and help improve students' higher-order thinking skills in Mathematics, the PISA or Program for International Student Assessment assesses the knowledge and skills of 15 – 15-year-old students around the globe in reading, science and mathematics. PISA 2018 showed that the Philippines ranked second to last in Mathematics based on the country's means. In PISA 2023, the Philippines had the second-lowest score, with an average score of 350.0. In mathematics, the

Philippines got 44th in the global ranks out of 75 countries (Lapinid et al., 2022). This result implies that the Philippines has not performed better in mathematics.

In line with the PISA results, the Department of Education requires every school to conduct the Enhanced Regional Unified Numeracy TEST (E-RUNT). Results revealed that for the pre-test E-RUNT 2023-2024, Pavia National High School Grade 9 learners have156 non-numerates out of 1094. For the mid-test ERUNT 2023-2024, there are 89 non-numerates out of 1094. The results show that some learners still cannot master the four fundamental operations (addition, subtraction, multiplication, and division). It is very alarming that there are still students who are non-numerates. These results motivate mathematics teachers and researchers to find a solution that could enhance the quality of mathematics education.

Given the current results of mathematics education at Pavia National High School, the researcher utilises the Concept Attainment Strategy to enhance the HOTS of the grade 9 mathematics learners of Pavia National High School. The goal is to determine whether concept attainment may enhance the HOTS of students positively or otherwise compared to other methods, resulting in improved students' academic performance and a change in teachers' strategies at Pavia National High School.

II. LITERATURE REVIEW

A. Higher Order Thinking Skills (HOTS)

Higher-order thinking skills focus on developing students' abilities to analyse effectively and evaluate by drawing



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inferences from existing information and synthesising the available information. Since the essence of education is to remould or reshape individuals' mindsets and thinking capacities, higher-order thinking skills can be achieved through the individual's deep intellectual thoughts and abilities. Therefore, higher-order thinking is required for high-quality education (Kareem, 2022).

In addition, higher-order thinking skills go beyond lowerorder thinking skills like concept formation, basic reading comprehension, or rote memorisation, including the ability to analyse, synthesise, and evaluate information. Lower-order thinking skills might help you memorise the correct answers for a multiple-choice test. Still, higher-order thinking skills are necessary to write an essay that makes a cogent argument. Higher-order thinking skills have been well-researched, and we envision them in our classrooms (Nye, 2022).

B. Concept Attainment Strategy Model

- 1. According to Jayarani B. (2022), a concept is a group of specific things, symbols or events having similar characteristics and can be denoted by particular names or symbols. The concept Attainment model compares and contrasts examples to help students lead to a concept. It uses the process of conceptualising to help the learners be mindful. The teacher gives structured examples and feedback to help students group their ideas based on shared attributes.
- 2. In the study of Kaviani (2023), the concept attainment strategy uses an inductive approach that relies on studying examples and distinguishing them from nonexamples. A concept is an idea that shares common attributes, and without one of its key attributes, the concept will lose its status and become a non-example. The notion of attainment is a clear and systematic way of engaging learners. The teacher needs to become a researcher and consult reliable sources (e.g., dictionaries, encyclopaedias, scholarly articles, etc.) that define the concept under examination.

C. Grade 9 Mathematics Performance

PISA 2022 results show that 16% of students in the Philippines attained at least Level 2 proficiency in mathematics, significantly less than on average across OECD countries (OECD average: 69%). At a minimum, these students can interpret and recognise, without direct instructions, how a simple situation can be represented mathematically (e.g. comparing the total distance across two alternative routes or converting prices into a different currency). Almost no students in the Philippines were top mathematics performers, meaning they attained Level 5 or 6 in the PISA mathematics test (OECD average: 9%). In addition, compared to 81 countries, the Philippines ranks sixth lowest in mathematics and reading. One out of five Filipino students who participated in PISA "can interpret or recognise, without direct directions, how a simple situation can be represented mathematically". This outcome means that 84% of Filipinos who took the test do not have sufficient mathematical skills. (Chi, 2023)

In the study of Aplaon (2024) entitled "Unveiling Mathematics Proficiency Challenges: A Comprehensive Needs Assessment Among Junior High School Students", the majority of students in any grade level have difficulties in grasping fundamental mathematical concepts such as number sense, patterns, and algebra. The result of the study shows that only a small percentage while a large percentage have attained an average performance, which can be seen from their low mean scores observed across grade levels, indicating a widespread issue with mathematical performance among students. In the study (Cabuquin, 2023), High school learners who are proficient in mathematics tend to succeed and perform better in their academic courses, while low mathematics performer learners tend to experience difficulties in their academic achievement.

III. PURPOSE OF THE STUDY

This study aims to determine the effects of using a Concept Attainment Strategy to Enhance the HOTS of Grade 9 Mathematics Learners at Pavia National High School, Pavia, Iloilo.

Specifically, it seeks answers to the following questions.

- 1. What is the pre-test HOTS in Mathematics of Grade 9 learners with and without exposure to Concept Attainment Strategy?
- 2. What are the post-test HOTS in Mathematics of Grade 9 learners with and without exposure to Concept Attainment Strategy?
- 3. Is there a significant difference between the pre-test HOTS in Mathematics of Grade 9 learners with and without exposure to Concept Attainment Strategy?
- 4. Is there a significant difference between the post-test HOTS in Mathematics of Grade 9 learners with and without exposure to Concept Attainment Strategy?
- 5. Is there a significant difference between the pre-test and post-test HOTS in Mathematics of Grade 9 learners with and without exposure to Concept Attainment Strategy?
- 6. Is there a significant difference between the pre-test and post-test HOTS in Mathematics of Grade 9 learners without exposure to Concept Attainment Strategy?

IV. THEORETICAL FRAMEWORK

This study was anchored in Jerome Bruner's works, which were based on the principle of concept formation. It is a game of "find the rule." It is a "backward conceptualising approach" to making new ideas (Mishal, 2021).

Furthermore, Bruner's concept attainment model of teaching has three phases. Phase 1 will be the identification of data and the identification of concepts. In phase one, the students do not know the idea, and they will have to use specific instances of positive and negative examples

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presented by the teacher to identify the characteristics of the idea. Then, phase 2 is the testing and attainment of the concept. The remaining hypothesis is tested by having the students identify unlabeled concept examples as "yes" or "no." Lastly, phase 3 will be the analysis of the thinking strategies. Students will analyse the approach in which they will attain the concept. (Mishal, 2021). In addition, students may learn how to examine a concept from the number of perceptions and how to classify relevant information. The concept attainment model is an excellent evaluation tool when teachers want to determine whether essential ideas introduced earlier have been mastered. It quickly reveals the depth of understanding and strengthens previous knowledge (Patel et al., 2020).

Learners can form the correct concept with the right examples and teacher questions. Concepts are one of the building blocks of mathematical knowledge. It leads to learning more complex ideas. Learners can think creatively and critically by constructing concepts based on mathematical examples and non-examples.

Moreover, using graphic organisers, higher-order thinking skill questions, and making and justifying inferences can help improve the higher-order thinking skills of mathematics learners.

Based on the above principles and theories, the researcher conducted this study to determine the effect of utilising the concept attainment strategy in enhancing the higher-order thinking skills of Grad 9 mathematics learners of Pavia National High School.

V. CONCEPTUAL FRAMEWORK

This study is guided by the conceptual model, as shown in the paradigm.





The study's paradigm shows the use of the Concept Attainment strategy in enhancing the higher-order thinking skills of learners. The independent variables establish the plan in the concept attainment and non-concept Attainment strategies. In contrast, the dependent variable is the higher-order thinking Skills in Mathematics of Grade 9 learners of Pavia National High School for the Academic Year 2024-2025.

VI. METHODOLOGY

6.1. Research Design

The pretest-posttest control group design was used since the researcher conducted the study in two groups to control the teacher factor.

6.2. Subjects of the Study

The study involved 122 Grade 9 learners from Pavia National High School in Pavia, Iloilo. The section taught by the teacher-researcher was used to manage and control the various stages of experimentation throughout the study's conduct.

6.3. Research Instrument

A researcher-made, validated, and pilot-tested "performance test" in mathematics was used to gather the data needed in this study. This research instrument consisted of a 50-item test on functions.

6.4. Data Gathering Procedure

The researcher secured a permit to conduct the study from the Schools Division Superintendent of the Schools Division of Iloilo. After the approval, the principal and the head of the Mathematics Department of Pavia National High School, Pavia, Iloilo, were given copies of the approved letter. After the permission was granted, the researcher identified the learners as the study participants. The consent of the participants and their parents/guardians was asked before giving them the instruments.

Sixty-one (61) Grade 9 learners were selected as the study subjects. The experimental and control groups will be assigned randomly. Sixty-one students were assigned to the experimental group, and the other sixty-one to the control group. The researcher taught both groups to control the teacher factor during the experimental period. Grade 9 second-quarter grades will be considered when selecting the respondents.

A presentation on "Concept Attainment Strategy" emphasising class participation will be explained to the students. The students in the experimental group were informed about the methods and how this approach was used.

Before the start of the experiment, the learners were given the pre-test using the researcher-made test instrument for both groups. After that, the researcher-teacher taught both groups the geometry lessons using the prepared instructional materials for the study, which will last for nine (9) weeks (from January to March, S.Y. 2024-2025).

The study involved pre-experimental activities, proper experimental procedures, and post-experimental activities. The first stage was the administration of the pre-test on the topic of Geometry in Junior High School Mathematics subject. The second stage was the employment of the teaching strategies (Concept Attainment strategy and Traditional method of teaching) for the two groups of participants. This stage lasted for nine (9) weeks. It started in



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the second week of January and ended in the second week of March 2025. The third stage of the study was the administration of the post-test after covering all the selected topics in Geometry.

The experimental group used the Concept Attainment strategy, while the control group used the traditional teaching method. The same competencies, topics, and reference books will be used. The experimental group class took place in New Building 2 from 1:00 to 2:00 in the afternoon during class days, while the control group took place in their classroom from 7:30 to 8:30 in New Building 1 in the morning.

6.5. Data Analysis

After the experiment, the data gathered for this study were subjected to appropriate computer-processed statistics employing the Statistics Package for Social Sciences (SPSS) software. The level of significance was 0.05.

Mean and standard deviation were used for descriptive statistics, and the t-test for dependent and independent samples was used for inferential statistics.

6.6. Ethical Considerations

The Code of Ethics has guided the study's actions based on moral principles. Putting the participants' welfare first, the researcher asked for their consent to participate voluntarily. Anonymity was preserved, formal correspondence was sent by email, and they were identifiable by number coding. They were given the researcher's word that the information they submitted would only be used for that purpose. The author declares no conflict of interest.

VII. RESULTS AND DISCUSSION

Table 1

Pre-test Higher Order Thinking Skills (HOTS) in Mathematics of Grade 9 Learners with and Without the Use of Concept Attainment Strategy.

Table 1: Pre-test HOTS in Mathematics of Grade 9 Learners

 with and Without the Use of Concept Attainment Strategy.

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Category	Ν	Mean	Description	Sd
Entire group	120	13.88	Low	3.24
With Concept Attainment Strategy Without Concept	61	13.97	Low	3.46
Attainment Strategy	61	13.79	Low	3.02

Note: Very High 40.01 – 50.01 Low 10.01 – 20.00 High 30.01 – 40.00 Very Low 0.00 – 10.00 Average 20.01 – 30.00

The result showed that the pre-test concept attainment strategy in developing higher-order thinking skills of the mathematics learners as an entire group was "low" (M= 13.88, SD = 3.24). The higher-order thinking skills of the mathematics learners with concept attainment strategy were

considered "low" (M=13.97, SD = 3.46), and those without concept attainment strategy were also low (M=13.79, SD = 3.02) based on the scale used in the study. Their level of prior knowledge before the treatment is the same. The present result supports the study of Lapinid et al. (2022); schools and teachers should identify who is at risk of performing poorly in mathematics at the early stages of instruction. Teachers should pay attention to the needs of the learners and provide appropriate instruction.

Difference in the Pre-test Higher Order Thinking Skills in Mathematics of Grade 9 Learners

Table 2 presents the difference in the pre-test higher-order thinking skills in mathematics of grade 9 learners who used a concept attainment strategy or not.

Table 2. t-test Result of the Difference in Pre-test Higher

 Order Thinking Skills (HOTS) in Mathematics of Grade 9

 Learners With and without the Concept-Attainment Strategy

Category	Mean	df	t- value	Sig
With Concept Attainment Strategy	13.97	10	No.	
	44	120	.307	.760
Without Concept Attainment Strategy	13.79			

Table 2 showed no significant difference in the pre-test of higher-order thinking skills in Mathematics of Grade 9 learners with or without concept attainment strategy (t[122] =.307, p=.760). This result shows that learners' higher-order thinking skills before the intervention are the same. The experimental group and control group's pre-test scores were close to each other. Both groups were comparable in terms of their higher-order thinking skills in Mathematics.

The study's results affirm the study of Lapinid et Al. (2022), which suggests that teachers should design more effective learning activities in mathematics for students who are at risk of failing. Teachers should develop engaging activities that motivate students to learn and value mathematics.

Post-test Higher Order Thinking Skills in Mathematics of Grade 9 Mathematics Learners

Table 3 presents the higher-order thinking skills in Mathematics of Grade 9 learners with or without using a concept attainment strategy.

Table 3. Post-test Developing Higher Order Thinking Skills(HOTS) in Mathematics of Grade 9 Learners with and

without the Use of Concept Attainment Strategy.

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Ν	Mean	Description	Sd	
122	29.05	Average	3.84	
61	32.66	High	4.26	
	N 122 61	N Mean 122 29.05 61 32.66	NMeanDescription12229.05Average6132.66High	



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Category	Ν	Mean	Description	Sd
Without Concept				
Attainment Strategy	61	25.43	Average	3.42

Note: Very High 40.01 – 50.01 L High 30.01 – 40.00 V Average 20.01 – 30.00

Low 10.01 – 20.00 Very Low 0.00 – 10.00

The data in Table 3 revealed that the mean score in the post-test concept attainment strategy in enhancing higherorder thinking skills of the mathematics learners as an entire group was "average" (M=29.05, SD = 3.84). Also, the concept attainment strategy was "high" (M=32.66, SD = 4.26) based on the scale used in the study and without was "average" (M=25.43, SD = 3.42). This result indicates that learners with and without using the Concept Attainment strategy improve their higher-order thinking skills. Learners who used the Concept Attainment strategy performed better than those without using the Concept Attainment strategy, with a mean difference of (M=7.23).

The results of this study supported the study of More (2023), which encourages students to explore and make conclusions on their own. This concept attainment strategy promotes critical thinking, problem-solving, and deep comprehension.

Difference in the Post-test Higher Order Thinking Skills of Grade 9 Mathematics Learners

Table 4 presents the difference in the post-test higher-order thinking skills in Mathematics of Grade 9 learners who used a concept attainment strategy.

Table 4. t-test Result of the Difference in Post-test Higher

 Order Thinking Skills (HOTS) in Mathematics of Grade 9

 Learners with or without the Concept-Attainment Strategy

Category	N	Mean	df	t-value	Sig
With Concept Attainment Strategy	61	32.66			
			120	10.34	.000*
Without Concept Attainment Strategy	61	25.43			

*p < .05 -significant

The data in Table 4 revealed a significant difference in the post-test concept attainment strategy of the learners with and without the concept attainment strategy (t [120] =10.34, p=.000). The result shows the different influences of the two teaching methodologies, with and without the concept attainment strategy, adopted for teaching mathematics.

The study of Angraini et al. (2021) confirms a difference in the increase in students 'mathematical critical thinking abilities who obtain learning concept attainment models compared to students who obtain conventionally. The mathematical initial skills of each student who gets the concept attainment learning model and conventional learning can distinguish students' mathematical critical thinking abilities.

Difference in the Pre-test and Post-test Higher Order Thinking Skills of Grade 9 Mathematics Learners without the Use of Concept Attainment Strategy

Table 5 presents the difference between the pre-test and post-test higher-order thinking skills in mathematics for Grade 9 learners with a concept attainment strategy.

 Table 5. t-test Result of the difference in Pre-test and Post-test Higher Order Thinking Skills (HOTS) in Mathematics of Grade 9 Learners with the Use of Concept Attainment Strategy.

Category	Μ	Mean Diff	t-value	df	Sig
Pre-test	13.97				
		18.69	-31.15	60	.000*
Post-test	32.66				
$*p < .05 - si_{0}$	gnificant	4			

Table 5 showed a significant difference between the pretest and Post-test higher-order thinking skills in Mathematics of Grade 9 learners using concept attainment strategy (t [60] =-31.15, p=.000). The result showed a significant increase in the learners' higher-order thinking skills with concept attainment strategy compared to their pre-test. The mean difference of 18.69 shows that learners improve their higherorder thinking skills in mathematics. It also shows that learners taught with concept attainment strategy have higher thinking skills.

The study's results supported Habib's analysis (2019). Teachers should use the concept attainment model in classrooms. It strengthens students' cognitive structure, clarifies ideas, and introduces aspects of content.

Difference Pre-test and Post-test Higher Order Thinking Skills in Mathematics without the Use of Concept Attainment Strategy

Table 6 presents the difference between the pre-test and post-test higher-order thinking skills in mathematics for Grade 9 learners without concept attainment strategy.

Table 6. t-test Result of the difference in Pre-test and Posttest Higher Order Thinking Skills (HOTS) in mathematics of Grade 9 Learners without the Use of Concept Attainment

Strategy.

Category	М	Mean Diff	t-value	df	Sig
Pre-test	13.79				
		11.64	-28.60	60	.000*
Post-test	25.43				

*p < .05 -significant

Table 6 showed a significant difference between the pretest and Post-test higher-order thinking skills in mathematics of Grade 9 learners without using the concept attainment strategy.

This present study is supported by the analysis of Alam and



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Malik (2019), which showed that the pre-test/post-test model is comparatively more effective in achieving learning outcomes in a lecture setting.

VIII. SUMMARY OF THE FINDINGS

The following were the findings of the study:

- 1. The pre-test Higher Order Thinking Skills in Mathematics of the Grade 9 learners exposed to Concept Attainment Strategy was "low", and the pre-test Higher Order Thinking Skills in Mathematics without Concept Attainment Strategy was also "low".
- 2. The post-test higher-order thinking Skills in mathematics of the Grade 9 learners with exposure to the Concept Attainment Strategy were "high", and the post-test higherorder thinking Skills in mathematics without exposure to the Concept Attainment Strategy were "average."
- 3. There was no significant difference between the pre-test Higher Order Thinking Skills in Mathematics of Grade 9 learners with and without exposure to the Concept Attainment Strategy. However, the learners without exposure to the Concept Attainment Strategy had higher pre-test scores than those with exposure to the Concept Attainment Strategy.
- 4. There was a significant difference between the post-test Higher Order Thinking Skills in Mathematics of Grade 9 learners with exposure to Concept Attainment Strategy and without exposure to Concept Attainment Strategy. The post-test Higher Order Thinking Skills in Mathematics of Grade 9 learners with exposure to Concept Attainment Strategy is higher than the without exposure to Concept Attainment Strategy.
- 5. There was a significant difference between the pre-test and post-test higher-order thinking Skills in Mathematics of Grade 9 learners with exposure to the Concept Attainment Strategy and those without exposure to the Concept Attainment Strategy. The learners exposed to the Concept Attainment Strategy can enhance their higherorder thinking skills in mathematics.
- 6. There was a significant difference between the pre-test and post-test Higher Order Thinking Skills in Mathematics of Grade 9 learners without exposure to Concept Attainment Strategy, implying that learners without using Concept Attainment Strategy also performed better in their post-test.

IX. CONCLUSIONS

Based on the findings gathered and observations made by the researcher, the following conclusions were drawn:

1. The level of higher-order thinking skills in mathematics of the Grade 9 learners with exposure to the Concept Attainment Strategy and without exposure to the Concept Attainment Strategy were the same. The learner's higherorder thinking skills in mathematics were less developed before exposure to the Concept Attainment Strategy and without exposure to the Concept Attainment Strategy. Both have the same Higher Order Thinking Skills level and are not subjected to different teaching strategies.

- 2. The post-test higher-order thinking Skills in Mathematics of the Grade 9 learners with and without exposure to the Concept Attainment Strategy improved. The learners exposed to the Concept Attainment Strategy performed better than those taught using the traditional method. Giving and associating examples, testing the hypothesis, and creating a concept can enhance the learners' higherorder thinking skills.
- 3. Before the experiment's start, the learners with and without exposure to the Concept Attainment Strategy were comparable. They had the same level of higher-order thinking Skills.
- 4. Implementing an Attainment Strategy to develop higherorder thinking Skills in Mathematics for Grade 9 learners was more effective than without exposure to the strategy. Utilising the strategy improved and enhanced the learners' higher-order thinking Skills in Mathematics compared to those without exposure to it. Hence, using examples to create a concept positively affects the learners' higherorder thinking Skills.
- 5. Using the Concept Attainment Strategy in teaching mathematics improves the learners' higher-order thinking skills. Constructing concepts from the given examples aids in developing critical and creative thinking skills.
- 6. The traditional teaching method improves the higherorder thinking skills of mathematics learners. This strategy is widely used in teaching mathematics and has already been proven to improve teaching.

X. RECOMMENDATIONS

The researcher formulated the following recommendations based on the findings and conclusions made in the study.

- 1. Teachers should use the Concept Attainment Strategy and different methods to deal with the needs of the learners.
- 2. Teachers should support and enhance the learners' development of higher-order thinking skills necessary for problem-solving in mathematics.
- 3. Teachers should ensure that the teaching and learning materials align with the essential mathematics learning competencies for students to improve.
- 4. Teachers should intensify their critical and problemsolving skills by attending workshops, training, and seminars to enhance the learners' higher-order thinking skills.
- 5. School administrators should support teachers' innovation and strategies, such as the concept attainment strategy, which could help learners improve their studies.
- 6. Traditional teaching methods are still possible, provided they suit the learning styles and situations inside the classroom.
- 7. The results of this study may be helpful to future



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researchers in enhancing their teaching strategy in Mathematics and the utilisation of the Concept Attainment strategy in improving the higher-order thinking skills of learners.

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