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IMPACT OF CONCEPT ATTAINMENT MODEL ON STUDENTS' ACADEMIC ACHIEVEMENT IN GEOMETRY AT UPPER PRIMARY LEVEL

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Abstract:

The Concept Attainment Model (CAM) is an inductive teaching strategy that significantly improves student learning in geometry compared to conventional teaching methods by engaging students in identifying attributes and forming hypotheses, leading to higher-order critical thinking and better retention of learning. It facilitates the understanding of abstract geometric concepts by using examples and non-examples, enhancing student engagement and academic outcomes, particularly at the upper primary level. By shifting from rote memorization to a structured inquiry process, the model helps students understand complex spatial relationships and abstract geometric definitions more effectively than the conventional teaching methods. This teaching model (CAM) turns geometry from a static subject into a dynamic, creative, and student-centered inquiry process. The main objective of the study was to find out the impact of the Concept Attainment Model on students' academic achievement in geometry at the upper primary level. A quasi-experimental design was employed for this study. The study was carried out in the district of Purba Bardhaman. A total 190 students of Class VIII were selected as a sample through a random sampling technique. The students were divided into two groups: an experimental group and a control group. The results of the study showed that students taught through CAM performed better in geometry than those taught through conventional methods.

Keywords: Concept Attainment Model, Spatial-visualization, Academic Achievement, Geometry, Upper Primary Level

1. INTRODUCTION:

Mathematics is the language of the universe, whereas geometry is the fundamental language of the physical world that determines how objects occupy space and interact with one another. Geometry is called a spatial-visual language as it uses shapes, points, and lines to represent and communicate information about physical space, much like words depict ideas in verbal language. Spatial visualization involves manipulating shapes mentally – a process that acts as a cognitive language of space.

Problem-solving in geometry involving complex thinking requires integrating visualization, logical reasoning, and strategy planning. It goes beyond rote memorization of theorems and formulas involving creative, non-routine, and multi-step reasoning. Key skills encompass breaking down complex figures, making logical inferences, and applying different theorems to solve complex, often non-routine, mathematical problems. In geometry, complex problem-solving moves beyond just memorizing formulas; it requires spatial reasoning and logical synthesis. Thus, mastering geometry demands the ability to connect abstract properties to visual structures.

The concept attainment model (CAM), developed by Jerome Bruner (1960s), is an inductive teaching strategy that enhances active learning and conceptual understanding. This model shifts students from passive recipients of information to active participants in the learning process. By analyzing "Yes" (examples) and "No" (non-examples) prompts, students generate hypotheses, identify essential attributes, and uncover patterns on their own, which fosters divergent thinking, originality, and flexibility in solving geometric problems.

Instead of memorizing a specific definition, students use CAM to identify multiple characteristics of a geometric concept. This encourages critical thinking and multiple solutions for a particular geometric topic. This model transforms abstract geometric definitions into a visual "search for attributes", where students apply inductive reasoning to identify the properties of shapes through systematic comparison. Since geometry is inherently visual, CAM leverages this by having students identify essential objects and primitive elements within complex figures, leading to a richer "concept image" in their minds.

The structured inquiry process of CAM – forming, testing, and refining hypotheses – equips students to tackle open-ended, non-routine, and three-dimensional geometry problems with greater creativity and confidence.

The present study aims to examine the effectiveness of the Concept Attainment Model in enhancing students' academic achievement in geometry among upper primary students. Specifically, this research study emphasizes on Class VIII students from different schools in Purba Bardhaman, with reference to the topic "The sum of interior angles of an n-sided polygon is 2(n-2) right angles".

2. RATIONALE OF THE STUDY:

Geometry is referred to as a spatial-visual language because it acts as a structured system of symbols, rules, and relationships used to describe, analyze, and communicate the structure of the physical world around us. It translates abstract mathematical concepts into visual forms such as lines, shapes, angles, and uses spatial reasoning to transform those forms into rotation, scaling, and reflection, making it both visual and spatial. The Concept Attainment Model (CAM) helps to improve spatial reasoning in geometry by guiding students to actively discover the defining attributes of shapes and spatial relationships through comparative analysis, rather than passive memorization. By contrasting "Yes" (examples) with "No" (non-examples), learners develop critical thinking and spatial visualization skills necessary to identify patterns, classify objects, and understand spatial transformation like rotation or flipping. Rather than being told a formula, students formulate their own definitions of two-dimensional or three-dimensional objects based on observed patterns, which creates a deeper, long-lasting mental map of the geometric concepts that leads to the development of inductive reasoning.

Therefore, the use of the Concept Attainment Model in teaching geometry is expected to foster inductive reasoning, meaningful learning, and improved academic achievement among the students at the upper primary level. The specific topic "The sum of the interior angles of an n-sided polygon is 2(n-2) right angles" has been chosen in such a way that students can compare and differentiate all types of angles, triangles, quadrilaterals, and polygons with their attributes in a single topic. This enables learners to perform as active investigators rather than passive recipients of knowledge.

3. REVIEW OF RELATED RESEARCH:

- **Honmane et al. (2024)** investigated the effectiveness of the use of Concept Attainment Model on senior secondary one students' achievement in Mathematics in Lokoja Metropolis, Kogi State, Nigeria. The results of the study found that the students taught using Concept Attainment Model (CAM) improved in their achievement than those taught without CAM.
- **Angraini & Wahyuni (2021)** highlighted the effect of Concept Attainment Model on Mathematical Critical Thinking Ability. The findings of the study revealed that the mathematical critical thinking abilities of the students who use the Concept Attainment Model learning is better than the students who use Conventional Learning based on mathematical initial abilities of students.
- **Herma (2021)** investigated the effect of CAM on mathematics achievement of 8^{th} graders in the unit of square and square root. The result of the study showed that the concept attainment model was more effective than the traditional method, but the achievement of the students belonging to the high academic achievement group did not differ significantly either they have learnt through concept attainment model method or traditional method.
- **Angraini (2019)** examined the influence of concept attainment model in mathematical communication ability at the university students. The results of this study showed that there is a difference on students' mathematical communication who got the concept attainment model and

students who got the conventional teaching. The concept attainment model provides a better influence on students' mathematical communication ability, it is also necessary to see the influence of the concept attainment model on students' high-level mathematical thinking ability.

- **Habib (2019)** experimented the effectiveness of Concept Attainment Model of Teaching on Achievement of XII standard students in Social Sciences. He reported that concept attainment model is very useful in terms of achievement of the students in the teaching of social science.

4. OBJECTIVES OF THE STUDY:

The objectives of this study are stated as:

- To find out the entry-level knowledge of the student in geometry at the upper primary level.
- To identify the specific topic in selected units of geometry.
- To design and develop instructional materials for experimentation.
- To conduct experiments based on the Concept Attainment Model (CAM) and the Conventional Method.
- To examine the effect of the Concept Attainment Model on students' academic achievement in geometry at the upper primary level.
- To find out the differences in achievement scores of the students taught through the Concept Attainment Model and the Conventional Method.
- To develop an achievement test (post-test) on selected topics of geometry at the upper primary level.
- To compare the difference between pre-test and post-test scores within each instructional strategy.

5. HYPOTHESES OF THE STUDY:

Based on the above objectives, the following hypotheses were framed:

- **H_{01}:** There is no significant difference between the mean achievement scores of the students taught through the CAM and the Conventional method. (Pre and Post Conditions within Strategies)
- **H_{02}:** There is no significant difference between the mean achievement scores of the students taught through the CAM and the Conventional method. (Post Conditions between Strategies)
- **H_{03}:** There is no significant difference between the mean achievement scores of boys and girls taught through the CAM and Conventional method.

6. SCOPE AND DELIMITATIONS OF THE STUDY:

There is a huge scope for conducting this type of research. But considering the feasibility and cooperation from the schools, it is necessary to delimit the study. This study was delimited under the following areas:

- **Area:**
  This type of study could have been conducted in any district of West Bengal. But considering the feasibility, the study was conducted in the district of Purba Bardhaman.
- **Schools:**
  Three secondary schools of West Bengal Board of Secondary Education at the upper primary level were selected for the study. Out of three schools, one school for boys, one school for girls and one co-educational school were selected at the upper primary level for this study.
- **Class:**
  Class VIII at the upper primary level was selected for this study.
- **Instructional Strategies:**
  There are several teaching strategies for instruction to the students of secondary schools at the upper primary level in geometry, such as analytic and synthetic method, lecture method, project method, laboratory method, heuristic method, problem-solving method etc.
  In this study two instructional strategies were selected for experimentation, one is Concept Attainment Model (CAM) and another one is Conventional method.
- **Content Area:**
  One unit of class VIII was selected for conducting the experiment with instructional strategies. The selected topic for experimentation was “The sum of all interior angles of an n-sided polygon is 2(n-2) right angles”.

7. RESEARCH DESIGN AND METHODOLOGY OF THE STUDY:

7.1 Research Design:

A quasi-experimental design was adopted for the study.

7.2 Sample:

A total of 190 students at the upper primary level were taken as a sample for this study. Out of 190 students, 92 students belong to the boys group, and 98 students belong to the girls group.

7.3 Variables:

- **Independent Variable:** Gender, Teaching Strategy [Concept Attainment Model (CAM) and Conventional method]
- **Dependent Variable:** Student’s academic achievement in geometry

- **Controlled Variable:** Syllabus, Teacher, Teaching time

7.4 Tools:

The following tools were selected for collecting the data:

i) An Entry-Level Test (Pre-Test) was used to measure the entry-level knowledge of the students of class VIII in Geometry.

ii) An Achievement Test (Post-Test) was used to measure the achievement of the students after experimentation.

iii) Learning materials on the selected units based on the instructional strategies selected for the study were used for the experiment.

All the tools were constructed and developed by the investigator herself.

7.5 Methodology:

For the selection of the sample, three secondary schools in the district of Purba Bardhaman were selected randomly.

After the selection of schools, students of class VIII of different section from each school were selected purposively. 190 students were selected from class VIII for experimentation. Out of these, a group consisted of 98 students treated as the experimental group, and another group consisted of 92 students treated as the control group.

This research was conducted in three phases:

- **Phase-I:** A pre-test was administered for both groups (experimental group and control group) to assess the entry-level knowledge of the students in geometry.
- **Phase-II:** The experimentation was done in this phase. The experimental group was taught through the Concept Attainment Model (CAM), whereas the control group was instructed through the Conventional Method.
- **Phase-III:** After conducting the experimentation, a post-test was administered for both groups (experimental group and control group) to measure their academic achievement in geometry.

8. ANALYSIS AND INTERPRETATION OF DATA:

8.1 Analysis of Data for Testing H_{01}:

[H_{01}: There is no significant difference between the mean achievement scores of the students taught through CAM and Conventional method. (Pre and Post Conditions within Strategies)]

Table-8.1
Showing t-value between Pre and Post achievement scores of Students

Strategies	No. of Students (N)	Test	Mean Score	S.D	SE_D	t-value	Level of Significance
CAM	98	Pre-Test	10.68	4.15	0.34	12.47	0.01
		Post-Test	14.92	4.02			
Conventional Method	92	Pre-Test	11.80	4.39	0.64	4.17	0.01
		Post-Test	9.13	4.34			

Interpretation:

It has been observed from the results in Table 8.1 that the achievement of students instructed through CAM differs significantly at 0.01 levels between Pre and Post conditions. Similarly, same type of result has been found in case of Conventional method. Hence, the effects of strategies on learning differ significantly. Also, it indicates that the Concept Attainment Model is better than the Conventional method.

8.2 Analysis of Data for Testing H_{02}:

[H_{02}: There is no significant difference between the mean achievement scores of the students taught through CAM and Traditional method. (Post Conditions between Strategies)]

Table-8.2

Showing t-value between Mean Achievement Scores of Students of Different Strategies

Strategies	No. of Students (N)	Test	Mean Score	S.D	SE_D	t-value	Level of Significance
CAM	98	Post-Test	14.92	4.02	0.61	9.49	0.01
Conventional Method	92	Post-Test	9.13	4.34			

Interpretation:

The table-8.2 shows that there is a significant difference on the achievement of the students in learning geometry taught through Concept Attainment Model and Conventional Method. Also, the table shows that Concept Attainment Model (CAM) is very much effective than Conventional method in improving students' academic achievement in geometry at upper primary level.

8.3 Analysis of Data for Testing H_{03}:

[H_{03}: There is no significant difference between the mean achievement scores of boys and girls taught through CAM and Conventional method.**]**

Table-8.3a
Showing t-value between Mean Achievement Scores of Boys and Girls of Different Strategies (Within Strategy)

Strategies	Gender	No. of Students (N)	Mean Score	S.D	SE_D	t-value	Level of Significance
CAM	Boys	48	16.19	4.72	0.77	1.92	N.S
	Girls	50	13.7	3.91			
Conventional Method	Boys	34	8.91	3.76	0.85	0.41	N.S
	Girls	58	9.26	4.16			

Table-8.3b
Showing t-value between Mean Achievement Scores of Boys and Girls of Different Strategies (Between Strategy)

Strategies	Gender	No. of Students (N)	Mean Score	S.D	SE_D	t-value	Level of Significance
CAM	Boys	48	16.19	4.71	0.94	8.52	0.01
Conventional Method		34	8.91	3.71			
CAM	Girls	50	13.7	3.90	0.78	5.72	0.01
Conventional Method		58	9.26	4.16			

Interpretation:

The table 8.3a shows that there is no significant difference on achievement of learning geometry of boys and girls through CAM. Also, the table 8.3b shows that there is a significant difference on achievement of learning Geometry of boys and girls taught through two different strategies. Therefore, CAM is more effective than Conventional method for boys as well as girls in case of scoring to solve geometric problems.

CONCLUSION:

The findings of the study revealed that the Concept Attainment Model (CAM) is a more effective instructional strategy than the Conventional method in enhancing students' academic achievement in geometry at the upper primary level. Students taught through CAM achieve above-average scores on standardized test of geometric concepts, whereas those taught through Conventional methods generally perform at an average level.

This model facilitates learning beyond rote memorization by enabling students to identify essential attributes through the analysis of examples and non-examples, leading to a deeper understanding of complex geometric concepts. Beyond immediate test scores, this teaching model (CAM) improves the long-term retention of the geometrical concepts and develops higher-order thinking skills, such as inductive reasoning and hypothesizing. This teaching model creates a more comparative and lively classroom environment that increases student engagement and responsiveness. Hence, the Concept Attainment Model (CAM) proves to be an effective instructional strategy for teaching-learning geometry at the upper primary level.

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