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Difficulties In Remembering Theorem Statements Among Ninth Standard Students

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ABSTARCT

This study examines the difficulties ninth-grade students face in remembering mathematical theorem statements and evaluates the effectiveness of activity-based strategies in improving recall. The research followed an experimental design with four students from Sri Gokula School, Mysuru. A researcher-developed pre-test and post-test containing objective and short-answer items measured recall levels. Pre-test results showed low retention due to weak conceptual understanding, reliance on rote memorization, limited interaction, and difficulty with mathematical language. An action plan using five activities- Theorem Memory Card, Theorem Quiz Bowl, Jigsaw Group Activity, Chalk Talk Theorem Walk, and Theorem Bingo was implemented. Post-test scores revealed clear improvement, demonstrating that visual, collaborative, and recall-oriented methods enhance understanding and long-term retention of theorem statements.

Keywords

Geometry learning, experimental study, memory enhancement strategies, interactive teaching methods.

Introduction

Remembering mathematical theorem statements is a key requirement for success in secondary school mathematics, particularly in Grade 9, where students are formally introduced to abstract reasoning. However, many learners face difficulties in retaining theorem statements due to factors such as limited conceptual clarity, lack of exposure to varied practice and anxiety toward mathematics. When students learn theorems through memorization without understanding the underlying ideas, their recall becomes weak and short-lived. This challenge not only affects their performance in geometry but also reduces their confidence in solving proof-based problems. Therefore, investigating the reasons behind students' difficulty in remembering theorem statements is essential for designing effective instructional strategies that strengthen both memory and understanding.

Need and Importance

Understanding why 9th-grade students find it difficult to remember theorems is important because these theorems lay the foundation for learning other mathematical concepts and developing higher-order skills. If students fail to recall theorem statements, it becomes difficult for them to solve problems and apply mathematical reasoning. This affects their overall performance in mathematics and reduces their confidence in handling abstract concepts. This study is significant because it identifies the root causes preventing effective retention, such as a lack of conceptual understanding and limited exposure to reasoning skills. By recognizing these challenges, teachers can adopt better strategies—such as activity-based methods, visual learning and regular revision—to strengthen student memory. The findings of this research will guide improvements in classroom practices and support students in becoming more confident and skilled in mathematics.

Causes for the Problem

1. **Lack of conceptual understanding:** When conceptual clarity is weak, memory retention becomes shallow.
2. **Use of complex and technical language:** Complex language increases the difficulty to retain the theorem as they focus on terminology rather than understanding the actual logic.
3. **Limited exposure to proof-based thinking:** Many students lack skills in logical justification and step-by-step reasoning, causing them to struggle to recall theorem statements accurately.
4. **Rote learning approach:** When students memorize theorem statements without visual or practical connections, they forget them easily.
5. **Limited classroom interaction:** When students passively listen instead of actively participating their learning stays surface-level.
6. **Inadequate teaching strategies:** The absence of interactive methods, such as recall games, concept mapping or peer explanation, can lead to poor retention.
7. **Over-reliance on rote memorization:** Proofs often contain many logical steps, if these steps are memorized without reasoning students cannot recall them accurately later.
8. **Anxiety or negative attitude towards mathematics:** Mathematics anxiety affects students' concentration, working memory and confidence.

Prioritized Causes

1. Limited classroom interaction
2. Over-reliance on rote memorization.
3. Use of complex and technical language.
4. Lack of conceptual understanding

Objectives of the Study

1. To enhance students' ability to remember theorem statements through structured, recall-based activities.
2. To improve students' understanding and retention of theorems using collaborative and interactive learning strategies.
3. To strengthen recall of theorem statements through the use of visual, board-based and hands-on activities.
4. To promote quick and accurate recall of theorems through quizzes, games and oral and written practice activities.
5. To reduce students' dependence on rote memorization by integrating conceptual and activity-based learning methods.

Review of Related Literature

Patac, Patac and Crispo (2022) investigated the geometric understanding of 38 Grade 9 ESL students in the Philippines through a problem-posing intervention involving four text-based theorems. Utilizing a descriptive analysis of fluency, flexibility and syntactic structure, the study required participants to generate problems from theorems without symbolic prompts to assess cognitive processing. Findings indicated that students struggled with translanguaging and lacked semantic grasp, resulting in high technical errors and low reasoning skills due to the absence of visual registers. Consequently, the authors recommend integrating routine problem-posing activities and ensuring symbolic representation to bridge the gap between natural and mathematical languages for learners.

Dhungana, Sandip (2021) mixed-method study aimed to identify the obstacles in secondary students facing learning geometry theorems and the underlying reasons for these difficulties. Utilizing an explanatory sequential design, the research sampled 270 students and 27 teachers for a quantitative survey, followed by qualitative interviews with six participants, including educators and curriculum experts. The activities involved analyzing responses on content, pedagogy and resources to correlate teaching styles with student performance. Findings revealed that students perceive theorems as abstract and impractical due to traditional teacher-centric methods, rote memorization for exams and a lack of ICT or math labs, though gender was not a significant factor. To address this, the paper suggests contextualizing curriculum to real-life scenarios, integrating technology for visualization and enhancing teacher training to foster student-centric, collaborative learning environments.

Rudi, Suryadi and Rosjanuardi (2020) studied the difficulties junior high students face in understanding and applying the Pythagorean Theorem. The research involved 25 ninth-grade students, with four chosen for detailed interviews. Using tests and structured interviews, the study examined how students reasoned through concept and application questions. The findings showed that many students struggled with understanding definitions, symbols and mathematical objects, often depending on memorization. However, they performed better in applying procedures, though translating ideas into symbols was still difficult. The authors recommend using these insights to strengthen teacher knowledge and improve teaching methods to support both conceptual and procedural understanding.

Movshovits-Hadar (1988) explains that many mathematics theorems contain an element of surprise. The paper suggests that using this unexpected aspect can make lessons more engaging for students. It describes ten types of mathematical surprises with examples from geometry, algebra and number theory. The author encourages teachers to introduce theorems in a way that sparks curiosity before showing the proof. This approach, called the "Stimulating Responsive Method," helps make learning more interesting. The study concludes that curriculum planners and teacher training programs should include such strategies to improve students' appreciation of mathematics.

Research Methodology

In the present study, Quantitative Research method and Experimental research design is used.

Sampling: The sample consists of 4 students studying in 9th standard of Sri Gokula School, located at Kuvempunagara, Mysuru, which belongs to Kuvempunagara cluster of Mysuru South Block.

Research Tool: Researcher developed pre-test and post-test questionnaire consisting maximum of 25 marks including objective type and short answer questions.

Procedure

The Action Research test was conducted for 9th Std. students. The pre-test was given and after the evaluation of the answer sheet, marks list is obtained. Different activities that help in remembering the statement of theorems were taken place. After conduction of these activities, to check the improvement of the students/sample selected after the pre-test, a post-test was given. The results of both pre-test and post-test are compared and interpretations, graphical representations are made followed by enlisting research based findings and suggestions.

Action Plan

Table-1: Details of Action Plan

Sl. No.	Action Plan	Duration (in min)	Frequency
01.	Theorem Memory Card	10	3
02.	Theorem Quiz Bowl	15	2
03.	Jigsaw Group Activity	20	2
04.	Chalk Talk Theorem Walk	15	3
05.	Theorem Bingo	20	1

Description of Action Plans:

1. **Theorem Memory Card:** This is an engaging, game-based learning activity .It helped students remember the statements of mathematical theorems through active recall and peer interaction. In this activity, each student was given a set of memory cards. Each card contained either the name of a theorem or the correct statement of that theorem. Students matched the theorem name with its correct statement, just like a memory-matching game. This playful repetition helped students to repeatedly read, recall and verify the theorem statements in an enjoyable way. This activity encouraged collaboration and playful engagement, the activity makes theorem leaning enjoyable.

2. **Theorem Quiz Bowl:** This is an energetic, team-based activity designed to make learning mathematical theorems both exciting and meaningful. Questions were asked to 4 students individually as there was no group or teams. Set of questions were prepared which included identifying theorem names, stating the theorem accurately, key concepts and simple applications of theorem to given problems. Students competed to answer first. This activity encouraged students to think independently as it was a individual format. Throughout the activity students remained attentive and motivated as they prepared for their turn. It created a lively, positive sense of excitement and healthy competition among students. It helped them recall theorem statements faster and understand them better. The Quiz Bowl not only reinforces their memory of theorems but also improves listening skill, concentration and confidence. By transforming theorem learning to a interactive challenge.

3. **Jigsaw Group Activity:** This is a collaborative learning technique designed to help students deeply understand mathematical theorems while reducing their dependence on rote memorization. In this activity each students were given different theorems to learn. Instead of simply memorizing the statements students first become "experts" in their assigned theorem. After the expert phase each member teaches their theorem to their peers. This activity requires students to explain concept in their own words, answer questions and clarify doubts. This interactive nature of jigsaw activity creates a supportive learning environment where students learn from one another. The activity promotes teamwork, communication and responsibility. It helped students in understanding the topic deeply and makes learning more engaging and interactive. The jigsaw method effectively addresses the problem of over reliance on rote memorization.

4. **Chalk Talk Theorem Walk:** This is an interactive, visual strategy in which students silently write ideas, theorem names, their statements, diagrams and explanation related to theorem on board or chart paper. In this activity, the teacher displayed different theorem statements, diagram and key step of the proof. Students silently walked from their one place, read the content and write their thoughts, explanations, theorem names, theorem statements or diagram directly on the board. As students circulate, they read what their peers have written and add clarifications, corrections or further insights. This quiet movement allows every student to think independently without discussion. The activity encourages reflection, recall and a deeper understanding of theorem statements. It also makes learning

active and engaging while giving the teacher a quick view of students' understanding. . Because the activity requires silent communication, promotes deeper comprehension encourages active participation and helps to overcome the problem caused by use of complex and technical language.

5. **Theorem Bingo:** This is a fun classroom activity designed to strengthen students understanding of mathematical theorem in a fun, game based format. Each student received a bingo cards containing theorem names, diagram, short statements or keywords of different theorems. Instead of calling out numbers like a traditional bingo game, the teacher announces the clues such as theorem statements, applications, properties or visual representations. Students must carefully interpret the clues and identify the corresponding theorem or concept on their card and mark the matching item on their cards. This game encourages students to actively recall and connect theorem names with their statements. It keeps the classroom energetic and helps students remember concepts in an enjoyable way. When a student completes a row, column or diagonal, they call out "BINGO "and the teacher verifies the answer. The lively, interactive nature of Theorem Bingo makes theorem learning enjoyable and concept-focused.

Statistical Analysis

Table-2: Students Scores in Pre-test and Post-test

Sl. No	Samples	Pre-test (T_1)	Post-test (T_2)	T_1~T_2	%
01.	Sample 1	1	8	7	28
02.	Sample 2	2.5	11.5	9	36
03.	Sample 3	4	15	11	44
04.	Sample 4	4	15.5	11.5	46

Graphical Analysis

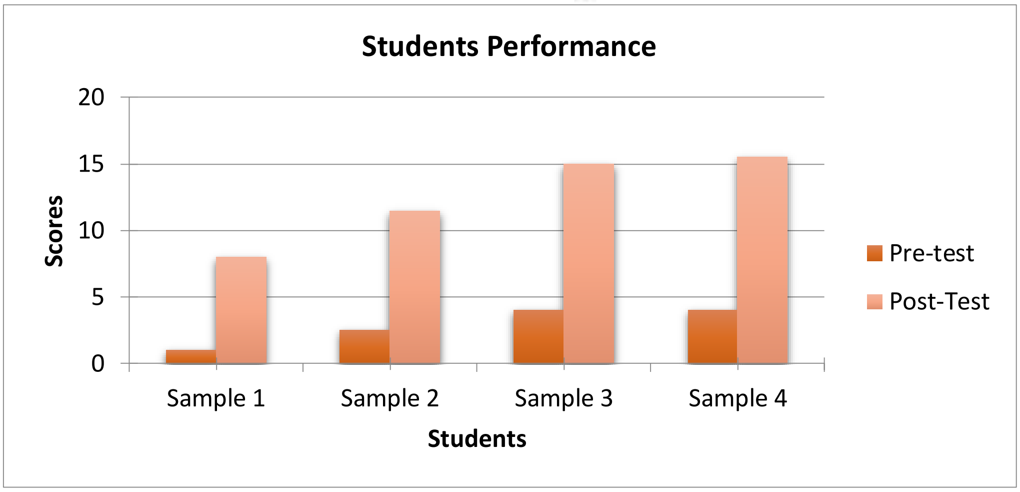

Figure-1: Students Performance in Pre-test and Post-Test

Interpretation

The tests were conducted on 9th-grade students. The pre-test scores of the 4 samples were 1, 2.5, 4 and 4; this showed that the students were finding it difficult to remember the theorem statements. After the action plan and activities were carried out, the post-test scores increased to 8, 11.5, 15 and 15.5 respectively. This improvement showed that with proper guidance, repeated practice and recall-based activities, students were able to remember the concepts better.

Research Findings

1. Students struggled to remember theorem statements during the pre-test, showing low initial understanding and weak recall skills.
2. Students lacked basic conceptual knowledge, which made it difficult for them to understand and retain the theorems.
3. Students were unfamiliar with the practical use of theorems, so they found statements abstract and confusing.
4. Using the regional language made theorems easier to understand and remember for the students.
5. Activities like games, quizzes and group work increased students' interest, making theorem learning enjoyable.
6. Post-test scores improved significantly, showing that activity-based methods helped students recall theorems better.

Suggestions

1. Use short, simple and repeated revision of theorem statements to strengthen memory.
2. Include diagrams, visuals and hands-on activities regularly to support understanding.
3. Connect theorems with real-life situations to make them meaningful for students.
4. Explain the concepts clearly before teaching the theorem statement so that students understand the idea behind it.
5. Conduct frequent oral and written recall activities to keep the theorems fresh in students' memory.
6. Encourage group work and peer explanation to help students learn from one another.
7. Use multilingual explanations when needed, especially in regional language, to increase clarity.

Conclusion

The study concludes that many 9th-grade students struggle to remember theorem statements mainly because they depend on memorization rather than understanding. When theorems are presented only as sentences to learn, students find it difficult to retain the exact wording or apply them correctly. However, when teaching methods included diagrams, hands-on activities, reasoning exercises and regular revision, students were able to recall theorem statements more accurately and with greater confidence.

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