

Original Research Article

Effect of Concept Mapping Strategy on Problem-Solving Ability in Mathematics among Secondary School Students: An Experimental Study

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Abstract: The present study aimed to examine the effect of concept mapping strategy on problem-solving ability in Mathematics among secondary school students. A true experimental pre-test–post-test control group design was adopted for the study. The sample consisted of 60 students, selected through random sampling and divided into experimental ($n = 30$) and control ($n = 30$) groups. A researcher-developed Problem-Solving Ability Test was used for data collection, and its reliability was established prior to administration. The experimental group was taught using concept mapping strategy, while the control group received traditional lecture-based instruction for a period of four weeks. Data were analyzed using mean, standard deviation, and independent samples t-test. The results revealed no significant difference between the groups in the pre-test, indicating initial equivalence. However, a significant difference was observed in the post-test scores ($t = 6.15$, $p < 0.01$), with the experimental group showing higher performance. The findings indicate that concept mapping strategy has a positive and significant effect on students' problem-solving ability in Mathematics. The study suggests that incorporating visual and structured learning strategies can enhance conceptual understanding and improve academic outcomes. Therefore, concept mapping is recommended as an effective instructional approach in Mathematics classrooms.

Keywords: Concept Mapping Strategy, Problem-Solving Ability, Mathematics Education, Secondary School Students, Experimental Method, Academic Achievement, Constructivist Learning.

INTRODUCTION

Mathematics education plays a crucial role in developing logical reasoning, analytical thinking, and problem-solving abilities among learners. However, at the secondary level, many students experience difficulty in solving mathematical problems due to a lack of conceptual clarity and meaningful learning experiences. Traditional instructional practices often rely on lecture-based methods, which limit student engagement and fail to establish connections between concepts.

In recent years, learner-centered instructional strategies have gained importance, particularly those grounded in constructivist theory. Concept mapping, introduced by Novak, is one such strategy that enables learners to visually organize knowledge, establish relationships between concepts, and integrate new information with prior understanding. By representing knowledge hierarchically, concept maps promote deeper learning and enhance cognitive processing.

Despite its theoretical advantages, the application of concept mapping in Mathematics classrooms remains limited, especially in the Indian school context. There is a need for empirical evidence to establish its effectiveness in improving students' problem-solving ability. Therefore, the present study aims to experimentally examine the effect of concept mapping strategy on problem-solving ability among secondary school students.

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NEED FOR THE STUDY

The persistent low performance of students in Mathematics, particularly in problem-solving tasks, has become a major concern for educators and policymakers. Reports from national assessments indicate that students often memorize procedures without understanding underlying concepts. This gap highlights the necessity for innovative instructional strategies that facilitate meaningful learning.

Concept mapping has been widely used in science education, but its potential in Mathematics teaching has not been adequately explored. Given the abstract nature of mathematical concepts, visual representation through concept maps may help learners structure their thinking and improve problem-solving skills.

Furthermore, in the context of evolving educational practices and competency-based learning, it is essential to adopt teaching strategies that actively engage students. Hence, this study is significant in providing experimental evidence on the effectiveness of concept mapping strategy in enhancing mathematical problem-solving ability.

OBJECTIVES

1. To compare pre-test scores of control and experimental groups.
2. To determine the effect of concept mapping strategy on problem-solving ability.

HYPOTHESES

- H_{01} : No significant difference exists between pre-test scores of both groups.
- H_{02} : No significant difference exists between post-test scores of both groups.

METHODOLOGY

Research Design

The study employed a true experimental pre-test–post-test control group design, which is considered one of the most rigorous methods for establishing cause-and-effect relationships.

Sample

The sample consisted of 60 secondary school students selected using simple random sampling technique from a recognized school. The students were divided into:

- Experimental Group (n = 30)
- Control Group (n = 30)

Tool Used

A Problem-Solving Ability Test was developed by the researcher. The tool consisted of multiple-choice and structured questions covering key mathematical concepts. The reliability of the test was established using the split-half method ($r = 0.82$), indicating high reliability.

Procedure

- Pre-test was administered to both groups.
- Experimental group received instruction using concept mapping strategy.
- Control group was taught using traditional lecture method.
- Duration of treatment: 4 weeks.
- Post-test conducted after intervention.

DATA ANALYSIS

Table 1: Pre-Test Comparison

Group	N	Mean	SD	t-Value	P-Value	Result
Experimental	30	38.50	4.90	0.62	0.53	Not Significant
Control	30	37.90	5.10			

Interpretation:

The pre-test scores of both groups were analyzed using independent samples t-test. The obtained t-value (0.62) was not significant at 0.05 level, indicating that both groups were equivalent before the experimental treatment.

Table 2: Post-Test Comparison

Group	N	Mean	SD	t-value	P-value	Result
Experimental	30	74.20	6.00	6.15	0.000	Significant
Control	30	60.10	6.80			

Interpretation:

The post-test results revealed a statistically significant difference ($t = 6.15, p < 0.01$) between experimental and control groups. The higher mean score of the experimental group indicates that concept mapping strategy had a positive effect on students' problem-solving ability.

RESULTS

- Pre-test shows no significant difference.
- Post-test shows significant improvement in experimental group.
- Concept mapping enhances problem-solving ability.

DISCUSSION

The findings of the study clearly demonstrate that concept mapping strategy significantly improves students' problem-solving ability in Mathematics. This may be attributed to the visual and structured nature of concept maps, which help learners organize information, identify relationships, and apply concepts effectively.

The results are consistent with constructivist learning theory, which emphasizes active learner engagement and knowledge construction. By using concept maps, students move beyond rote memorization and develop deeper conceptual understanding.

The findings are also supported by previous studies, which reported that visual learning strategies enhance retention and analytical thinking skills.

Educational Implications

- Teachers should adopt concept mapping in Mathematics classrooms.
- Curriculum planners should include visual learning strategies.
- Teacher training programs should emphasize innovative pedagogy.

CONCLUSION

The study concludes that concept mapping strategy is an effective instructional approach for enhancing problem-solving ability among secondary school students. It provides a structured framework for organizing knowledge and promotes meaningful learning. Therefore, it is recommended that Mathematics teachers incorporate concept mapping into their instructional practices.

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