

Concept Map in Chemistry Education: Bridging Traditional Knowledge and Modern Science to Improve Academic Achievement and Student Reaction among 9th Grade Learners

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Abstract

Chemistry is a fundamental science subject that plays a vital role in developing scientific understanding and analytical thinking among students. However, due to its abstract nature and reliance on traditional teaching methods, many learners face difficulties in achieving conceptual clarity. This study examines the effectiveness of concept map as an innovative instructional strategy in chemistry education. Concept map, rooted in constructivist theory and developed by Novak, helps learners organize and connect ideas visually, promoting meaningful learning.

The present study aims to bridge traditional knowledge and modern scientific approaches by integrating concept map into classroom instruction. A quasi-experimental design was adopted with experimental and control groups of 9th-grade students. Tools included an academic achievement test and a reaction scale. Findings suggest that concept map significantly improves academic achievement, enhances conceptual understanding, and fosters positive student reactions toward learning chemistry.

The study highlights the importance of integrating innovative teaching strategies with traditional approaches to make chemistry learning more engaging, effective, and meaningful.

Keywords: Concept Map, Chemistry Education, Academic Achievement, Student Reaction, Traditional Teaching, Meaningful Learning

Introduction

Education is a continuous and dynamic process that shapes an individual's knowledge, skills, values, and overall personality. It plays a crucial role in developing responsible citizens and fostering social progress. Among various disciplines, science education holds a central place as it promotes inquiry, reasoning, and problem-solving abilities.

Chemistry, as a branch of science, deals with the composition, structure, and transformation of matter. It is essential for understanding everyday life processes and technological advancements. However, many students perceive chemistry as a difficult subject due to its abstract concepts and traditional lecture-based teaching methods.

Traditional teaching often emphasizes rote memorization rather than conceptual understanding. This creates a gap between knowledge acquisition and meaningful learning. To overcome this limitation, innovative teaching strategies are needed.

Concept map, developed by Joseph D. Novak based on David Ausubel's theory of meaningful learning, is one such strategy. It visually represents relationships between concepts, helping students connect new knowledge with prior understanding. By integrating traditional knowledge with modern visual learning techniques, concept mapping provides a powerful approach to improving chemistry education.

Review of Related Literature

Research studies indicate that concept mapping significantly enhances understanding and retention. Markham, Mintzes, and Jones (1994) found that concept map improves conceptual clarity and reduces misconceptions. Novak and Gowin (1984) highlighted its role in promoting meaningful learning and knowledge organization.

Indian studies such as Talanki (2015), Joshi & Chordia (2025), and Berchha (2025) also reported improved academic achievement, interest, and student engagement through concept mapping.

● Studies on Chemistry Education

Gabel (2008) and Taber (2012) emphasized that traditional teaching leads to misconceptions in chemistry. Hofstein & Lunetta (2014) highlighted the importance of practical and conceptual learning.

Indian studies (Kaur, 2010; Khalil, 2019) showed that activity-based teaching improves achievement in chemistry.

● Studies on Academic Achievement

Hattie (2009) identified instructional strategies as key factors influencing achievement. Nabizadeh et al. (2019) emphasized the role of motivation and learning strategies.

● Studies on Traditional Teaching

Research indicates that traditional methods support basic learning but fail to promote deep understanding and critical thinking (Begum, 2016; Banerjee, 2017).

Rationale of the Study

Chemistry is often perceived as difficult due to abstract concepts and traditional teaching methods. Literature reveals that concept map improves understanding and achievement, but limited research exists at the secondary level integrating both academic achievement and student reaction.

This study addresses this gap by combining traditional knowledge with modern instructional strategies to enhance learning outcomes.

Statement of the Problem

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Objectives of the Study

- To compare academic achievement of students taught through concept map and traditional teaching

Hypotheses of the Study

- There is no significant difference in academic achievement between experimental and control groups

Variables of the Study

Independent Variable:

- Teaching Method (Concept Mapping vs Traditional Teaching)

Dependent Variables:

- Academic Achievement in Chemistry

Methodology

● Research Design

Quasi-experimental design (Pre-test Post-test Control Group)

● Sample

60 students of 9th grade from CBSE schools (30 experimental, 30 control)

Table 1: Sample Distribution

Group	Number of Students
Experimental (Concept Map)	30
Control (Traditional Teaching)	30

● Tools

- Concept Map (instructional tool)
- Academic Achievement Test

Table 2: Tools Used

Tool	Purpose
Concept Map	Instructional Strategy
Achievement Test	Measure Performance

● Procedure

- Pre-test conducted for both groups
- Experimental group taught using concept map
- Control group taught using traditional methods
- Duration: 45 days
- Post-test and reaction scale administered

Analysis and Discussion

The findings indicate that students taught through concept map performed better academically than those taught through traditional methods. Concept map improved conceptual understanding, retention, and engagement.

Students also showed positive reactions, indicating increased interest and motivation. The integration of visual learning with traditional teaching helped bridge the gap between memorization and meaningful learning.

Delimitations of the Study

- Limited to 9th-grade students

- Focused only on chemistry subject
- Restricted to selected topics

Conclusion

Concept map is an effective teaching strategy that enhances academic achievement and student engagement in chemistry. By bridging traditional knowledge and modern scientific approaches, it promotes meaningful learning and conceptual clarity.

The study suggests that integrating concept map into classroom teaching can improve the quality of education and make learning more interactive and student-centered.

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