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EXPLORING THE INFLUENCE OF CONSTRUCTIVIST PRACTICES ON CHEMISTRY ACHIEVEMENT AT SECONDARY LEVEL

Education

Pratima Das Research Scholar, Education Kumar Bhaskar Varma Sanaskrit & A S University, Nalbari
Dr. Alaka Das Ass. Prof. Education Kumar Bhaskar Varma Sanaskrit & A S University, Nalbari

ABSTRACT

This study looked at how the constructivist learning approach affects Chemistry achievement among Class IX students at Vivekananda Kendra Vidyalayas in Nalbari. The research used a pre-test post-test quasi-experimental design with 120 students, where the experimental group was taught using the constructivist 5E Model, and the control group received traditional teaching. Two tools were utilized for data collection in this study, Chemistry lesson plans focused on atoms and molecule as instructional tool, and a Chemistry achievement test both prepared and developed by the investigator. The t-tests showed that both groups were similar before the intervention. After the intervention, the experimental group showed a significant improvement in Chemistry achievement, proving that the constructivist approach was more effective than traditional methods. Thus, it is recommended to use the 5E-model strategy in teaching to enhance students' Chemistry achievement at the secondary level.

KEYWORDS

Achievement, Chemistry, Constructivist Approach, 5 E model

INTRODUCTION

Science education at the secondary level aims to build foundational knowledge for advanced studies in modern science and technology while fostering personal satisfaction. It equips students with scientific thinking skills to address global challenges such as resource management and environmental sustainability. However, the persistent use of traditional teaching methods, characterized by teacher-dominated classrooms and teacher-student interaction, makes achieving scientific literacy a significant challenge (Gillies & Khan, 2008; Saye & Brush, 2006). To overcome these challenges, teachers must focus on improving their instructional strategies, fostering student engagement, and creating effective learning environments (Copeland, 2002). Instead of relying on passive knowledge transmission, encouraging students to construct their own knowledge can enhance learning outcomes. A constructivist approach, emphasizing activity-based, real-life, and problem-based learning, is particularly effective in making science education relevant and impactful. Constructivism, a key framework in science education, asserts that knowledge is actively constructed through sensory experiences and interactions with the environment. This theory highlights the learner's active role in understanding rather than passively absorbing information. Jean Piaget formalized constructivism, stressing that knowledge arises not only from books but also through mental processes. Additionally, Vygotsky (1978) emphasized the crucial role of social interaction in cognitive development. This study aims to investigate the impact of constructivist teaching practices on students' achievement in chemistry at the secondary education level.

With this perspective, the problem of the study has been stated as-

"Exploring the Influence of Constructivist Practices on Chemistry Achievement at Secondary Level"

Justification Of The Study

Chemistry and chemists are deeply connected to everything on Earth, summarized by the phrase, "What on Earth is not chemistry?" This study looks at how the constructivist learning method affects students' success in chemistry, focusing on making students active learners. Science education is crucial but often faces issues due to low motivation and traditional teaching methods. Researchers Dara & Ogoamaka (2005) and Njoku (2009) found that poor teaching methods are a major cause of low achievement in chemistry. Inappropriate teaching methods negatively impact students' success and attitudes towards chemistry (Stocklmayer & Gilbert, 2007). This study investigates the influence of the constructivist learning approach on 9th-grade students' chemistry achievement. Research indicates that the constructivist approach, especially the 5E Model, significantly improves understanding, critical thinking, and skill application (Reynolds et al., 2001; Dara & Ogoamaka, 2005; Njoku, 2009; Stocklmayer & Gilbert, 2007). By providing insights into the effectiveness of constructivist methods, the study supports science teachers in developing better teaching strategies and aids policymakers in enhancing educational experiences in Indian classrooms, ultimately promoting a more holistic and effective science education.

Constructivist Approach

Constructivist Approach is a teaching approach that incorporates the fundamentals of constructivist teaching and is adaptable to students' needs is referred to as a Constructivist Approach based Teaching-Learning Strategy. In this study, the teaching of science (Chemistry) is planned through Engage, Exploration, Explanation, Expansion and Evaluation, the 5 E model developed by Robert Bybee (1980).

Traditional Approach

A teaching program which involves teacher-centred of teaching where students are only the passive learners is considered as Traditional Approach based Teaching-Learning Strategy. In this study, traditional approach implies, teaching of science (Physics, Chemistry and Biology) through teacher's and student's activity in three stages of teaching - Introduction, Presentation and Closure.

Vivekananda Kendra Vidyalaya

Vivekananda Kendra Vidyalaya (VKV) is the academic branch of Vivekananda Kendra, an organization rooted in Swami Vivekananda's life-reforming principles. VKV operates a network of schools under the project Vivekananda Kendra SikshaPrasarVibhag (VKSPV).

Objectives Of The Study

1. To examine the difference in the achievement of students in Chemistry of control group and experimental group before intervention
2. To study the effect of constructivist approach on the achievement of students in Chemistry in terms of-

i. the difference in achievement of students in Chemistry of control group and experimental group after intervention.
ii. the difference in achievement of students in Chemistry of control group before and after intervention.
iii. the difference in achievement of students in Chemistry of experimental group before and after intervention.

Hypotheses Of The Study

1. H_{01} There is no significant difference in the achievement of students in Chemistry of control group and experimental group before intervention
2. i.H_{01} There is no significant difference in achievement of students in Chemistry of control group and experimental group after intervention

ii. H_{02} There is no significant difference in achievement of students in Chemistry of control group before and after intervention
iii. H_{03} There is no significant difference in achievement of students in Chemistry of experimental group before and after intervention.

Review Of Literature

Studies have been conducted about the effectiveness of the constructivist approach in science achievement. Kruckeberg (2006) identified that students often see science as difficult and irrelevant. Jimoh (2007) highlighted poor performance among chemistry students

at both secondary and tertiary levels. Roth (1990) found that constructivist classrooms encourage risk-taking, leading to higher achievement and stronger interest. Sridevi (2008) showed that the constructivist method improves science achievement, process skills, and perceptions of nature, with girls having better scientific attitudes than boys. Nagalakshmi (2011) found it effective for enhancing science achievement, skills, and attitudes among seventh graders. Aydisheh (2015) reported improvements in various cognitive skills due to constructivist teaching. Mayasari (2017) and Verma (2017) observed positive impacts on student achievement, chemistry competence, and attitudes. Despite these findings, there is limited research specifically on the impact of constructivist methods in science teaching particularly in Chemistry in India and Assam, highlighting a gap that this study aims to address.

Delimitation Of The Study

The study was conducted in the Vivekananda Kendra Vidyalayas of Nalbari, Kajalgaon, Tezpur and Mangaldai on Class IX standard students and it was limited to one unit of Chemistry only.

Research Methodology

The study intends to investigate the impact of the constructivist approach on students' achievement in Chemistry. Considering the context and nature of the study, a quasi-experimental design with non-equivalent control groups was utilized.

Sample Of The Study

Researcher has taken 120 students from the following four schools.

Name of the School	Name of the group	Total no. of students	Students taken for the experiment
VKV,Nalbari	Experimental group	55	60
VKV, Kajalgaon	Experimental group	43	
VKV Tezpur	Control group	57	60
VKV Mangaldai	Control group	26	

Plan Of The Study

Both traditional and constructivist lesson plans for Chemistry have been constructed by the investigator, which were reviewed by experts and revised based on their feedback. These revised lesson plans were then implemented in the classroom with the experimental group to assess their effectiveness. To evaluate student achievement, the researcher designed a 30-mark Chemistry achievement test. This structured approach was aimed at measuring the impact of the constructivist teaching method on students' performance in Chemistry.

RESULT & DISCUSSION

Objectives No. 1 To examine the difference in the achievements of students in Chemistry of Control group and Experimental Group before intervention

Table 1.0 Significance of Difference in Achievements of students in Chemistry of Control Group and Experimental Group before Intervention

Group	N	Mean	S. D	S_{ED}	t value	Level of Significance
Pre (Control)	60	16.17	3.80	0.68	0.46	Not Significant
Pre (Experimental)	60	15.88	3.77			

Table 1.0 shows that the pre-test mean scores for Chemistry achievement were 16.17 for the control group and 15.88 for the experimental group, with standard deviations of 3.80 and 3.77 respectively. The t-value of 0.46, which is not significant at any level, indicates no significant difference between the groups' chemistry achievement before the intervention. Thus, the hypothesis that there is no significant difference in mean achievement scores of students in Chemistry between the control and experimental groups before the intervention has been accepted**.**

Objectives No. 2 (i) To study the difference in achievement of students in Chemistry of Control group and Experimental group After intervention

Table No 2.0 Significance of Difference in Achievements of students in Chemistry of Control Group and Experimental Group After Intervention

Group	N	Mean	S.D	S_{ED}	t value	Level of Significance
Post (Control)	60	16.60	4.36	0.86	2.33	Significant at 0.05 level
Post (Experimental)	60	18.61	5.05			

Table 2.0 indicates that the mean post-test scores in Chemistry for the control group and experimental group are 16.60 and 18.61 respectively, with standard deviations of 4.36 and 5.05. The t-value of 2.33 is higher than the tabular value at the 0.05 level of significance, suggesting a significant difference in achievement between the groups after the intervention. Therefore, the hypothesis of no difference in Chemistry achievement between the control and experimental groups after the intervention has not been accepted.

Objectives No. 2 (ii) To study the difference in the achievement of students in Chemistry of Control group before and after intervention

Table 3.0 Significance of Difference in Achievements of students in Chemistry of Control Group Before and After Intervention

Group	N	Mean	S. D	S_{ED}	t value	Level of Significance
Pre (Control)	60	16.17	3.80	0.74	0.58	Not Significant
Post (Control)	60	16.60	4.36			

Table 3.0 shows that the pre-test and post-test mean scores for the control group's Chemistry achievement are 16.17 and 16.60, with standard deviations of 3.80 and 4.36 respectively. The calculated t-value of 0.58 indicates no significant difference in the group's Chemistry achievement before and after the intervention. Thus, the hypothesis of no significant difference in the control group's mean achievement scores in Chemistry before and after the intervention has been accepted.

Objectives No. 2(iii) To study the difference in the achievement of students in Chemistry of Experimental group Before and After intervention

Ho_3 "There is no significant difference in the achievement of students in Chemistry of experimental group before and after intervention

Table 4.0 Significance of Difference in the Achievement of students in Chemistry of Experimental Group Before and After intervention

GROUP	N	MEAN	S.D	S_{ED}	t value	Level of Significance
Pre(Experimental)	60	15.88	3.77	0.81	2.48	Significant at .05
Post (Experimental)	60	18.61	5.05			

Table 4.0 shows that the pre-test and post-test mean scores for the experimental group in Chemistry are 15.88 and 18.61, with standard deviations of 3.77 and 5.05 respectively. The calculated t-value of 2.48 is greater than the tabular value at the 0.05 level of significance, indicating a significant difference. Thus, the hypothesis of no difference in Chemistry achievement for the experimental group before and after the intervention has not been accepted.

Thus, in Post intervention, the experimental group scored higher (18.61) compared to the control group (16.60), showing the constructivist teaching approach effectively improved Chemistry achievement. The increase from a pre-test mean score of 15.88 to a post-test mean score of 18.61 in the experimental group conclusively demonstrates that the constructivist teaching approach significantly enhanced students' achievement in Chemistry.

Implications And Conclusion

The study's findings suggest that using a constructivist approach can significantly benefit students, teachers, administrators, curriculum developers, and policymakers. This approach helps students enhance their creative and reflective thinking while promoting knowledge sharing and collaborative learning in chemistry. Teachers can develop lesson plans that focus on hands-on experiences and student engagement. A conducive learning environment with group discussions, projects, and creative tasks nurtures critical thinking. A spiral curriculum supports continuous reflection, deepening understanding and knowledge. Emphasizing engagement, exploration, and evaluation in curricula empowers students to solve problems independently. Constructivist principles, central to the National Curriculum Frameworks (2005, 2023) and the National Education Policy (2020), highlight the importance of experiential

learning. Understanding cognitive processes allows students to critically shape their learning. Increased focus on constructivist instructional models has spurred extensive research, showing that applying this theory in science education deepens understanding of scientific concepts.

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