



## Effectiveness of the Constructivist Approach in Science Teaching for Upper Primary Students in Aligarh

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### ABSTRACT:-

*In the 21st century, modern-day instructors are under great pressure to adopt novel teaching strategies to strengthen and mould their pupils' cognitive capacities. Constructivist method is a modern student-centred form of education where students develop their knowledge based on active engagement and experience. The present study was done to analyse the impact of the Constructivist Approach (CA) on upper primary pupils' conceptual knowledge of Science. The research objectives included producing lesson plans utilising the Constructivist Approach and analysing its influence on students' understanding. The enquiry adopted an experimental technique including a sample of 40 pupils. Researchers evaluated the difference between pre-test and post-test scores of experimental and control groups. The findings demonstrated a considerable gap in conceptual comprehension scores between the two groups, with the experimental group receiving education using the Constructivist Approach and the control group taught using standard teaching techniques. The findings suggested that the group trained using the constructivist technique beat the traditional instruction group in delayed performance after two weeks, i.e., retention levels were greater with the constructivist approach.*

**KEYWORDS:** Constructivist Approach (CA), Conventional Method of Teaching (CMT), Academic Achievement, Delayed Performance, Retention.

### INTRODUCTION:

Education is an essential process designed to cultivate people, facilitate social reform, and advance country development. It enables individuals to attain information, skills, and attitudes, so Improving their quality of life for themselves, their communities, and the nation. Achieving this necessitates meticulous preparation of educational activities and a transformation in the teaching-learning paradigm. The education system must be reformed to incorporate new

teaching and learning methodologies that align with the demands and ambitions of a revitalised society. The Indian educational system is characterised by rote memorisation and conventional pedagogical approaches, resulting in restricted autonomous thinking, enquiry, and participation. The educational system should be reformed to enhance engagement and relevance by promoting experiential learning, critical thinking, and the application of knowledge acquired outside the classroom to academic contexts.

Science education is essential for cultivating individuals' intellectual and emotional attributes, enabling them to become practical, productive, and progressive contributors to society. Science education aids individuals in alleviating poverty, ignorance, and superstition within a forward-thinking community. Science education cultivates critical enquiry, reverence for truth, simplicity, flexibility, and methodical effort, all of which are vital for societal transformation and national development. The National Curriculum Framework (2005) endorses the Constructivist Approach in educational instruction to enhance children's motivation to study. This methodology underscores the learners' involvement in the acquisition and comprehension of knowledge, centring on the 5E (Engage, Explore, Explain, Elaborate, and Evaluate) framework. Constructivist education emphasises educating students to integrate components into a cohesive whole, providing several advantages, including enhanced retention, knowledge growth, cooperation, and assistance for students with social or emotional challenges. Implementing a learner-centred strategy may render the education system more interesting, pertinent, and successful in addressing the demands and ambitions of a revitalised society.

### **CONSTRUCTIVIST APPROACH (CA) OF TEACHING SCIENCE:**

Constructivism, a learning theory originating from Jean Piaget's research in the 1970s, is well-established in educational theory and research. It asserts that individuals actively construct knowledge based on their assumptions, personal experiences, and cognitive frameworks. Constructivism emphasises the cultivation of problem-solving skills in ambiguous contexts and critiques traditional pedagogical approaches. This approach in science education necessitates that educators employ strategies that engage students in comprehending scientific concepts and promote conceptual shifts. In contrast to traditional or behaviourist methods that focus on structured knowledge transmission, constructivist educators promote student reflection on how activities contribute to their conceptual understanding and learning processes. They promote direct instruction to facilitate the development of mental models and engage learners in activities that enable the assessment and refinement of their knowledge. In science education, constructivism entails encouraging students to formulate questions, participate in class activities, and consistently evaluate their understanding and performance. This approach benefits students by distinguishing between the core concept of informing Science and the act of delivering knowledge. The text recognises the diversity present in scientific disciplines such as Biology, Physics, and Chemistry education, with the main objective of

enhancing student learning outcomes. A variety of studies have investigated teaching methodologies and curriculum enhancements aimed at improving science education. Constructivism is a prominent approach in science education, highlighting active learning strategies, varied learning methods, and the development of critical skills necessary for success in advanced Science.

Within a constructivist framework, students ought to participate in collaborative, inquiry-based, reflective, problem-based, and developmental learning approaches. These methods synthesise both new and existing knowledge to advance contemporary ideas. Project-based learning adheres to a production model, whereas problem-based learning employs an inquiry-based approach. Collaborative learning entails group work, while cooperative learning focuses on small groups. Brainstorming facilitates the generation of new ideas, and scaffolding aids in student development. Inquiry-based learning encourages questioning and surveys, and guided instruction offers direction. The 5E Learning Cycle Model is utilised in this context.

### **5E MODEL OF CONSTRUCTIVIST APPROACH:**

The 5E Model represents a structured pedagogical framework comprising five distinct stages: Engaging, Exploring, Explaining, Elaborating, and Evaluating. The stages facilitate the application of prior knowledge, the construction of meaning, and the ongoing evaluation of understanding regarding a concept.

The Engaging phase entails integrating prior and current learning experiences through brief exercises that link existing knowledge to new experiences. The Explore phase entails students identifying and developing concepts, procedures, and skills via laboratory enquiries or practical activities.

The Explain phase enhances students' comprehension of subjects, enabling them to exhibit newly acquired skills and behaviours. • The Elaborate phase facilitates the practice of behaviours and abilities, while deepening their conceptual understanding. The Evaluating stage enables students to reflect on their knowledge and skills, while teachers assess their comprehension of fundamental concepts and abilities. The teaching-learning environment is critical for educators and learners alike, and students are required to exhibit a solid grasp of the foundational concepts presented to them. Studies demonstrate that the constructivist approach, especially the 5E learning cycle model, is effective in educational contexts both internationally and within India. Sartika and Hadi (2021) demonstrated the efficacy of the 5E Model in enhancing students' comprehension of salt hydrolysis within university chemistry education. Hector et al. (2022) demonstrated that the 5E Model, within the framework of the Constructivist Approach, enhanced both conceptual understanding and attitudes towards Science. Owusu et al. (2022) documented an enhancement in mathematics problem-solving skills utilising this Model, whereas Kibici (2022) noted

advancements in music lesson performance, attitude, and retention via an online 5E model. The effectiveness of the enhanced 5E Model in teaching natural Science was demonstrated by Vu et al. (2022), while Nadeem and Awan (2022) provided evidence of its superiority compared to traditional lecture methods in terms of academic achievement. The 5E Model significantly improved the performance and learning of physics students, as indicated by Dahal (2023) and Lasaiba (2023). Nurpatri et al. (2021) and Arthur (2021) found that constructivism enhanced critical thinking and motivation in the teaching of physics and statistics. Doss (2022) and Unodiaku (2022) reported improvements in science achievement and interest in mathematics. Siagian et al. (2023) demonstrated the Model's effectiveness in improving physics education via animated video. This study utilised the 5E Model of the Constructivist Approach to assess its effectiveness in teaching science to upper-primary students in U.P.

### **REVIEW OF RELATED LITERATURE:**

A few studies on the efficacy of the Constructivist Approach are given below:

### **STUDIES CONDUCTED ABROAD:**

- A study conducted by Igwebuikwe and Oriaifo (2014) revealed that the Constructivist Approach enhanced students' emotional results in scientific disciplines. A meta-analysis conducted by Ayaz and Sekerci (2015) revealed that the constructivist approach significantly enhanced students' academic performance in comparison to traditional teaching methods
- Aydisheh and Gharibi (2015) conducted a study demonstrating that constructivist education markedly improved students' knowledge, understanding, application, analysis, synthesis, and assessment skills.
- Research conducted by Qarareh (2016) revealed that the constructivist approach markedly enhanced students' performance in chemistry courses. The findings indicate that greater emphasis should be placed on integrating the constructivist teaching style into scientific curricula, and additional study is necessary to comprehend its effects on diverse learning outcomes.
- Demir and Emre (2020) investigated the influence of the 5E learning paradigm on the academic advancement, essential process skills, attitudes towards Science, and the rectification of misconceptions among fourth-grade scientific students. The research indicated that the experimental group had superior ratings in academic achievement, disposition towards Science, and misconceptions.
- Nurpatri et al. (2021) discovered that the constructivist method enhanced students' critical thinking skills.
- Grau et al. (2021) discovered that the 5E Model markedly enhanced pupils' conceptual growth.

- Subedi (2021) examined the effectiveness of the constructivist approach in chemistry education.
- Rahmawati et al. (2021) discovered that the 5E learning cycle model was more effective than the discovery learning model for students using fresh milk quality requirements.
- Sartika and Hadi (2021) discovered that the 5E Model enhanced students' understanding of salt hydrolysis.
- Hector et al. (2022) investigated the cognitive dimensions of learning and the influence of instructional aids on student performance.

#### **STUDIES CONDUCTED IN INDIA:**

Sridevi (2013) and Sharma (2014) examined the efficacy of a constructivist approach in scientific teaching. Research indicated that constructivist education outperformed traditional techniques, enhancing achievement scores and attitudes for both genders while promoting a more favourable learning environment.

Bhattacharjee and Mehera (2014) discovered that the constructivist approach substantially influenced students' performance in Science.

Kaur and Kaur (2016) determined that constructive education outperformed traditional techniques, and that constructivist 5E learning improved mathematical proficiency.

Siddiqui (2016) executed an empirical investigation on the constructivist strategy to assist 9th-grade pupils in comprehending the chapter on colloids.

Parveen (2017) examined the effect of the 5E Model on the academic performance of primary school pupils with hearing impairments in Science.

Adak (2017) discovered that the constructivist approach enhanced secondary science academic performance, with pupils utilising the 7E Model achieving superior scores across all IQ levels. Pangat (2017) discovered that the constructivist method enhanced secondary school pupils' arithmetic performance, resulting in augmented knowledge and self-reflective capabilities. Banu and Mahmood (2019) discovered that the constructivist method enhanced the mathematics performance of ninth-grade pupils.

Singh et al. (2021) discovered that the 5E instructional Model and peer group techniques were impactful during the epidemic.

Shivam and Mohalik (2022) discovered that an ICT-integrated 5E model improved secondary-level pupils' higher-order thinking skills in biology.

The success of India depends on its ability to provide outstanding educational opportunities to its youth, who are pursuing job and skill enhancement. By 2030, the Sustainable Development Agenda intends to achieve this goal, emphasising high-quality education. To achieve this

objective, India must prioritise the improvement of elementary education. Innovative pedagogical methods, such as the Constructivist Approach (CA), have proven effective in enhancing academic achievement and promoting active learning and critical thinking. Research undertaken in India supports these findings, demonstrating that CA yields higher academic performance and exceeds standard teaching approaches in efficacy. An ongoing project in U.P. aims to assess the influence of the Constructivist Approach on enhancing academic performance and higher-order thinking skills among upper-primary pupils in science education.

### **OBJECTIVES OF THE STUDY**

The researchers formulated the following objectives:

1. To study the mean Pre-Test score of upper-primary students' performance in Science on the Criterion Referenced Test.
2. To study the efficacy of the Constructivist Approach (CA) and the Conventional Method of Teaching (CMT) on upper-primary students' immediate performance in Science on the Criterion-Referenced Test.
3. To study the efficacy of the Constructivist Approach (CA) and the Conventional Method of Teaching (CMT) on upper-primary students' two-week delayed performance in Science on the Criterion-Referenced Test.

### **HYPOTHESES OF THE STUDY**

The following hypotheses were formulated by the researcher, keeping in view the nature of the objectives of the study:

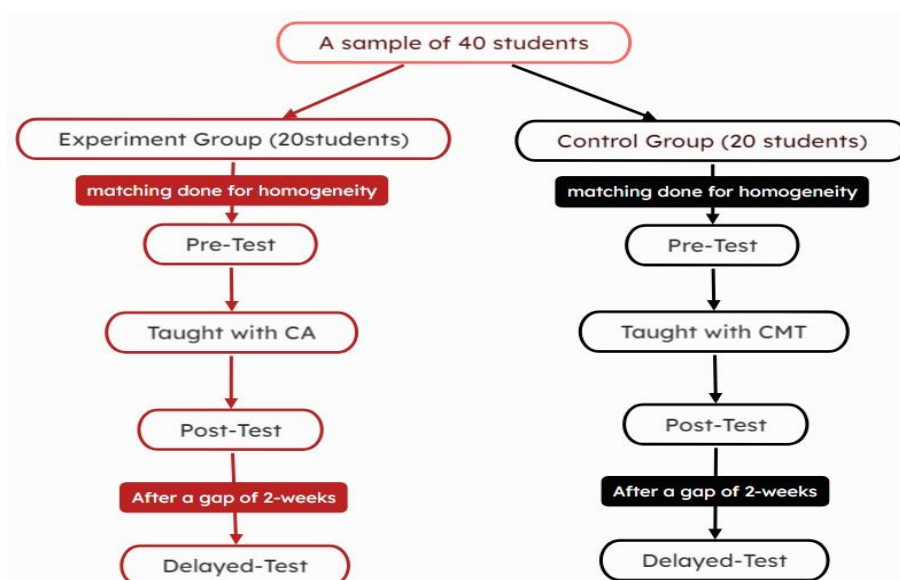
1. There is no significant difference in the Pre-Test achievement scores between the 7<sup>th</sup>-grade students in Science on the Criterion-Referenced Test.
2. There is no significant difference in the Post-Test immediate achievement score between the 7<sup>th</sup>-grade students following the Constructivist Approach (CA) and the Conventional Method of Teaching (CMT) in Science on the Criterion-Referenced Test.
3. There is no significant difference in the two-week delayed achievement score between the 7<sup>th</sup>-grade students following the Constructivist Approach (CA) and the Conventional Method of Teaching (CMT) in Science on the Criterion-Referenced Test.

### **METHOD AND MATERIAL**

The study aims to evaluate the effectiveness of the Constructivist Approach (CA) versus the Conventional Method of Teaching (CMT) in enhancing the academic performance of upper-primary children in Science in Aligarh, employing an experimental research methodology.

### **RESEARCH DESIGN:**

The researcher adopted the Pre-Test-Post-Test Experimental Research Design for the completion of this study. The present study was conducted with a sample of 40 students with two comparable



groups, i.e., i) Constructivist Approach Group and ii) Conventional Method of Teaching Group. The Research Design is illustrated graphically below:

#### POPULATION:

The study population comprises all seventh-grade students registered at the Children's Basic Education in Uttar Pradesh, India. The selected schools are situated in the Aligarh district of U.P., operating under the jurisdiction of the U.P. Basic Shiksha Parishad, Government of Uttar Pradesh. The total enrolment of seventh-grade students at these two institutions amounted to 199 for the academic year 2024-25. Furthermore, it is suggested that the findings of the study may hold significance for all seventh-grade students in the district concerning their comprehension of Science subjects.

#### SAMPLE AND SAMPLING TECHNIQUE:

Two schools for the experiment were chosen due to their feasibility and the cooperation shown by the school authorities. Consequently, random sampling was utilised to select the schools for both the experimental and control groups. The study included 20 students from class VII, divided into control and experimental groups. The randomisation method established the equivalence of the three experimental groups by considering their previous achievement scores.

**Table 1: The Study Sample**

Sl. No.	Name of School	Groups	No. of samples taken
1	Upper primary school koyle wali gali, Aligarh, U.P.	Experimental Group (CA Group)	20
2	Upper primary school, Rasalganj, Aligarh, U.P.	Control Group (CMT Group)	20
	Total		40

## TOOLS USED:

- Lesson Plans prepared by the researcher on the Constructivist Approach (CA) with the 5E Model of teaching.
- The Criterion-Referenced Test (CRT) was developed and standardised by the researcher.

**EXPERIMENT DESCRIPTION:** The researchers adhered to the protocol for experimenting:

- Step 1: Pre-Test Score: In the initial phase of the study, the Criterion-Referenced Test (CRT) was administered to both groups to acquire Pre-Test Scores. The evaluations indicated participants' comprehension of the Class VII Science chapters of the sample students.
- Step 2: Executing the Lesson Plan: The Experimental Group got 27 CA-based lesson plans sequentially. Upon the conclusion of each Lesson Plan, a formative assessment was conducted. A new lesson plan was initiated after confirming that 80% of students achieved a minimum of 80% on the formative assessment. The control group received instructions from the CMT, as per typical protocol. The Control Group did not undergo any formative assessment.
- Step 3: Post-Test Score: Following the completion of all lesson plans, the CRT was administered to both the Experimental and Control Groups to ascertain the Post-Test Score.
- Step 4: Delayed Score: Researchers implemented a two-week gap between the immediate execution of the experimental and control group participants. Subsequently, the researchers re-administered the CRT to both student groups after a two-week interval to get the 'Delayed Score.'

## DELIMITATIONS

The experimental study has the following delimitations:

- The study was delimited to 7<sup>th</sup>-grade students in Aligarh district of U.P.
- The study is also delimited to schools affiliated with the U.P. Basic Shiksha Parishad, U.P.
- The study was delimited to six chapters of 7<sup>th</sup>-grade Science, viz., Nutrition in Plants, Nutrition in Animals, Heat, Motion and Time, Acids, Bases and Salts, and Physical and Chemical Changes.
- Academic performance included knowledge, understanding, and application dimensions of the cognitive domain.

## RESULTS AND DISCUSSION:

The samples were analysed by assessing the significance of the difference between the mean scores of the experimental and control groups by t-tests. The principal findings of the study are delineated below in alignment with the pertinent aims and hypotheses:

**Objective-1:** To study the mean Pre-Test score of 7<sup>th</sup>-grade students' performance in Science on the Criterion-Referenced Test.

**Hypothesis:** There is no significant difference in the Pre-Test achievement scores between the 7<sup>th</sup>-grade students in Science on the Criterion-Referenced Test.

Table 2: Showing t-value of mean pre-test scores of CA & CMT groups of 7<sup>th</sup>-grade students.

Groups	N	Mean	SD	t-value	Level of significance
CA Group	20	49.4	6.81	0.746	Not significant at the 0.05 level of significance
CMT Group	20	47.8	6.76		

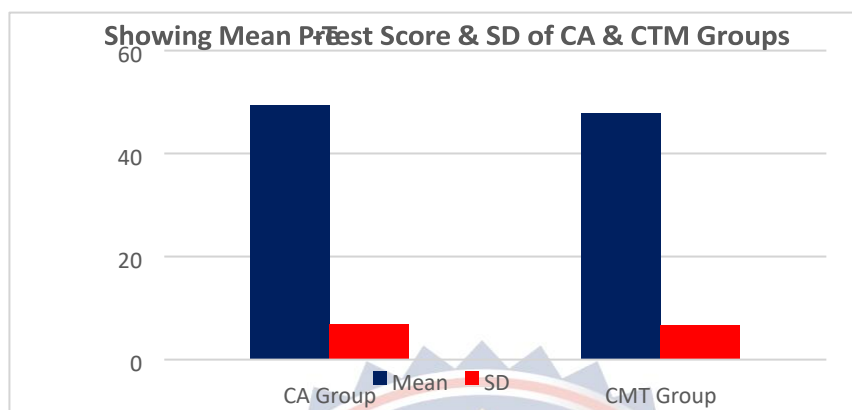


Figure 3: Comparison of Pre-Test Scores of CA &amp; CMT Groups

Table 2 indicates that the computed t-value came out to be 0.746, which is less than the table t-value (2.02). Therefore, the computed t-value 0.746 has not been found significant at the 0.05 level of significance for 38 df, and the formulated Hypothesis "*There is no significant difference in the Pre-Test achievement scores between the 7<sup>th</sup>-grade students in Science on the Criterion-Referenced Test*" got rejected. It means that 7<sup>th</sup>-grade students who were taught to teach using the Constructivist Approach and the Conventional Method of Teaching showed no significant difference in their Pre-Test scores on the CRT, indicating the equivalence of the groups.

**Objective-2:** To study the efficacy of the Constructivist Approach (CA) and the Conventional Method of Teaching (CMT) on upper-primary students' immediate performance in Science on the Criterion-Referenced Test.

**Hypothesis:** There is no significant difference in the Post-Test immediate achievement score between the 7<sup>th</sup>-grade students following the Constructivist Approach (CA) and the Conventional Method of Teaching (CMT) in Science on the Criterion-Referenced Test.

Table 3: Showing the t-value of mean post-test scores of CA & CMT groups of 7<sup>th</sup>-grade students.

Groups	N	Mean	SD	t-value	Level of significance
CA Group	20	131.3	6.08	16.7	Significant at the 0.01 level of significance
CMT Group	20	95.3	7.65		

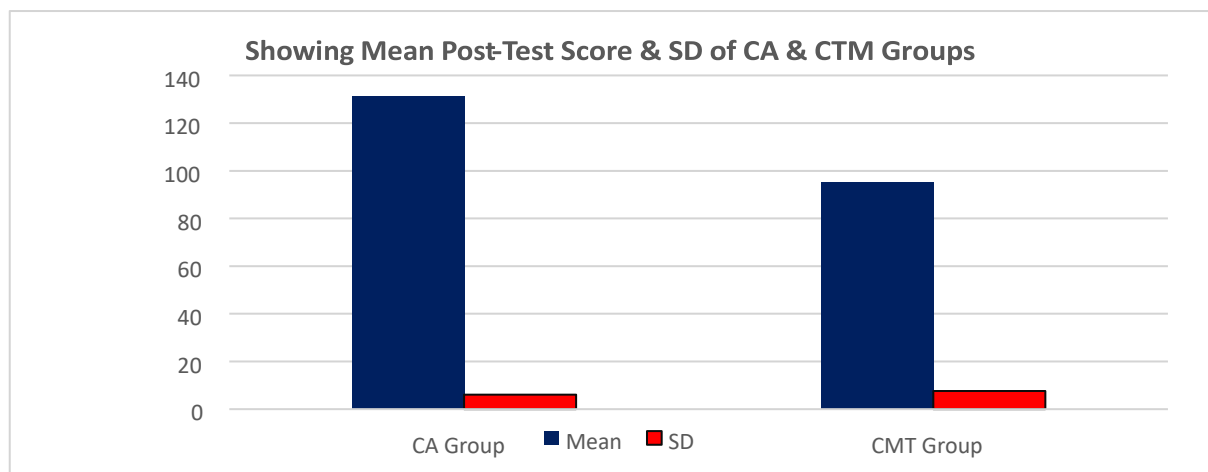


Figure 4: Comparison of Post-Test Scores of CA & CMT Groups

Table 3 shows the computed t-value as 16.7, surpassing the table t-value of 7.17, indicating significance at the 0.01 level for 38 df. Consequently, the Hypothesis "*There is no significant difference in the Post-Test immediate achievement score between the 7<sup>th</sup>-grade students following the Constructivist Approach (CA) and the Conventional Method of Teaching (CMT) in Science on the Criterion-Referenced Test*" was rejected. The finding suggests that students taught via CA outperformed those taught by CMT in immediate academic performance. Thus, the Constructivist Approach is deemed superior at the elementary school level. The CA group's mean score was 131.3 (87.53%), while the CMT group's was 95.3 (63.53%) on the Criterion-Referenced Test, further confirming CA's effectiveness. For clarity, the Post-test scores of the CA and CMT groups are shown in Figure 4. Supporting studies, such as Kaur and Kaur (2016), Gunsen et al. (2018), Holley and Park (2020), Nurpatri et al. (2021), Unodiaku (2022), and Siagian et al. (2023), conducted both in India and abroad, affirm the superiority of the Constructivist Approach.

**Objective-3:** To study the efficacy of the Constructivist Approach (CA) and Conventional Method of Teaching (CMT) on upper-primary students' two-week delayed performance in Science on the Criterion-Referenced Test.

**Hypothesis:** There is no significant difference in the two-week delayed achievement score between the 7<sup>th</sup>-grade students following the Constructivist Approach (CA) and the Conventional Method of Teaching (CMT) in Science on the Criterion-Referenced Test.

Table 4: Showing t-value of mean delayed-test scores of CMT and CAI groups of 7<sup>th</sup>-grade students.

Groups	N	Mean	SD	t-value	Level of significance
CAI Group	20	127.1	7.29	13.84	Significant at the 0.01 level of significance
CMT Group	20	92.55	8.46		

Showing Mean two week Delayed -Test Score &amp; SD of CA &amp; CTM Groups

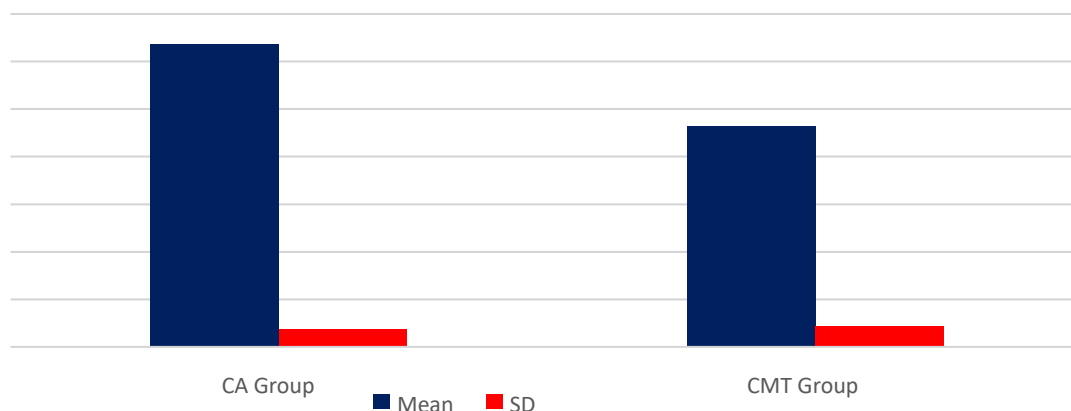


Figure 5: Comparison of two weeks' Delayed-Test Scores of CA &amp; CMT Groups

Table 4 reveals a computed t-value of 13.84, surpassing the table F value (2.704), indicating significance at the 0.01 level for 38 df, thus rejecting the hypothesis: "There is no significant difference in the two weeks delayed achievement score between the 7th-grade students following the Constructivist Approach (CA) and the Conventional Method of Teaching (CMT) in Science on the Criterion-Referenced Test." This signifies a significant difference in delayed performance between students taught via CA and CMT. The CA group's mean score was 127.1 (84.73%), while the CMT group's mean was 92.55 (61.7%) on the CRT, showing that CA students outperformed CMT students. For clarity, the two-week delayed scores of the CA and CMT groups are shown in Figure 5. Similar findings were reported by Elke & Lucyna (2001), Yadigaroglu & Demircioglu (2012), Tuna and Kascar (2013), Karsli & Ayas (2014), and Kibici (2022).

### FINDINGS OF THE STUDY:

The results of the study are presented as follows:

- The preliminary evaluation indicated no notable difference in the pre-test performance of seventh-grade science students before the commencement of the experimentation.

- A significant difference was observed in the post-test outcomes. Seventh-grade students instructed through the Constructivist Approach (CA) exhibited higher academic achievement than those taught via the Conventional Method of Teaching (CMT) in Science.
- The test scores from the two-week delay revealed a notable difference between the two groups. Upper primary students exposed to the Constructivist Approach in science education demonstrated improved retention of the material in their two-week delayed performance, exceeding the results of those taught through the Conventional Method of Teaching.

The Constructivist Approach showed more effectiveness than the Conventional Teaching Method in improving the academic performance of Class VII students in U.P. right after

the experimental intervention. Moreover, it demonstrated lasting positive impacts on students' performance two weeks after the intervention, suggesting better retention in comparison to the Conventional Method. This study indicates that educators can confidently adopt the Constructivist Approach to drive paradigm shifts in education and successfully meet Outcome-based education goals.

## CONCLUSION:

The National Policy on Education (NPE-1986), Programme of Action (1992), and National Education Policy (NEP-2020) all call for significant improvements to the educational system. These educational reforms need the use of contemporary teaching strategies. This study looked at the efficacy of the Constructivist Approach in teaching and learning science at the upper-primary level in Uttar Pradesh. The results showed that the Constructivist Approach improved the academic performance of seventh-grade pupils immediately after the instructional process, outperforming standard teaching techniques. Furthermore, when examined two weeks later, the Constructivist Approach improved the academic achievement of U.P.'s seventh-grade pupils. Based on these findings, the research recommends that educators broadly use the Constructivist Approach to support educational paradigm changes and successfully achieve the aims of outcome-based education.

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