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Effectiveness Of Constructivist Strategies With Lecture In Science

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ABSTRACT

The constructivist approach is a philosophy of teaching in which a learner constructs their knowledge with the help of their previous experiences. The constructivist approach advocates the teaching method and strategies which gives more scope to the learners in the classroom.This approach offers many strategies for teaching science which promote the construction of knowledge by the learners.This paper is intended to investigate the effectiveness of constructivist strategies with the lecture method. In the present study, the researcher has used the "pre-test post-test non-equivalent control group" design. All students of standard 9th of Vadodara city were considered as the population of the study.Two schools in Vadodara city have been purposively selected by the researcher. The sample of 100 (55 in the experimental group and 45 in the con[1]trol group) students who were studying in standard 9th. For Intervention, the syllabus suggested by NCERT has been followed by the researcher.The researcher has given intervention for amonth. During the intervention, the researcher used constructivist strategies with the lecture method according to the demand for content.For data collection, a self-made achievement test has been used. The researcher has used the Mann-Whitney U testto analyze the data. The finding revealed that if constructivist strategies are used with the lecture in the classroom for teaching science,then the achievement of studentsbecomes enhanced in comparison to the lecture.

Keywords: *Constructivist approach, Lecture Method, Problem Solving, Brainstorming.*

INTRODUCTION

In the realm of pedagogy, the ongoing discourse on effective instructional methods has led to an exploration of strategies that optimize learning outcomes while considering cognitive load. The juxtaposition of constructivist approaches with traditional lecture-based methods forms a critical area of inquiry in educational psychology. This research delves into the effectiveness of integrating constructivist pedagogical strategies within the context of lectures and its impact on both academic achievement and cognitive load.Constructivism is the theory that advocateslearning as an active process in which students create knowledge via meaningful interactions with the learning environment. It is based on the work of Piaget and Vygotsky. The application of constructivist principles within educational settings has garnered attention for its potential to enhance engagement, critical thinking, and knowledge retention among learners (Jonassen, 1999). The constructivist approach is also helpful in the enhancement of conceptual understating and academic achievement (Fernando and Marikar, 2017; McWright, 2017; Pangat, 2017; Sandhu, 2017; Chandi, 2020, Dahal, 2023), Contrastingly, traditional lectures, efficient in content delivery, often pose challenges related to high cognitive load, potentially hindering information processing and comprehension (Sweller, 1999). According to Sweller (2019), cognitive loadis divided into three types intrinsic, extraneous, and germane. This is concerned with the complexity of

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content and instructional method respectively, if the instruction is provided effectively then the cognitive load of the person will decrease (Ayres, 2011). On this belief, Liang and Lai (2013) designed instruction with the lack of equipment for color management, Figen (2014), designed instruction through storytelling, and Andrade et al. (2015) investigated the effect of multimedia-based instruction on cognitive load and revealed that better instruction reduced the cognitive load in learners but Bala et al. (2017) revealed that the lecture method is also an effective method for the teaching and learning and Hadie and Zul (2018) prove that lecture method also helps in decreasing cognitive load.However, after reviews, the researcher was unable to find the effect of constructivism on cognitive load. This study aims to investigate the effect of the symbiotic relationship between constructivist learning strategies, such as problem-based learning, collaborative learning, and scaffolding techniques when integrated with lecture-based instruction on the achievement and cognitive load of the learners. By assessing their impact on students' academic achievement and cognitive load, this research endeavors to contribute empirical evidence to the ongoing dialogue on optimizing pedagogical practices.The theoretical framework guiding this study draws upon the Cognitive Load Theory (CLT) proposed by Sweller, which elucidates the limitations of working memory in processing information and emphasizes the importance of instructional design in minimizing extraneous cognitive load to facilitate learning (Sweller, Ayres, &Kalyuga, 2011). Additionally, this study aligns with the socio-constructivist perspective, emphasizing the social and collaborative nature of learning, as advocated by Vygotsky (1978).

By shedding light on the intricate interplay between pedagogical methodologies and cognitive processes, this study aspires to offer insights that inform instructional design practices and optimize learning environments for diverse learners.

RATIONALE

The intersection of instructional methodologies and their impact on learning outcomes has been a focal point in educational psychology. The rationale for investigating the effectiveness of combining constructivist strategies with lectures on achievement and cognitive load stems from the recognized need to optimize pedagogical approaches to enhance learning experiences. Constructivism, as a theoretical framework, emphasizes active learner engagement and knowledge construction (Piaget, 1976; Pangat, 2017; Singh and Yaduvanshi. 2018). Integrating these principles into traditional lecture formats holds promise for fostering deeper understanding and application of content among students.Moreover, the efficacy of lectures, while fundamental in content dissemination, often encounters limitations related to cognitive load (Carpenter, Fister, & Torres, 2018). Cognitive Load Theory (CLT) asserts that an overload of cognitive resources can impede learning by overwhelming working memory capacity (Sweller, 1988). Understanding the intricate relationship between cognitive load and instructional design is pivotal in refining pedagogical methods to alleviate unnecessary cognitive burdens while optimizing learning engagement and comprehension.This research aims to bridge the gap between theoretical frameworks and practical application by investigating how the integration of constructivist strategies within lecture-based instruction influences both academic achievement and cognitive load. By analyzing the potential synergy between these methodologies, this study seeks to offer empirical evidence guiding educators and instructional designers in tailoring instructional approaches that strike a balance between effective content delivery and cognitive load management.

Research Questions

1. How farare interventionprogrammes based on constructivist strategies effective for science teaching?

Objectives

1. To study the Achievement of standard 9^{th} students in science subjects.
2. To study the Cognitive Load of standard 9^{th} students in science subjects.

3. To compare the experimental and control groups based on their intelligence.
4. To assess the effectiveness of intervention programmes based on constructivist strategies on the achievement of standard 9th students in the science subject.
5. To assess the effectiveness of intervention programmes based on constructivist strategies on the cognitive load of standard 9th students in the science subject.

Participants

All students of standard 9th of Vadodara city were considered as the population of the study. Two schools in Vadodara city have been purposively selected by the researcher. The sample of 100 (55 in the experimental group and 45 in the control group) students who were studying in standard 9thwereselected for the study.

Methods and Procedure

For Intervention, the syllabus suggested by NCERT has been followed by the researcher. The researcher has given intervention for a month. During the intervention, the researcher used constructivist strategies according to the demand for content with the lecture method. During the intervention two chapters of the science subject named 'Matter in our surroundings' and 'Is matter around us Pure?' were included. For the delivery of content brainstorming andproblem-solvingstrategies have been used with the lecture method. The lecture method was a dominant method for the during the intervention but at the time of intervention brainstorming and problem solving strategies was used by the researcher.

Delimitations of the study

1. This study was delimited only to standard 9th.
2. The present study delimited to only Vadodara city.

Tools:

Achievement Test- Self-constructed achievement test has been used by the researcher for collecting the scores of achievements. There were 25 questions concerning the respective chapters.

Cognitive Load Scale-The survey instrument utilized to assess cognitive strain has been adapted from the one created by Hwang and colleagues (2013). There are eight items total: three for "mental effort" and five for "mental load." With a Cronbach alpha of 0.784 for mental effort and 0.817 for mental load, the questionnaire's consistency is quite excellent. On a 5-point Likert scale, the student's response was 1 for strongly disagree and 5 for strongly agree.

Ravens Progressive Matrices- This tool was developed by Raven. In this tool, there were five sections each containing 12 questions of general intelligence with increasing difficulty level.

Operational Definition of the Terms

Effectiveness of Programme- The program's effectiveness in this study is determined by the score difference between the post-test results of the experimental and control groups.

Results:

Objective 1- To study the Achievement of standard 9th students in science subjects.

Table 1: Achievement Score of Control and Experimental Groups

Group	N	Minimum Score	Maximum Score	Mean
Control	45	14	68	34.28
Experimental	55	26	75	54.24

Result- The scores of the control group were a minimum score is 14, a maximum score is 68 andthe mean was 34.28 and the experimental group obtained a minimum score is 26, a maximum score is 75 and the mean was 54.24.
Objective 2- To study the Cognitive Load of standard 9th students in science subjects.

Table 2: Cognitive Load Score of Control and Experimental Groups

Variable	N	Minimum Score	Maximum Score	Mean
Control	45	10	36	21.48
Experimental	55	08	31	18.69

Result- The scores of the control group were a minimum score is 10, a maximum score is 36 and the mean was 21.48 and the experimental group obtained a minimum score is 10, a maximum score is 31 and the mean was 18.69.
Objective 3- To compare the experimental and control groups based on their intelligence.
H_{01}-There is no significant difference between the intelligence scores of the control group and the experimental group.

Table 3: Comparison Between Intelligence Scores of Experimental and Control Group

Group	N	Mean	Z-Value	U-Value	Level of Significance	Result
Experimental	55	38.48	.391	1772	0.05	Not Significant
Control	45	37.09				

Result-The obtained value of Mann-Whitney U between the control and experimental groups was 1772, while the Z Valuewas .391. Consequently, the null hypothesis is retained.
Interpretation- The value of Mann-Whitney U reached 1772, while the Z value was determined to be .391. Given that the sample size (N) exceeds twenty and the Z value falls outside the range of ±1.96 to ±2.58, the U statistic is not considered significant at the 0.05 level. This indicates an equal distribution of intelligence among the participants of both groups.
Objective 4- To assess the effectiveness of intervention programmes based on constructivist strategies on the achievement of standard 9th students in science subjects.
H_{02}-There is no significant difference between the achievement scores of the control group and experimental group in the Science subject at the secondary level.

Table 4: Comparison Between Achievement Scores of Experimental and Control Group

Group	N	Mean	Z-Value	U-Value	Level of Significance	Result
Experimental	55	54.24	-7.111	203.50	0.05	Significant at 0.05 alpha
Control	45	34.28				

Result-For the control and experimental groups, the value of Mann-Whitney U was 203.50, with the Z value appearing at -7.111. As a result, the null hypothesis is rejected.
Interpretation- The value of Mann-Whitney U was observed at 203.50, with the value of Z was -7.111. Given that the sample size (N) is above twenty and the value of Z does not

fall within the range of ±1.96 to ±2.58, it indicates that the U statistic is significant at the 0.05 level. This signifies that the integration of constructivist strategies alongside traditional lecture methods enhances student achievements in science more effectively than employing the lecture method alone.

Objective 5- To assess the effectiveness of intervention programmes based on constructivist strategies on the cognitive load of standard 9th students in science subjects.

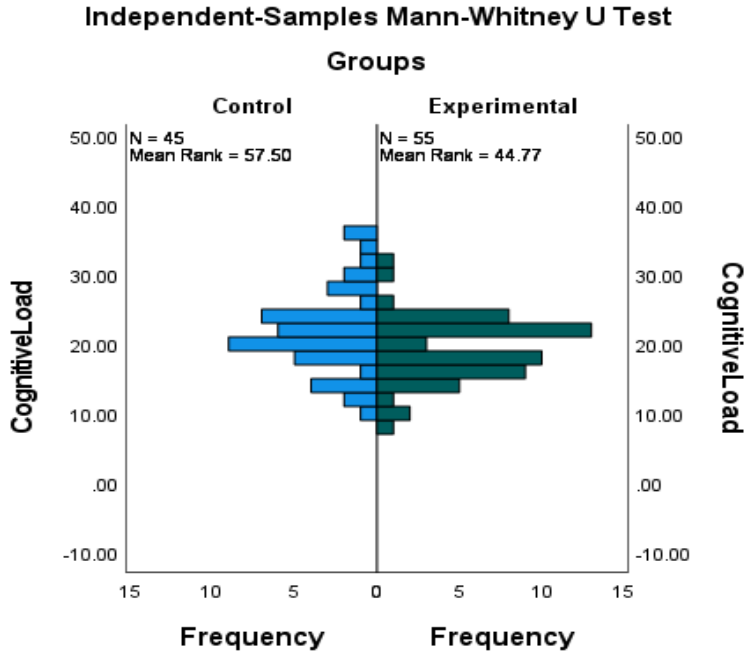
H_{03}-There is no significant difference between the Cognitive Load scores of the control group and experimental group in the Science subject at the secondary level.

Table 5: Comparison Between Cognitive Load Scores of Experimental and Control Group

Group	N	Mean	Z-Value	U-Value	Level of Significance	Result
Experimental	55	21.48	-2.18	922.5	0.05	Significant
Control	45	18.69				

Result: The null hypothesis is rejected because the experimental and control groups' Mann-Whitney U values were 922.50 and their Z-values were -2.18.

Interpretation- Analysis using Mann-Whitney-U, the Z is equal to -2.18 and U equals 922.50. The study's N exceeds twenty, and its Z-value falls between ±1.96 and ±2.58, indicating that U is significant at the 0.05 level. This suggests that using constructivist strategies alongside lectures helps lessen students' cognitive burden when teaching science.



DISCUSSION

This research has corroborated the hypothesis that employing constructivist strategies in conjunction with traditional lecture methods enhances students' academic achievements in science education more significantly than utilizing the lecture method in isolation. The

constructivist approach, which emphasizes student-centered learning and the construction of knowledge through experience and reflection, when amalgamated with the direct and structured transmission of knowledge characteristic of the lecture method, forms a comprehensive pedagogical strategy. This hybrid approach addresses diverse learning styles and needs, thereby fostering a more inclusive and effective learning environment.
The findings of this study are consistent with the research outcomes of several scholars, including Fernando and Marikar (2017), McWright (2017), Pangat (2017), Sandhu (2017), Chandi (2020), and Dahal (2023), who have all documented the efficacy of constructivist methodologies in science education. These researchers collectively assert that constructivist practices, which may include collaborative learning, problem-based learning, and inquiry-based activities, significantly contribute to a deeper understanding and retention of scientific concepts.This study also supported the findings of Ayres (2011) and Sweller (1999) who revealed that if the instructional method is good then the cognitive load of the learners decreases and if the instructional method is poor quality, then the cognitive load of the learners increases. This study has been done on a smaller number of the population and the sample of this study covers only two schools. This study was performed on selected chapters. These could be the limitations of the study.

CONCLUSION

This study shows that constructivist strategies like brainstorming, problem-solving, and questioning are very important methods for the teaching of science. If teachers use these strategies with the lecture, then they can improve the achievement of the students in the science subject and decrease the cognitive load.

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