

EFFECTIVENESS OF META-COGNITIVE STRATEGIES ON THE ACHIEVEMENT IN PHYSICS OF STANDARD IX STUDENTS

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Abstract

The quest for improved learning methods in education has led to the exploration of innovative strategies to enhance student achievement. One such promising avenue is the integration of meta-cognitive strategies. This study focuses on investigating the impact of meta-cognitive strategies on the academic achievement of standard IX pupils in the field of Physics. By examining the effectiveness of these strategies, we aim to shed light on their potential to positively influence students' performance in this critical subject. This research seeks to provide valuable insights into the role of meta-cognition in the learning process and its relevance to Physics education for standard IX pupils.

Keywords: Effectiveness, Metacognitive strategies, Achievement in Physics

Introduction

Education is an ever-evolving field, constantly seeking innovative approaches to enhance the learning experience and improve academic outcomes for students. In this pursuit of effective teaching methodologies, the utilization of meta-cognitive strategies has emerged as a promising avenue. Meta-cognitive strategies involve enabling students to become more aware of their own learning processes, which, in turn, can significantly impact their academic achievements. This study aims to explore the effectiveness of meta-cognitive strategies on the achievement in Physics for standard IX pupils.

The primary objectives of this research encompass a comprehensive evaluation of the impact of meta-cognitive strategies on both the initial knowledge levels and the post-instructional achievement in Physics. Additionally, the study seeks to analyze the differential effects of these strategies across different gender subgroups. The primary need for this research lies in the desire to improve the learning outcomes of standard IX students in Physics. Physics is often considered a challenging subject, and finding effective strategies to boost student achievement is crucial. Meta-cognitive strategies hold the potential to empower students with the skills and knowledge necessary for better comprehension and problem-solving in this field.

In today's changing education, it's important to find new teaching methods that work for different learners. Meta-cognitive strategies are a modern way of teaching that help students think critically and solve problems on their own. This research can contribute to the ongoing discourse on

pedagogical innovation. Metacognitive strategies are designed to monitor cognitive progress. Metacognitive strategies are ordered processes used to control one's own cognitive activities. It is an effective tool to increase the achievement of students and as an evaluation tool. Review shows that not many researches are conducted on the effectiveness of metacognition and its strategies on the achievement in physics. Hence the researcher investigates on the effectiveness of metacognitive strategies on the achievement in physics.

Review of Studies

Langdon et al (2019) studied the effect of different metacognitive interventions on knowledge and regulation of cognition, as well as academic performance (i.e., exam and final grades) in three sections of an undergraduate human anatomy and physiology course. Kummin, S. A., & Rahman, S. (2010) studied the relationship between the use of metacognitive strategies and achievement in English among students in University Kebangsaan Malaysia compared with other learning strategies. Students with high achievement in English use more metacognitive strategies than students of low achievement in that language.

Ramganesh (2008) conducted a study on 'effect of meta-cognitive strategies on enhancing teaching competency in mathematics among prospective teachers', makes an attempt to determine the effectiveness of meta-cognitive strategy on enhancing the teaching competency among B.Ed. students. The finding was that teacher trainees could strengthen their teaching competency through meta-cognitive control.

Savithri (2006) conducted a research entitled 'Impact of metacognitive strategy in enhancing perceptual skills among high school students on learning geometry'. The study reveals the effectiveness of metacognitive strategies in learning Geometry.

Elaine & Sheila (1990) in their study 'developing metacognition' proves that metacognitive strategies can be used to increase learning skills and the independent use of these metacognitive strategies can be gradually developed in people. The students should connect new information to old information and deliberately select thinking strategies, plan, monitor and evaluate these thinking processes.

The review of related literature gives a wide perspective of the problem under investigation. Reviewing the studies, the investigator found out large number of studies related to meta-cognitive strategies. Most of the studies were done in a variety of subjects and almost all of the studies explained the importance of meta-cognitive strategies for teaching different subjects. Langdon et al (2019) studied the effect of different metacognitive interventions on knowledge and regulation of cognition, as well as academic performance, Kummin, S. A., & Rahman, S. (2010) studied the relationship between the use of metacognitive strategies and achievement in English, Ramganesh (2008), Savithri (2006), Elaine and Sheila (1990), tried to study the effectiveness of meta-cognitive strategies on different subjects.

Statement of the problem

The present study is entitled as “EFFECTIVENESS OF METACOGNITIVE STRATEGIES ON THE ACHIEVEMENT IN PHYSICS OF STANDARD IX STUDENTS”

Operational Definition of Key Terms

Effectiveness

Effectiveness is defined as the adequacy to accomplish a purpose on the capacity to produce the intended result (Webster, 1996).

For the present study effectiveness is defined as the improvement in academic achievement as an effect of a particular treatment.

Meta-cognitive strategies

John Flavell originally coined the term metacognition in the late 1970s to mean “cognition about cognitive phenomena,” or more simply “thinking about thinking” (Flavell, 1979, p. 906). Meta-cognitive strategies are systematic cognitive techniques to assist students in recognizing, planning, implementing and monitoring solutions to problems. (Smith, Steven, W. 1992).

For the present study, meta-cognitive strategies mean that all the techniques used in the class room to assist students in recognizing, planning, implementing and monitoring solutions to problems such as connecting new information to former knowledge, Selecting thinking strategies deliberately, Planning, monitoring and evaluating thinking process deliberately, which activate the cognitive domain of the students.

Achievement in Physics

In the present study, the term Achievement in Physics means the level of performance of an individual in the unit ‘Motion and Wave Motion’ of standard IX physics syllabus.

Objectives of the study

- a) To compare the mean pre-test scores of experimental and control groups
- b) To compare the mean post test scores of achievement in Physics for experimental and control groups for total sample and the subsamples based on gender.
- c) To compare the mean gain scores of experimental and control groups for total sample and the subsamples based on gender
- d) To study the effectiveness of meta-cognitive learning strategies over the existing method of teaching on the achievement in Physics of standard IX students.

Hypotheses of the study

- There exists significant difference in the pre-test scores of the experimental and control groups.
- There exists significant difference in the mean scores of the post-test of the experimental and control groups for total sample and subsamples based on gender.
- There exists significant difference in the mean gain scores of the experimental and control groups for total sample and subsamples based on gender.

- There exists significant difference in the Achievement of Physics between the experimental and control groups.

Method

The present study was conducted employing the true experimental design. The design used in the study was the pre test- post test equivalent group design. The study made use of two types of lesson transcripts and achievement test in physics for measuring the effectiveness of meta cognitive strategies on the achievement in physics. The same test has been administered in pre and post experiment phases.

Sample

The sample for the study consisted of 54 students in the experimental group and 49 in the control group. The sample for both experimental and control groups were two divisions of standard IX students drawn from the Govt. Ganapath Vocational Higher Secondary School, Feroke, Calicut.

Tools used for the study

The following tools were used, which are developed and standardized by the investigator with the help of supervising teacher.

- Lesson Transcripts Based on Meta-cognitive Strategies and Existing Method (Constructivist Method) in the subject Physics for standard IX students for selected topics
- Achievement test in Physics for class IX students of Kerala school syllabus. The test was constructed as per the designed blueprint. The achievement test was standardized as per norms.

Analysis of Data

Metacognitive strategies of teaching can help to improve secondary school students' achievement in physics. Researchers gathered data from 54 students in the experimental group and 49 students in the control group. Researchers conducted a physics achievement test before and after the teaching intervention in both groups. Results of the pre test and post test analysis were used for comparison. The results are given in table 1

Table 1

Statistical Constants for Pre-Test and Post-Test Scores of Achievement in Physics among Class IX Students

Group	Variables	N	Mean	Median	Mode	SD	Skewness	Kurtosis
Experimental	Pre - test	54	14.18	14.00	15.00	3.16	0.210	0.006
	Post - test	54	33.11	33.50	44.00	8.94	-0.366	-0.988
Control	Pre - test	49	14.16	15.00	15.00	5.07	0.50	2.831
	Post - test	49	23.65	24.00	24.00	9.82	-0.046	-0.921

The measures of central tendency like mean, median and mode of the pre-test and post- test scores of the experimental and control groups are almost equal. It shows that pre-test and post-test scores of experimental and control groups are normally distributed.

Comparison of mean pre-test scores of Achievement in Physics for Experimental and Control Groups

The mean scores of experimental and control groups on the pre-test were compared and studied using the test of significance of difference between means of large independent sample and the results are given in table 2.

Table 2

Data and results of the test of significance of difference between mean pre-test scores of achievement in physics among Class IX students

Group	N	Mean	SD	Critical Ratio	Level of Significance
Experimental	54	14.18	3.16	0.027	Not significant
Control	49	14.16	5.07		

The obtained t-value (0.027) is below the limit set for 0.05 level of significance. So no significant difference found in the mean pre-test scores of experimental and control groups for the achievement in Physics. It can be inferred from the t-test that the performance of the experimental and control groups are similar in case of their pre-experimental status of achievements measured in terms of pre-tests.

Comparison of the Mean Post-test scores of Achievement in Physics for Experimental and Control groups

The mean post-test scores of control and experimental groups were compared by using independent sample t-test and the results are given in Table 3. The t-value (5.12) is greater than the tabled value (2.58) at 0.01 level of significance. The mean score of the experimental group (33.11) is significantly higher than that of the control group (23.65). It indicates that there is a significant difference in the post-test scores between experimental and control groups. The data and results are given in table 3.

Table 3

Data and results of the test of significance of difference between mean post-test scores of achievement in physics among Class IX students

Group	N	Mean	SD	Critical Ratio	Level of Significance
Experimental	54	33.11	8.94	5.12	Significant at 0.01 Level
Control	49	23.65	9.82		

The obtained t-value (5.12) is above the limit set for 0.01 level of significance. So there exist a significant difference in the mean post-test scores of experimental and control groups. It can be inferred from the result of the t-test that the performance of the experimental and control group is different in the case of their post experimental status of achievement in Physics measured in terms of a post-test.

Comparison of the Mean Post-test scores of Achievement in Physics for Boys between Experimental and Control Groups

The mean performance of boys of experimental and control groups in the post-test were studied and compared using the test of significance of difference between means small independent sample. The data and results of the t-test are presented in table 4.

Table 4

Data and results of the test of significance of difference between Experimental and Control Group Mean Post-test Scores of Boys

Group	N	Mean	SD	Critical Ratio	Level of Significance
Experimental	24	33.08	10.26	4.15	Significant at 0.01 Level
Control	29	21.79	9.48		

The obtained t-value (4.15) for the mean post-test scores of achievement in Physics between experimental and control groups boys is greater than the tabled value required for significance at 0.01 level. This significant t-value indicates that the mean post-test scores of boys of the experimental and control groups are not similar. This revealed the superiority of boys of experimental group over the boys of control group in case of post-test scores.

Comparison of the Mean Post-test scores of Achievement in Physics for Girls between Experimental and Control Groups

The mean performance of girls of experimental and control groups in the post-test were studied and compared using the test of significance of difference between means small independent sample. The data and results of the t-test are presented in table 5.

Table 5

Data and results of the test of significance of difference between Experimental and Control Group Mean Post-test Scores of Girls

Group	N	Mean	SD	Critical Ratio	Level of Significance
Experimental	30	33.13	7.92	2.68	Significant at 0.01 Level
Control	20	26.35	9.91		

The obtained t-value (2.68) for the mean post-test scores of achievement in Physics for girls between experimental and control groups are greater than the tabled value required for significance

at 0.01 level. It can be inferred from the table that the mean post-test scores of girls of the experimental and control groups are dissimilar. This indicates that the girls of the experimental group achieved more than the girls of control group.

Comparison of the Mean Gain Scores of Achievement in Physics for Experimental and Control Groups

The mean gain scores of Experimental and Control groups were studied and compared using the test of significance of difference between means of large independent sample. The comparison was done for the total sample in the experimental and control groups. The data and results of t-test is given in table 6.

Table 6

Difference in Mean Gain Scores of Experimental Group and Control Group

Group	N	Mean	SD	Critical Ratio	Level of Significance
Experimental	54	18.92	8.54	5.66	Significant at 0.01 Level
Control	49	9.48	8.33		

The obtained t-value (5.66) for the mean gain scores is greater than the tabled value required for significance at 0.01 level. This suggests that there exists significant difference in the mean gain scores of experimental and control groups. So the gain performance of the experimental and control groups are not similar. High mean gain scores for the experimental group over the control group for the total sample is noticed. The critical ratio obtained by comparison of gain scores of the groups and higher mean value of the experimental group shows that metacognitive strategies are more effective.

Comparison of the Mean Gain Scores of Boys between Experimental and Control Groups

The mean performance of boys of experimental and control groups in the gain scores were studied and compared using the test of significance of difference between means of small independent sample. The data and results of the test are presented in table 7.

Table 7

Data and results of the test of significance of difference between Boys of Experimental and

Control Groups in the Mean Gain Scores

Group	N	Mean	SD	Critical Ratio	Level of Significance
Experimental	24	19.95	9.50	4.51	Significant at 0.01 Level
Control	29	8.69	8.67		

The obtained t-value (4.51) for the mean gain scores of boys between experimental and control groups, is greater than the tabled value required for significance at 0.01 level. This indicates that the mean gain scores of boys of the experimental and control groups are dissimilar. This significant t-value reveals that the superiority of boys of experimental group over the boys of control group in case of gain scores.

Comparison of the Mean Gain Scores of Girls between Experimental and Control Groups

The mean performance of girls of experimental and control groups in the gain scores were studied and compared using the test of significance of difference between means of small independent sample. The data and results of the test are presented in table 8.

Table 8

Data and results of the test of significance of difference between Experimental and Control Group Mean Gain Scores of Girls

Group	N	Mean	SD	Critical Ratio	Level of Significance
Experimental	30	18.10	7.76	3.31	Significant at 0.01 Level
Control	20	10.65	7.88		

The obtained t-value (3.31) for the mean gain scores of girls between experimental and control groups, is greater than the tabled value required for significance at 0.01 level. This indicates that the mean gain scores of girls of the experimental and control groups are dissimilar. This significant t-value reveals the superiority of girls of experimental group over the girls of control group in case of gain scores

Conclusions and Educational Implications

It generally concludes that meta-cognitive strategies have helped the students to improve their performance in studies to a great extent. From the study, it is clear that both boys and girls have improved in their studies with better increment in the case of boys. In the case of both low achievers and high achievers meta-cognitive strategies have raised their level of achievement with considerable improvement in the case of high achievers.

After teaching through meta-cognitive strategies, the students have effective utilization of time; it made learning easier and at the same time interesting and also has helped the students to develop a positive attitude towards their studies by boosting their motivation. We reach on all these conclusions by considering the statistical analysis which we have done.

The statistical analysis considered was seven test of significance of means. Out of these seven mean comparisons, six values were found to be significant. Only the mean comparison between

pre-test scores of experimental and control groups were not significant. The values obtained by test of significance of difference between means of experimental and control groups for post-tests and gain scores for the total sample and the subsamples based on gender were highly significant. Hence we can conclude that the pupils taught through the new method of teaching using meta-cognitive strategies have achieved more than that of the control group taught by the existing constructivist method of teaching.

From the above statement we can safely conclude that the method of teaching using meta-cognitive strategies is an effective method of teaching over existing method of teaching on achievement in Physics.

The present study reveals the importance of meta-cognitive strategies which are effective for the proper understanding and meaningful learning of the students. Even though the investigation is carried out on a small sample, the findings throw light on the current educational practice – especially in the teaching-learning process of Physics.

The existing Physics curriculum may be modified to inculcate meta-cognitive strategies in it. Teachers may be trained to practice this method. These strategies are useful in curriculum planning and organization.

The experimenter put forward some educational implications of the present study on the basis of the major findings and conclusions of the study

- 1) The development of meta-cognitive strategies will remain important in advancing students' academic, personal and professional success.
- 2) By providing proper assistance and guidance, low achievers and average achievers can improve their academic performance.
- 3) In teaching-learning process, if teachers take the responsibility of equipping students with the important meta-cognitive strategies, students would become independent learners to a great extent.
- 4) By acquiring meta-cognitive strategies, the children have a deeper understanding of their own learning so that they can learn effectively.
- 5) Students can identify the ways of improving their own performance and to take responsibility for their own learning and achieving goals.

The conclusions arrived in the course of present study clearly established the effect of meta-cognitive strategies in the improvement of academic achievements in Physics for standard IX students. These findings have considerable implications for the students, teachers, parents, administrator, counsellors and for the society at large. The findings of the study suggest the importance of these new meta-cognitive strategies for improving the academic achievement of students in physics.

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