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EFFECTIVENESS OF INSTRUCTIONAL MATERIAL BASED ON GRAPHIC ORGANIZERS WITH RESPECT TO SCIENCE ACHIEVEMENT OF EIGHTH GRADE STUDENTS

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Abstract

The purpose of the present study was to investigate the effectiveness of instructional material based on graphic organizers in terms of science achievement and retention in science of eighth grade students. For this, pretest - posttsest control group experimental research design was used. A purposive sample of 65 students of two intact section of eighth class from one private school of Yamuna Nagar district was selected. Two intact section of eighth class was randomly designated as control group and experimental group and their equivalence was measured on the basis of 1st semester Examination scores in science. The self developed Instructional material based on graphic organizers was used for the purpose of experimental treatment whereas science Achievement Test & parallel forms of science achievement test were used for dependent variables (science achievement & retention in science). Experimental group was taught through graphic organizers and control group was taught through traditional teaching method. Data was analyzed by employing t-test. The study found that the students exposed to graphic organizers significantly achieved better and retained more than those exposed to the traditional teaching approach. The results revealed that the instructional material based on graphic organizers was more effective than traditional teaching approach with respect to science achievement and retention. It is therefore recommended that graphic organizer should be used in science teaching for improving performance in classroom.

Key words: Graphic Organizers, Science achievement, and retention.

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1.0 Introduction and background

Education is the channel between "existing knowledge" and "evolving knowledge". Knowledge is a relational aspect of education and is directly related to its richness of learning experiences provided to students. Mertens (1998) states that teaching is actually a process of imparting knowledge, skills and values as required and desired by the society. Effectiveness of a teacher and students learning can be enhanced through the appropriate strategy adopted in learning. It is well known fact about science education that students lack the capacity to grasp knowledge learned in one setting and apply it appropriately to a different setting. Many innovative strategies are applied to improving the status of science education viz. Constructivism, Cooperative learning, problem solving approach, inquiry based teaching, Graphical Knowledge Display etc. Graphic organizers are visual and spatial displays designed to facilitate the teaching and learning of textual material through the use of lines, arrows, and a spatial arrangement that describes text content, structure and key conceptual relationships (Kim et al., 2004). Graphic organizers have many uses in the classroom and can be used across the curriculum and in increasing patterns of complexity (Moore, 2003). Students are able to learn how to learn while they are in the process of acquiring new knowledge. They are not only able to learn content but they are becoming readers that know how to ask questions while reading, construct images of ideas being presented in text, and summarize what is being read. Hudson et al. (1993) also states that positive outcomes for curricular enhancements require the use of effective teaching practices

Nor and Jin (2012) stressed that graphic organizer as visual instructional aid embarks into the varied strata of learners' excellence and academic achievements. Moreover, Hawk (1986) confirmed the view that graphic organizers require minimal training time with teachers, little investment in materials, no investment in equipment, and no change in the existing physical plan. McKnight (2010) accepted that Graphic organizers are important and effective educational tools for organizing ideas & knowledge and facilitating comprehension of new information. Therefore, learners at all age levels benefit from graphic organizers and visual symbols in the practices related to a subject (Dye, 2000).

The researches highlighted supports for the utilization of graphic organizer as a contributory factor in improving performance in classroom and achievement test scores if they used effectively and become an integral part of classroom instruction.

2.0 Justification of the study

Generally, it is observed that science is being taught in schools in a very mechanical way. If we critically examine the evolution of science in the schools of India, we see a clear trend of including more content in the form of factual information & content seems too overwhelming to students. They lack the capacity to grasp knowledge learned in one setting and apply it appropriately to a different setting. The reason for student's poor performance is simple. This is due to the prevailing traditional teaching method. One of the major shortcomings of traditional teaching method to teach science subject, students understand subject at knowledge level and they usually memorize the science concepts without understanding the real meaning. As a result, they do not conceptualize the science concepts and integrate abstractions with applications. Bucayong (2019) suggested that lack of learning motivation and poor teaching methods are the major factors for poor performance of students in science subject. Because of the importance and the difficulty of the subject, science teachers seek for alternative teaching approaches in their teaching.

One approach that can be used to overcome the student's poor performance is the use of adjunct aids or displays that are inserted in text to communicate which information is important and how it is structured. Graphic organizers are important and effective instructional tools for organizing content, ideas and facilitating learners' comprehension of newly acquired information.

McMackin & Witherell (2005) also emphasizes that Graphic organizers help students in linking the newly gained knowledge with already known information. It is obvious that alternative teaching approaches needed to teach this sort of difficult concepts in science education. **Shamefsky (2007)** explained that graphic organizers such as concept maps enhance acquisition and application of scientific skills. Moreover, When fiction and nonfiction books are integrated into the teaching of a content area such as science, graphic organizers are useful for organizing information and enabling students to classify observations and facts, comprehend the

relationships among phenomenon, draw conclusions, develop explanations, and generalize scientific concepts. It can be used as teaching strategy where students solve problems, actively think through the task and apply information to the everyday situation. Creating a graphic organizer for an instructional lesson plan is an effective way to engage students in learning. You give them more ownership of the learning process by sharing the purposes and direction of instruction and by providing opportunities during the construction process for them to express their perceptions about the lesson content. It also provides a way to integrate an additional learning modality into instruction (Lenz et al, 2004).

Most of the reported studies in this field have been conducted in western countries. Compared to this, only a very small portion of the studies have been conducted in India. Hence, the investigator feels there is a need to conduct a study to see the effectiveness of instructional material based on graphic organizers in term of science achievement of eighth grade students.

3.0 STATEMENT OF THE PROBLEM

Keeping in view of the above justification, the present study was entitled "Effectiveness of instructional material based on graphic organizers with respect to science achievement of eighth grade students".

4.0 OPERATIONAL DEFINITION OF THE TERMS USED

Graphic organizers: in the present study, graphic organizers may include Venn diagrams, cause & effect, semantic feature analysis, & numerous other types of visual graphic outlines etc.

Science achievement: in the present study, science achievement means score obtained by students in science achievement test (SAT) developed by investigator.

5.0 Objectives of the study

The present study was undertaken in light of the following objectives.

1. To study the effectiveness of instructional material based on graphic organizers with respect to science achievement and retention in science of eighth grade students.
2. To study the effectiveness of traditional teaching approach with respect to science achievement and retention in science of eighth grade students.

3. To compare the effectiveness of instructional material based on graphic organizers and traditional teaching approach with respect to science achievement and retention in science of eighth grade students.

6.0 Hypotheses of the study

Following hypotheses were formulated for the present study and tested at 0.01 level of significance.

1. There exists no significant difference between the mean pretest and mean posttest science achievement scores of control group taught through traditional teaching approach.
2. There exists no significant difference between the mean posttest and mean delayed - posttest scores of control group taught through traditional teaching approach.
3. There exists no significant difference between the mean pretest and mean posttest science achievement scores of Experimental group taught through graphic organizers.
4. There exists no significant difference between the mean posttest and mean delayed – posttest scores of experimental group taught through graphic organizers.
5. There exists no significant difference between the mean gain science achievements scores of students taught through graphic organizers than those taught through traditional teaching approach.
6. There exists no significant difference between the mean retention scores of students taught through graphic organizers than those taught through traditional teaching approach.

7.0. METHODOLOGY

7.1. Research Design

The present study is an experimental research. This study adopted a pre-test post-test control group research design. This study was conducted on two intact groups of students studying in eighth class. Their equivalence was measured on the basis of 1st semester examination marks in the subject of science. Both groups were randomly designated as the control & Experimental group. The diagrammatic representation of the research design is shown in figure – 1

G1	O1	X	O2
G2	O3	C	O4

Pretest-posttest Control Group Experimental Research Design

Figure - 1

Where O1, O3 represent pre-test

O2, O4 represent post-test

X1 represents treatment (graphic organizers teaching method)

X2 represents without treatment (traditional teaching method)

7.2 Sample of the study

For the present study, a purposive sample of 65 students from two intact section of eighth class of one private school of Yamuna Nagar city affiliated with C.B.S.E board was selected. Two intact sections were randomly designated as control group and experimental group.

7.3 Tools used

7.3.1 Instructional tool:

Instructional material based on graphic organizers were prepared on the selected topics of science and used by the researcher. At first researcher selected the four chapter of chemistry from science textbook prescribed by N.C. E.R.T. The chapters are Materials in daily life, Metals and Non-Metals, combustion and flame and coal & petroleum. Researcher identified concepts and sub concepts from the selected topics and developed graphic organizer against every topic. During teaching learning process researcher explained every topic with the help of graphic organizer, graphic organizers was also prepared and discussed in the class. After end of the chapter, researcher summarized the complete chapter through concept map.

7.3.2 Measuring tool

The self developed science achievement test and parallel form of achievement test were used as pretest and posttest for both the groups (control and experimental groups). The reliability coefficient of the test was calculated by Kudar – Richardson formula (KR 20) i.e.0.906 &

Equivalent/parallel form of reliability (0.902). The coefficients of correlations are extremely high.

7.4 Procedure

The procedure of the study consisted of following sequential steps

1. After getting the permission from the principal of the school, two intact section of eighth class were selected for the present study. Then their equivalence was measured on the basis of previous semester examination marks in subject of science. Both groups were randomly designated as control group and experimental group.

2. Science achievement test was administered as pretest on both the groups.

3. After the administration of the pretest, Control group was taught through the Traditional teaching approach and experimental group taught through instructional material based on graphic organizers for a period of six weeks.

4. At the end of the treatment the parallel form of achievement test was administered as posttest on both the groups.

5. After a gap of two weeks, same posttest was administered as delayed-postttest on both the groups to measure the retention in science achievement.

7.5 Statistical techniques used:

The following Statistical techniques were used to analyze the data

1. Descriptive Statistics: Mean & Standard Deviation

2. Inferential Statistics: t-Test to compare the groups.

8.0 Results

This section reports the analysis and interpretation of data related to the effect of teaching approaches on science achievement and retention in science of eighth grade students. The Results obtained have been reported in two different sections

Section I

Results related to equivalence of control group and experimental group

In order to examine the equivalence of control group and experimental group in terms of science achievement was explored by employing t-test. The mean scores of both the groups obtained in 1st semester science examination and the t – value are presented in table 1.

Table - 1

Significance of difference between mean scores obtained by experimental and control group in 1st semester science examination

Sr. No.	Science achievement score	N	Mean	S.D	SEd	Df	t – value	Level of significance
1.	**Control group**	32	50.875	15.568	3.935	63	.725	Not significant
2.	**Experimental Group**	33	53.727	16.141				

The computed t- value is .725 which is less than the table value i.e. 2. 750 at 0.01 level of significance. Hence, there exists no significant difference between students of control group and experimental group with regard to science achievement. It reveals that both groups were equivalent in terms of their science achievement.

Further, the equivalence of both groups was also measured on the basis of pretest performance. The‘t’ was employed to know the significance of difference between both groups. The mean pretest scores of both the groups and t- value are shown in table – 2.

Table – 2

Significance of difference between pretest science achievement scores of students in control group & experimental group

Sr. No.	Achievement in Science	N	Mean	S.D	SEd	Df	t – value	Level of significance
1.	**Control group**	32	19.187	5.817	1.781	63	.088	Not significant
2.	**Experimental Group**	33	19.030	8.293				

It can be observed from the table that the computed t – value (0.088) is less than the table value i.e. 2.750 at 0.01 level of significance. Hence, there exists no significant difference between the control group and experimental group in terms of pretest scores. This indicates that the both the groups are equivalent in terms of prior learning.

Section II

Effect of teaching approaches on science achievement and retention in science

This section deals with the effectiveness of graphic organizers and traditional teaching approach in terms of science achievement and retention in science. The results related to effectiveness of teaching approaches have been reported in different subsection as follows -

A. Effectiveness of traditional teaching approach with respect to science achievement and retention in science.

B. Effectiveness of instructional material based on graphic organizers with respect to science achievement and retention in science.

C. Comparative effectiveness of instructional material based on graphic organizers and traditional teaching approach with respect to science achievement and retention in science.

A. Effectiveness of traditional teaching approach with respect to science achievement and retention in science.

In the present subsection, effectiveness of traditional teaching approach with respect to science achievement and retention in science is studied. The means, standard deviations of pretest, posttest, & delayed posttest scores of students in control group along with standard error of mean differences and t – value are shown in table 3.

Table – 3

Significance of difference between means pretest & mean posttest scores, and mean posttest &mean delayed - test scores of students in control group

Variables	Test phase	N	Mean	**Mean difference**	**S.D**	**SEd**	**Df**	**T – value**	**Level of significance**
Science Achievement	Pretest	32	19.187	8.0	5.817	.804	31	9.944	Significant
	Posttest		27.187		6.260				
Retention	Posttest	32	27.188	4.75	6.260	.389	31	12.215	Significant
	Delayed posttest		22.438		5.086				

The data presented in the first row of the table -3 shows that the obtained t- value (9.944) is greater than table value i.e. 2.750 at 0.01 level of significance. Hence the concerned null hypothesis i.e. “There exists no significant difference between the mean pretest and mean posttest science achievement scores of control group taught through traditional teaching approach” is rejected. Further, the mean posttest score was more than the mean pretest score of control group. This reveals that science achievement scores of students in control group improved significantly after teaching through traditional approach. Therefore, the traditional teaching approach is effective in terms of students’ science achievement.

The data presented in second row of the table shows that the calculated t – value is 12.215 which is greater than the table value i.e. 2.750 at 0.01 level of significance. Hence the concerned null hypothesis i.e. “There exists no significant difference between the mean posttest and mean delayed- posttest scores of control group taught through traditional teaching approach” is rejected. Further, the mean delayed – posttest score was less than the mean posttest score. This indicates that students have failed to retain significantly what they taught through traditional teaching approach. This shows that there is decline in students’ science achievement with respect

to time and forgetting is significant. Hence there is no significant retention in science achievement of students taught through traditional teaching approach. Now it may be concluded that traditional teaching approach is not effective in terms of retention in science.

B. Effectiveness of instructional material based on graphic organizers with respect to science achievement and retention in science.

This subsection deals with the effectiveness of instructional material based on graphic organizers with regards to science achievement and retention in science is studied. The means, standard deviations of pretest, posttest, & delayed posttest scores of students in experimental group along with standard error of mean differences and t – value are shown in table 3.

Table - 4

Significance of difference between means pretest & mean posttest, and mean posttest & mean delayed - test scores of students in experimental group

Variables	Test phase	N	Mean	**Mean difference**	**S.D**	**SEd**	**Df**	**T – value**	**Level of significance**
Science achievement	Pretest	33	19.030	11.848	8.293	.631	32	18.782	Significant
	Posttest		30.879		7.881				
Retention	Posttest	33	30.879	3.485	7.881	.385	32	9.060	Significant
	Delayed posttest		27.394		8.181				

The data presented in 1st row of table 4 shows that the calculated t – value (18.872) for science achievement scores of students in experimental group exceeds the table value i. e. 2.750 at 0.01 level of significance. Consequently, the related hypothesis i.e. “There exists no significant difference between the mean pretest and mean posttest science achievement scores of Experimental group taught through graphic organizers” is rejected. Further the mean posttest score (30.879) was higher than the mean pretest score (19.030). This reveals that science

achievement scores of students in control group improved significantly after teaching through traditional approach. Hence it may be concluded that the instructional material based on graphic organizers was effective in improving achievement in science of students in experimental group.

The data presented in second row of table - 4 shows that the computed t- value is 9.060 which is greater than the table value i.e. 2.750 at 0.01 level of significance. Hence the concerned hypothesis i.e. "There exists no significant difference between the mean posttest and mean delayed - posttest scores of experimental group taught through graphic organizers" is rejected. "Further the mean delayed – posttest score (27.394) was lesser than the mean posttest score (30.879). It clearly shows that there is decline in student's science achievement with respect to time and forgetting is significant. Hence there is no significant retention in science achievement of students taught through instructional material based on graphic organizers.

C. Comparative effectiveness of instructional material based on graphic organizers and traditional teaching approach with respect to science achievement and retention in science.

In this subsection, the experimental group and control group are compared on the basis of mean gain achievement score and retention score. Science achievement of eighth grade students was studied on the basis of gain score which is the actual difference between the mean posttest and mean pretest score whereas retention scores were calculated in terms of percentage Gain scores and retention – test scores of students in control and experimental group students are presented in table 5. However, significance of difference between these two groups was explored by employing t-test.

Table 5

Significance of difference between gain scores & retention scores of students in Experimental group & Control group

Variables	N	Groups	Mean	S.D	Mean difference	SEd	Df	T – value	Level of significance
Science achievement	65	Control	8.000	4.551	3.849	1.019	63	3.778	Significant
		Experimental	11.849	3.624					
Retention (%)	65		82.882	6.493	5.105	1.882		2.713	Significant

		Control					63		
		Experimental	87.986	8.510					

Data presented in 1st row of table – 5 shows that the computed t – value (3.778) for gain scores of students in control group and experimental group exceeds table value i.e 2.66 at 0.01 level of significance. Therefore the concerned null hypothesis i.e. "There exists no significant difference between the mean gain science achievement scores of students taught through graphic organizers and those taught through traditional teaching approach" is rejected. Further the mean gain score of experimental group (11.849) was higher than the mean gain score of control group (8.000). Therefore students in experimental group gained more than students of control group with respect to science achievement. Now, it can be concluded that instructional material based on graphic organizers is more effective than the traditional teaching approach in relation to science achievement of eighth grade students.

Data presented in 2nd row of the table - 5 shows that the obtained t- value (2.713) for retention scores of students in control group and experimental group exceeds table value i.e. 2.660 at 0.01 level of significance. Hence the concerned null hypothesis i.e. "There exists no significant difference between the mean retention scores of students taught through graphic organizers and those taught through traditional teaching approach" is rejected. Further, the mean retention score of experimental group (87.986) is higher than the mean retention score of control group (82.882). From the mean scores, it is clear that the group of students taught through graphic organizers retained significantly more than those taught through traditional teaching approach. Now, it may be concluded that instructional material based on graphic organizers is more effective with respect to retention in science achievement of students taught through traditional teaching approach.

9.0 Discussion of the results

From the analysis of the data, results revealed that the both teaching approaches were effective with respect to science achievement. But in retention phase, students of control and experimental groups were unable to retain their knowledge and forgetting is significant in both groups. The

decay theory of forgetting suggests that our memories decay or weaken with passage of time. However, instructional material based on graphic organizers was more effective than traditional teaching approach with regard to science achievement and retention. The present study is in line with the finding of supreet & Kamini (2018) that teaching through graphic organizers have positive impact on achievement in science. The study conducted by Tandog & Bucayong (2019) agreed with the finding of the present study that the group of students taught through graphic organizers achieved more than those taught through traditional instruction in physical science. Griffin et al. (1995) also reveals that the performance of students who used graphic organizers was statistically superior to that of students in traditional instructional conditions

10.0 Main findings of the study

Followings are the main findings of the study.

1. Traditional teaching approach was effective with respect to science achievement. However, it is not effective with regard to retention in science achievement

2. Instructional material based on graphic organizers was effective with respect to science achievement. However the same method was not effective with regards to retention in science achievement.

3. Instructional material based on graphic organizers was more effective than traditional teaching approach with respect to science achievement and retention in science achievement.

11.0 Educational implications

Since, the finding of this study showed the positive outcomes of the effectiveness of instructional material based on graphic organizers in terms of science achievement. It is hereby recommended that:

1. Teachers should be encouraged to use instructional material based on graphic organizers for improving performance of students in science.

2. Workshops and seminars may be organised by educational institution to acquaint their science teachers with the skill of preparing and using graphic organizers in teaching various science topics.

3. Textbook writers may present and organize the content with the help of graphic organizers to children.

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