



EFFECTIVENESS OF CONCEPT MAPS IN TEACHING SCIENCE AT UPPER PRIMARY LEVEL

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Abstract

Teachers have an important role to play in teaching as well as an integral component of our continuum of schooling. It is up to the teachers to establish critical fundamental skills, communication, functioning attitudes, importance judgement and the correct adaptation of our students. The only individuals to illuminate the road to pupil growth is teacher and particular teaching method is important for learning. This present study was performed on two groups through two different teaching methods; namely lecture method and Concept Mapping Method in teaching science. The nature of study is quasi experimental in nature, By implementing Matching design, the researcher only monitored the internal validity hazard for match design and Coordination between them allows study to adopt a pre-test that tests the dependent variable, or the variables chosen to be tested by the participants in a control and test community in such a manner.. The research was carried out after obtaining insight into concept-mapping method under study. During the teaching process, the study community was handled for 60 business days with a concept mapping method. In order to assess the impact of the method, students were assessed on the dependent variables prior to and during the procedure (pre-test and post-test) and to find out there is any significant difference exist between the two group which were used to taught through the teaching methods in teaching science for this present study. The difference between two group means were calculated through the 't' values. With the help of 't' values the researcher test the significance of difference between two group means. The total individual gain scores of students taught through concept mapping method is found significantly higher than that the total individual gain score of students taught through lecture method

Teachers are an integral component of our continuum of schooling. It is up to the teachers to establish critical fundamental skills, communication, functioning attitudes, importance judgement and the correct adaptation of our students. The only individuals to illuminate the road to pupil growth is Teacher. The students impress and improve the student's actions by training a successful instructor. A particular teaching technique is important for learning. According to Milton, "teaching is not a 'giving' subject as is generally understood by the layman, but a process of teaching and learning or of teaching, in which the teacher does not only teach, but he learns as a complementary process." Not just a slogan is continuing to read. It applies to a particular pedagogical method that satisfies the learner's needs. Teaching and learning are interrelated, and this connection is essential for understanding the nature of teaching theories. Learning is a teaching commodity and it also emphasizes that the teaching and learning phase vary in phases simultaneously **Bigge (1964)**. The discrepancy between theories and the theories of teaching was also defined by **Bruner (1966)**, He relates to the definition of learning theory and growth. **Bawa (1991)** emphasis that Bruner teaching theory has four key characteristics, firstly, teaching theory should signify interactions that should effectively be embedded in an individual's preparation for learning. Secondly, a teaching principle should show how the knowledge should be structured in order to be understood by learners and thirdly, the principle shows the appropriate orders for displaying the teachers' content. Finally, in order to instruct and understand, an instructor may determine the essence and speed of incentive and punishment. In Indian context lecture method is dominating in our education system at school and college level. It is well known fact that lecture method is not suitable and effective for understanding and to the linking of pupils. For making lecture method more effective lots of efforts are being made in this direction. The term teaching theory was described by **Kerlinger (1999)** as a set of interrelated structures, definitions and proposals which provide a systemic vision of learning between the variables for the purposes of explanation and prediction of data. According to **Novak (1995)**, there is no isolation exists in concepts, but they depend upon each other for meaning. Concepts are well connected through cross-links in a concept map. A powerful connection of relevant concepts forming through these cross-links called 'web', thereby enhancing their anchorage and connecting general concepts to specific ones; 'Very powerful connections anchor previously learned concepts to newly acquired ones. Descending hierarchy of concepts are linked in concept maps, i.e., start from general concepts are placed they are followed by the each ones, they make a pyramid like look of concept map. A attempt was made by **Ausubel (2000)** for the fulfillment of this need. David Ausubel has given the theory of meaningful verbal learning. He developed an Advance Organizer Model, based on his learning theory. This is very useful in understanding the content in cognitive domain. **Gahre(2000)** concept map is a concise representation and convenient of conceptual framework about any forms of knowledge and can be defined as 'interlocking' network of "newly and previously gained knowledge" of the learners. Some linkage in form of 'words' & 'phrases' link the concepts to one another to form concept map. **Kinchin,LM (2000)** A research was conducted to explain the relative utility concept map to understand the meaningful learning for high school students of science and biology. It also observed that the definition any concept, concept mapping approach is more successful for higher secondary students than the lecture method of biology. **Bilal A, Munawar C and Mirza S. (2013)** The impact of concept mapping, scientific abilities, and ability to solve problems of secondary students, has been identified. **Safayeni (2013)** Concept maps are tool for leading meaningful learning and they enhance performance on concept learning outcome. Concept maps are tool which is used collect the quantitative and qualitative knowledge of learner's. More effective inter-relationship among concepts, leads more meaningful learning through concept maps. Systematically Organization of subject matter leads meaningful learning. Concept map activity has lots of variations in the way of design. **Schwendimann, B. A. (2015)** her study reveals that the definition of any content, concept mapping was seen as an important method for teaching in the math and science and findings demonstrate that the mapping of definitions is an appropriate technique for this

Some linkage in form of 'words' & 'phrases' link the concepts to one another to form concept map. Concepts in a concept map are generally enclosed in fix boundary, may be circle or box. Relationships between these concepts are related by connecting lines. These connecting lines joint together to form the concept.

1.1 Definition of the terms used:

- Effectiveness

Any method by which the presence, quality or genuine of anything is determine (International dictionary of Education, 1979).

In this context effectiveness means the process or by which the effectiveness of prepared concept maps is determined.

- Concept Maps

A two-dimensional visual representation a body of knowledge, a picture of conceptual relationship (Wikipedia)

Ryan & Edward (2015) concept map is a graphical and hierarchical representation of concept that exist in the mind which are represented on paper with verbs and verb clauses linking between them.

- Science

A knowledge about the natural world based on facts learned through observation and experiments. Science is “Knowledge attained through study or practice” (Webster’s New Collegiate)

- Upper Primary Level

Upper primary level refers to the class from 6th to 8th grade.

1.2 Objective of the study:

To find out significance of difference in achievement score (gain scores) in Science between students taught through Concept Mapping Method and traditional Lecture Method.

1.3 Hypothesis

There is no significant difference between taught through concept mapping method and lecture method group with regard to achievement scores (gain scores) in science

2.0 Delimitations of the study

The study was delimiting as

- Only eighth grade students were selected for the study.
- Only eight grade Science subjects was selected for the study.
- Only one upper primary school of Rohilkhand Region, UP, India was selected for the experimentation

3.0 Design of study

The nature of study is quasi experimental in nature; For this study, the researcher randomly selects an upper primary level school for his experimental challenge from the predefined community. However, the researcher was not willing to randomly classify subjects in this analysis. Therefore, for this analysis, the researchers plan to follow almost experimental style. By implementing Matching design, the researcher only monitored the internal validity hazard (Best & Kahn2006) This also is also named the design of the pre-test control group match design (Fraenkel,1996) Coordination between them allows study to adopt a pre-test that tests the dependent variable, or the variables chosen to be tested by the participants in a control and test community in such a manner. Matching is useful where limited groups are used even where there are no

substantial variations among the two groups, it improves performance of the study. The research was carried out after obtaining insight into concept-mapping literature and issues under study. During the teaching process, the study community was handled for 60 business days with a principle mapping technique. In order to assess the impact of the therapy, students were assessed on the dependent variables prior to and during the procedure (pre-test and post-test).

3.1 Equating the Control and Experimental groups

Intelligences were evaluated in the control and study classes. selecting 30 students in the monitoring group and 30 students in the study group, 18 students from both classes reported similar scores following the administration of the intellect test. Another party suits a group like this. This is in the context of contrasting group averages and the matched groups are viewed as separate

Table 3.1
Control and Experimental Groups (Matching Design)

	Control	Experimental
1	A ₁	A'' ₁
2	A ₂	A'' ₂
3	A ₃	A'' ₃

Table 3.1 reveals that the experimental and control community can be subdivided into co- variate-minded matching classes. According to the Samoohik Mansik Yogyata Parikshan Ranking, the community falls in the mean mental capability of this sample and therefore sub group is not taken, This study group is thus known as a single test group counterpart.

3.2 Pre test – Post test Control Group Matching Design

Treatment group O M X1 O

Control group O M X2 O

This Matching of groups relates to the verity of the participants were paired in each category (with such variables) and not distributed to the groups alone. O applies to the component based at start and end of counselling. X1 is (concept maps) treatment; X2 does not treat (Fraenkel & Wallen 1996) in formation of Two Groups

Experimental method is employed to investigate the problem of study. Under the study two groups were chosen; one was taught through by Lecture Method taken as Control Group and second group was taught through Concept Mapping m e t h o d taken as Experimental Group.

Thirty students of class VIII were taken as sample for the treatment of each group and consisted of 15 boys and 15 girls. The two groups were taken such a way that their arithmetic mean was nearly same for Intelligence. The Arithmetic Mean and Standard Deviation on intelligence test of each group are shown in Table no. 3.2

Table no. 3.2

Arithmetic Mean and Standard Deviation of intelligence test (group wise)

Group	Category of students	No. of students	Arithmetic Mean and Standard Deviation of Intelligence Test	
			Mean	SD
Experimental Group	Boys	15	32.15	14.03
	Girls	15	33.89	13.86
	EG	30	34.78	14.03
Control Group	Boys	15	33.01	14.10
	Girls	15	34.00	13.89
	CG	30	34.81	14.66

3.3 Variable of the Study:

The following were the Independent, Dependent and confounding variable the study

• Independent variable

Independent variables are divided in to two types

- 1) Treatment variable
- 2) Organismic variable

1. Treatment variable:

Concept mapping is a type of teaching method used in this experiment to find out the effectiveness of achievement in science subject of grade 8th students and Selected units of science were taught through using concept maps to treatment group whereas the lecture method was used for the control group. So, concept maps treated as treatment variable in this study.

2. Organismic variable:

The grade, age, sex and level of intelligence of eight grade students plays a role organismic variable. The age, sex and level of intelligence of students cannot be altered by investigator. (Best & Khan ,2006) has mentioned that the experimenter can decide to include or remove them from the study. For its purpose experimenter decided that class eight students of age group 13 to 14 years of co-educational upper primary school are considered for this present study.

• Dependent variable

Achievement of students in science subject is the dependent variable for this experimental study.

- **Confounding variables (Intervening variables & Extraneous variables)** For any experimental study there are lots of factors that may influence our results of study. These factors may not be considered directly in our

experimental study such as anxiety, fatigue, home environment and time table etc., hence these factors remain uncontrolled during the experimental study.

3.4 Population and Sample of the Study

In the present study the students those who are studying in VIII standard for constitute the population, the investigator employed cluster sampling technique for the selection of schools and simple random techniques to select the students.

3.5 Tool Used

The present study, for the formation of two groups of students for experimental study.

Hence, the investigator, used standardized tool.

1. Group Test of Intelligence (10 to 16+ years) by Dr. R.K.Tandon
2. Concept maps are intended to represent meaningful relationship between concepts in the form of proposition. In this present study 15 such concept maps were developed for the topic under consideration. In developing these concept maps the concurrence of experts in the field of science was obtained for validation. The topics selected in science for teaching were carbon, oxides, acid, base, salt, minerals, metals, sound, energy, force, pressure, light, magnetism, electricity, & blood. Then ideal concept maps were developed by the investigator for each topic.

- *Achievement Tests*

The two groups with same arithmetic mean for Intelligence were selected. The fifteen units namely, Oxides, Acid, Base, Salt, Minerals, Metals, Sound, Energy, Force, Pressure, Light, Magnetism, Electricity, Blood were taught in 15 periods of each group with the one-hour duration. The two teaching methods were employed namely as lecture and concept mapping method to investigate the problem undertaken in the study on the selected fifteen topics.

The present study has required measures of Achievement test in selected 15 topics of science of class VIII syllabus. Therefore 15 Achievement Tests; one test for each topic were developed by the Investigator and each test has of 12 statements of multiple choice in the domain of Knowledge, Understanding, Application and Skill.

- *Scoring Keys*

The two marks were allotted for the correct answers in the Achievement Tests and one for wrong, thus making the total as twenty four.

- *Concept Maps*

Concept Maps developed by the investigator with the consultation of professors of the University/ College in the field of Education, Chemistry,

Physics, zoology and science subject school teachers of grade 8th

The concept maps on the topic of science subject taken under the study are shown in table no. 3.6

Table no.3.6
Details of 15 Units & Concept Maps

Unit	Topic no	Description of the topics	Number of concept maps
Carbon	1	Carbon	1
Oxides Acid	2	Oxides Acid	1
Base	3	Base	1
Salt	4	Salt	1
Minerals	5	Minerals	1
Metals	6	Metals	1
Sound	7	Sound	1
Energy	8	Energy	1
Force	9	Force	1
Pressure	10	Pressure	1
Light	11	Light	1
Magnetism	12	Magnetism	1
Electricity	13	Electricity Blood	1
Blood	14		1
	15		1

3.6 Experimental Procedure

The investigator taught the fifteen units namely Carbon, Oxides, Acid, Base, Salt, Minerals, Metals, Sound, Energy, Force, Pressure, Light, Magnetism, Electricity, Blood to each group with the duration of six months, taught through lecture method in control group and concept mapping method used in Experimental Group. The investigator applies the pre-test for all the individuals of two groups before commencing the lesson and again apply the post-test for all the individuals two groups after the completion of the lesson. This procedure was applied on all two groups during the study. The experimental design employed in the present study to investigate the problem is shown in Table.3.7

table no.3.7 Experimental design

Experimental group	15	15	Achievement in Science	Concept Mapping Method	Achievement in Science	Intelligence, Grade
Control Group	15	15	Achievement in Science	Lecture Method	Achievement in Science	Intelligence, Grade

3.7 Data Collection

The equal students were taken into two groups; namely Control Group and Experimental Group respectively. The selected 15 topics were taught through Control Group by the traditional Lecture Method and Similarly Experimental Groups was taught with same 15 topics through Concept Mapping Method.

The pre-test was applied on selected two group separately before the commencement of the lesson and with the post-test after the lesson completion for 15 topics into which the units were divided. The obtained scores served as pre-test and post-test measures.

Statistical Treatments

3.7.1 (a) calculation of Gain score

The Achievement score in form of gain score of lecture method is given by:

(GL)¹⁵ = (LP0)¹⁵ - (LPR)¹⁵, where

1 (GL)₁¹⁵ is achievement score (gain score) of 1 lecture method from unit 1 to unit 15.

(LP0)¹⁵ is post-test score of lecture method form unit1 to unit 15. (LPR)₁¹⁵ is pre-test score of lecture method form unit 1 to unit 15.

The achievement score in form of gain score of concept maps Method was calculated as:

(GC)¹⁵ = (CPO)¹⁵ - (CPR)¹⁵, where

1 1 1

(GC)₁¹⁵ is achievement score (gain score) of concept mapping method form unit 1 to unit 15

(CPO)₁¹⁵ is post-test score of concept mapping method form unit 1 to unit 15

(CPR)₁¹⁵ is pre-test score of concept mapping method form unit 1 to unit 15

(b) Mean and Standard Deviation is also used to calculate the obtained score value of each

3.7.2 Differential Analysis

To find out the significant difference between and among the independent and dependent variables, ‘t’ test was used.

Test of significance for difference between means was applied to test whether there exists any difference between pre-test and post-test achievement scores.

4.0 ANALYSIS AND INTERPRETATION OF DATA

This present study was performed on two groups through two different teaching methods; namely lecture method and Concept Mapping Method in teaching science. The Pre-test was applied to both the groups, after this treatment the post- test was applied on both treatment groups. The test paper which was used as pre-test and post-test was same in nature. 60 classes were taught by the researcher himself and 15 achievement tests were used for all 15 units as pre-tests and post- tests. The process by which the achievement scores in form of gain scores for all 15 achievement tests for all the two teaching methods were calculated through the method as shown in 3.9.1(a) & (b)

4.1 Analysis of Gain Scores

The achievement scores (gain scores) taught through the two methods; Lecture Method and Concept Mapping Method given in Table no. 4.2.

Table no. 4.2.1

Achievement scores (Gain scores) of Lecture method vs Concept Mapping method

Units	Achievement scores (Gain Scores) lecture Method		Achievement scores (Gain Scores) concept mapping method	
	Mean	S.D.	Mean	S.D.
1.	6.83	3.53	11.00	3.26
2.	6.33	4.02	12.00	3.16
3.	6.33	3.34	12.16	3.02
4.	7.00	4.08	13.00	2.37
5.	8.66	2.97	13.66	3.20
6.	6.00	3.57	13.66	2.68
7.	7.00	3.65	14.33	4.22
8.	8.16	3.07	12.50	2.36
9.	7.16	3.53	13.16	2.79
10.	7.83	3.88	12.16	1.56
11.	8.83	3.02	13.50	2.29
12.	8.83	3.28	13.50	2.92
13.	7.66	3.58	12.33	3.14
14.	7.33	4.45	13.66	3.49
15.	7.16	4.17	14.00	3.31

The scores of table (4.2.1) reflect that achievement scores (gain scores) of concept mapping method was found higher than lecture method in all the 15 units on the bases of obtained mean value and standard deviation was also calculated for the respectively.

Analysis of Achievement scores (Gain Scores) by the individuals

The total achievement scores (gain scores) of two groups by the individual in all the 15 tests are given in Table 4.2.

Achievement Scores (gain scores) of two groups in all the 15 tests

Serials of Individuals	Total individual achievement scores (gain scores) of two groups in all the 15 tests	
	Control Group (Lecture Method)	Experimental Group (Concept Mapping Method)
1.	76	180
2.	114	196
3.	100	208
4.	78	196
5.	90	192
6.	110	176
7.	108	198
8.	150	214
9.	140	210
10.	98	214
11.	114	186
12.	120	212
13.	116	212
14.	96	186
15.	124	216
16.	90	174
17.	76	186
18.	110	180
19.	86	188
20.	82	178
21.	190	206
22.	124	212
23.	138	212
24.	110	188
25.	126	204
26.	100	184
27.	118	196
28.	110	184
29.	130	204
30.	104	198
-	110.1	196.2
X	24.05	11.79
S.D.		

The individual (gain scores) achievement scores of control group (taught through the Lecture Method) varied from 76 to 190.

The arithmetic mean and standard deviation of achievement scores (gain scores) taught through lecture method (control group) were calculated as 110.1 and 24.05 respectively. The individual achievement scores (gain scores) of Experimental Group (taught through concept mapping method) varied from 174 to 216. The arithmetic mean and standard deviation of concept method were calculated as 196.20 and 11.79 respectively

The arithmetic mean and standard deviation of achievement scores (gain scores) of two teaching methods indicated that the concept mapping method has greater mean than lecture method. The standard deviation in reference of two methods shows that it is greater for lecture method and least for concept mapping method.

4.2 Differential Analysis

4.2.1 Analysis of Critical Ratio

To find out there is any significant difference exist between the two group which were used to taught through the teaching methods in teaching science for this present study. The difference between two group means were calculated through the 't' values. With the help of 't' values the researcher test the significance of difference between two group means.

The Critical Ratio of total individual achievement scores (gain scores) shown in table no.4.3.2.1.

table no. 4.3.2.1 Critical Ratio of Total Individual Achievement Scores (Gain Scores) of Two Groups

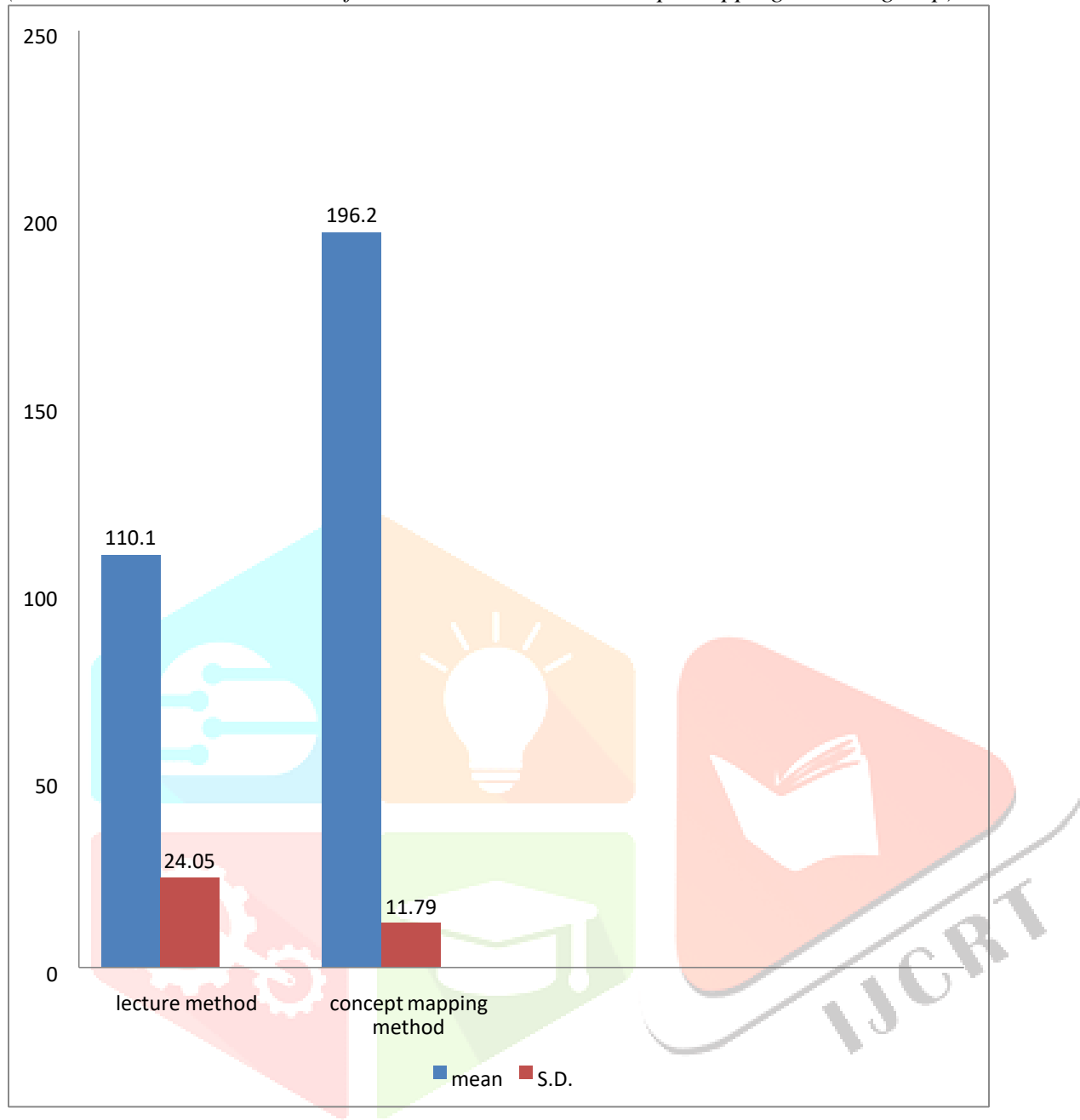
Groups	Mean	S.D.	t- value	Level of Significance
Lecture Method(N=30)	110.1	24.05	* 17.643	P < 0.01
Concept Mapping Method(N=30)	196.2	11.79		

*significant at 0.01 level

degree of freedom= 58

The results in Table 4.3.2.1 shows that there exists significant difference between the total individual obtained gain scores of students taught through lecture method and concept mapping method. The total individual gain scores of students taught through concept mapping method is found significantly higher than that the total individual gain score of students taught through lecture method. Therefore, concept mapping method are helpful to the students to achieve significantly higher scores in all the 15 Unit than the students taught through lecture method. Therefore, the concept maps are effective in teaching science at upper primary level.

(Mean & Standard Deviation of Lecture Method and Concept Mapping Method group)



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