Study of Effectiveness of Using Concept Maps in Science among VI Grade Students

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Abstract- Students of Faridabad district .The main findings of the study are:

(i) A significant difference has been found between the means scores of post test for the achievement test administered on the control group and experimental group both at 0.05 and 0.01 levels. The difference between the mean scores of the student s of the two groups are quite significant showing the effectiveness of the learning through Concepts Maps over Lecture method and proving that concepts Maps play positive role in enhancement of learning basic concepts of science.

(ii) It has been found that the correlation between Maps score and the scores on the maps related to multiple choice items on the unit test varied from 0.04 to 1, which inference that correlations are generally high. The present study was conducted to study the effectiveness of using concept maps in science among VI grade 100

Index Terms- Concept Map, Science, Effectiveness, Achievement

I. INTRODUCTION

Assessment of student achievement is changing largely because today's students' face a world that will demand new knowledge and abilities. In the present scientific and technological age, the conventional methods are not sufficient to arouse interest among the students and do not meet up to the intellectual, psychological and emotional needs of the students in new millennium. The method of teaching needs to be changed. The trend in education at present does not demand the text book learning alone. It aims at giving complete preparation to the pupils' .Since; science is a rapidly growing subject, its teaching demands continued re assessment and periodical review of the contents and the methods of teaching. Most new learning occurs through derivatives and correlative assumption of new concept meanings under existing concept or propositional frame work. Learning that is meaningful involves reorganization of existing beliefs or integration of new information with existing information. Cognitive structure is organized hierarchically, with new concept or concept meanings being subsumed under broader more inclusive concepts.

The theoretical frame work that supports the use of concept mapping is consistent with constructivist epistemology and cognitive psychology. Constructivism is a major influence in current science education.

Concept

Teaching concept in general science is not an easy task. It deals with the scientific objectives. The learning about the scientific objectives can be possible only by learning a concept. The general mental notion of things or events is arrived at by the students by processing of perception, classification and discrimination; it's used as a basis of thought and is expressed through symbolic language. The concept can be thought of as lower or higher order or as from the easily managed to the highly abstract. Concept formation is a process of developing concept, which was given by Piaget, Bruner etc. According to Gagne a concept is learned stimuli that belong to the same category or classification, but which can be done without applying such rule as "a chair must have four legs and a seat and a back." Recognition of the chair would be immediate upon presentation of an example just as rejection of a stool would be immediate and not subject to any logical application of rule.

A concept is defined as a class of stimuli or a coding system. According to Hung, Margin & Stone 1976, "A concept is a decision rule which, when applied to the description of an object specifies, whether or not a name can be applied."The concept centered teaching, a teacher – student interactive approach, following the constructivist approach, which helps in meaningful learning. It is a process of sequential instruction that applies theoretically, thousands of strategies for pupils understanding.

Constructivists make several assumptions about the learner, the context for learning, the learning process, and the outcomes. They believe that learning is a process of meaning making in which learners constantly explore their worlds, reflect upon their experience, articulate their thoughts and negotiate meaning with others. This process may start with a problem, a discrepant event or cognitive dissonance. On attempting to reconcile their conflicts, learners are able to create a shared ownership and meaning of the task, the concepts, the procedures and the strategies employed. Teaching is not regarded as a process of knowledge transmission. Rather, teachers should serve as a coach to facilitate learning and provide scaffolding and fading at appropriate junctures of the learning process.

Concept mapping fits well with the constructivist approach that learners "construct their own idiosyncratic understanding of concepts". The teacher can use a map as a basis for which to challenge student assumptions of how concepts are related maintain that most college faculty recognize that students will not remember specific facts from a course. What's more important is that students take away major themes or concepts and an understanding of how these concepts are related. Using a concept map to design a course can aid the teacher in guiding the

students to learn relevant concepts rather than trivial facts. Also, in knowing that students may perceive instruction differently from the way an educator intended, it can be helpful for the teacher to "construct a hypothetical model of the particular conceptual world of the students they are facing".

Concept mapping is a method to visualize the structure of knowledge. Science the knowledge expressed in the maps is mostly semantic. Concept maps are sometimes called semantic networks. Often it is claimed that concept mapping bears a similarity to the structure of long term memory. Instead of describing all concepts and their relation in text, one may choose to draw a map indicating concepts and relations in a graph or network. It the concept can be represented as eight era circle or a box .The relationship among concept and displayed using connecting link. Clarifying words and symbols are typically associated with linking lines to explain the specific relationships among the concepts.

II. NEED AND IMPOTRANCE OF THE STUDY

Knowledge of facts, terms and concepts is an important part of student's science knowledge in its own right and is also the basis for the development procedural knowledge while declarative knowledge may tend to be less valued.

The establishment of concept maps is a vehicle for assessing both declarative and procedural aspects of science knowledge. Concept maps monitor learning outcomes as instructional strategy emphasizes shift from basic to higher levels of performance. Concept mapping bears a similarity to the structure of long term memory Researches supports the idea that the use of concept mapping tool extend students learning in science and technology in important and unique ways. Concept maps may be most effective when use in science to stimulate and solve real problems, especially when scientific probes and technological tools are used to assist with lad experiments. Thus, in the present study investigator wants to study the comparative effectiveness of concept maps over traditional method

III. STATEMENT OF THE PROBLEM

"A   Study of effectiveness of using concept maps in science among VI grade students"

OBJECTIVES OF THE STUDY
- ➤ To develop concept maps in science.
- ➤ To study the effect of using concept maps on achievement of VI grade student in science class.
- ➤ To study of effectiveness of using concept maps over traditional method in learning concepts of science among VI grade students.
- ➤ To study the correlation between concept maps and pupil's achievements.

HYPOTHESIS FORMULATED
- ➤ There is no difference between the two methods used traditional method and learning with concept maps.

- ➤ There is no difference between mean achievement scores in science of pre-test and post-test of VI class students.
- ➤ There is no difference between mean achievement scores in science of control group and experimental group.
- ➤ There is no relation in use of concept maps and pupil's achievement.

IV. VARIABLES

Independent Variable:
The independent variable that was used in the present study is **Concept Maps**. The variable was manipulated to study the effect on achievement in science. The experimental group was taught through **Concept Maps.**

Dependent Variable:
The dependent variable or the criterion variable that was use in the study is achievement in science. This variable may also be termed as moderator variable as they include the variable that could have a moderating affect on the treatment. The students were scored on this variable before and after the treatment in the group, this variable was measured twice during the study i.e. first before the beginning of the treatment (pre-test stage), then after completing the treatment. (Post-test stage)

Control variable:
Those factors which are controlled by the experimenter to cancel out or neutralize any effect they might, otherwise have on the observed phenomenon. In the present study nature of the school, grade level and administration are controlled.

V. DESIGN OF THE STUDY

The present study is of pre-test - post-test Equivalent Group of Experimental Group Design

$RO_1 XO_2$ O_1 O_3 =   **Pre-test**
$RO_3 CO_4$ O_2 O_4 =   **Post-test**

Here, the pre-tests are to be administered before the application of treatment on the Experimental and Control Group and Post –tests at the end of the treatment on both the groups.

Nature of the School
The sample was selected from Jagriti Vidhya Niketan School Faridabad, affiliated to C.B.S.E.

Grade level
Sixth class is selected for the present study and grade level is thus kept constant during the study.

Subject
The group was taught the one chapter of Science subject.

VI.   SAMPLE

The present study was conducted on sample of **100** students (50 boys and 50 girls) studying in class VI of Jagriti Vidhya Niketan School.

VII.   TOOL USED

(i)Concept maps (developed by the investigator)
(ii)Multiple choice test in science subject

VIII.   STATISTICAL TECHNIQUES EMPLOYED

The statistical techniques employed for interpreting the data are:
  1. Mean
  2. Standard Deviation
  3 critical ratio't'
  4. Correlation (Karl Pearson)

IX.   REVIEW OF THE RELATED LITERATURE

Kumar, Satheeshi (2010) Studied learning with multimedia a constructive co-operative approach in education. He found that they provide the students with ways to assemble knowledge constructively when students develop multimedia materials as a component of project based learning in cooperative groups.

Km, Ananta (2010) Studied the concept maps in teaching biology. He found that presenting the theoretical foundation and origin of concept maps graphical representation on the information and understanding.

Rai, Renu and Shweta (Aug2010) studied the concept mapping as a technology to facilitate teacher education programme and enhance learning. He found that new technology is capable of overcoming the barriers due to its importance and use in the field of education**.**

Antoine Laurent Laviosier (2009) Studied on concept mapping in elementary science. He found that it is essential that teachers use technology in a classroom to provide the richest education possible for our students.

David, Brown (2009) Studied the effect of individual and group concept mapping on students conceptual understanding of photosynthesis and cellular respiration in three different academic levels of biology class. He found that the constructing concept maps in small groups can significantly increase the knowledge gained by lower level students.

Hong Gao, E. Shen (2007) Studied on Collaborative Concept Mapping: What have we learned about the Technical and what is next. He observed that the concept mapping technique in combination with other instructional strategies will hopefully augment the positive result associated with the technique.

John, Marangos (2007) Studied effectiveness of concept mapping in economics: evidence from Australia & USA. He found that concept mapping was in corporate in the teaching material in both courses at different countries and, at the end of the semester; the students complicated a survey regarding the use, effectiveness and accessibility of concept maps.

Hong Gao, E Shen (2007) Studied collaborative concept mapping: An instructional strategy to foster both individual learning and group knowledge construction. He found that the collaborative concept mapping is a potential effective instructional strategy to facilitate learners in both group knowledge construction and individual learning.

Raghawan, Andal (1991) Studied concept mapping in learning physical science and its relation to scholastic performance, cognitive ability, attitude towards concept mapping and science interest among standard IX students. He found that the experimental and control groups of boys, girls and co-educational students were found to have no difference in post test scholastic performance scores in physical science.

Joshi, Anuradha (1993) conducted studies on concept Attainment Model on general ability. He found that the adjustment mean of the general mental ability scores of student taught through **CAM** was significantly different from those who were taught through traditional method when per general mental scores were taken as a covariate.

Table1.1INDEPENDENT DEPENDENT &CONTROL VARIABLES

Independent Variable	Dependent Variable	Control Variable	Control Employed
• **Concept Maps** (Instructional package by investigator & **Inspiration Programme**	• Achievement In Science	• Nature of the school • Grade level (only VI grade to be taught). • Administrative (one chapter of science subject in the group to be taught).	• Administrative (all schools working under C.B.S.E.) • Administrative. • Administrative (one chapter of science subject in the group to be taught).

X.   DEVELOPMENT OF CONCEPT MAPS

There are 6 steps of creating Concept Map:-

1. Select key concepts: This is a recognition process that activates relevant knowledge and assists in topic identification.
2. Write the key concepts
3. Make an attribute list of the key concepts.
4. Relate key concepts in a special relationship.
5. Rearrange special representations.
6. Compare representation to the text.

XI.   ANALYSIS AND INTERPRETATION OF THE DATA

Table 1.2 CALCULATION OF 't' VALUE FOR THE CONTROL GROUP, PRE-TEST, POST- TEST

Mean, S.D, Std Error Mean and 't' value of achievement in science of pre-test and post-test:

GROUP (Control)	M	S.D.	N	't' value	df	Remark
Pre-test	8.72	4.03	50			Significant at 0.05 level
Post-test	10.74	4.22	50	2.44	98	Significant at 0.01 level

From the Table 4.1, it is evident that the 't'-value is 2.44 that is significant at 0.01 level that is 2.63 and at 0.05 level that is 1.98 with df = 98. It indicates that the mean scores of pre-test and post-test of control group differ significantly. Thus, **NULL** hypothesis that there is no significant difference between means scores of pre-test and post-test of control group is rejected. Further the mean scores of post-test of control group is as 10.74, which is significantly higher than the mean scores of pre-test as 8.72

Table 1.3 CALCULATION OF 't' VALUE FOR THE EXPERIMENTAL GROUP, PRE-TEST, POST-TEST

GROUP (EXPERIMENTAL)	M	S.D.	N	't' value	df	Remark
Pre-test	9.20	4.28	50		98	Significant at 0.05 level
Post-test	14.74	4.02	50	6.52		Significant at 0.01 level

From the table 4.2, it is evident that the't'-value is 6.52 that is significant at 0.01 level that is 2.63 and at .05 level that is 1.98 with df = 98. It indicates that the mean scores of pre-test and post-test of experimental group differ significantly. Thus, null hypothesis that there is no significant difference between means scores of pre-test and post-test of experimental group is rejected. Further the mean scores of post-test as 14.74, is significantly higher than the mean score of pre-test as 9.20.

Students' Concept Map Scores

12 concept maps were examined and student scores were recorded by using score. If one or more of the concepts were missing from the map, a score of 0 was given. To obtain a score other than 0 in this category, students had to have all essential stem and answer concepts somewhere on their maps. A positive score (+1) was given if the stem concept was linked accurately to the correct answer, and a negative score (-1) recorded if a linking error was made. The results of scoring for the maps of thirteen students are reported in Table 1.4

Table1.4 Students' Concept Map Scores

Concepts	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24	S25
Heat	-1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	-1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
Temperature	+1	+1	+1	-1	+1	+1	0	-1	+1	+1	0	+1	+1	+1	+1	+1	+1	+1	0	+1	0	-1	0	-1	+1
Unit of heat	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
Unit of Temperature	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
Kinetic Energy	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	0	+1	+1	+1	+1	+1
Heat Energy	+1	0	-1	-1	+1	+1	+1	0	+1	+1	0	+1	+1	-1	+1	0	+1	-1	0	+1	+1	0	0	+1	+1
Electrical Energy	+1	-1	0	0	+1	0	+1	+1	0	0	+1	0	+1	0	+1	+1	-1	+1	+1	0	+1	-1	0	-1	-1
Heat Transfer	+1	0	-1	+1	+1	0	+1	+1	+1	+1	+1	+1	-1	-1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
Convection	0	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	-1	+1	+1	+1	+1	+1	+1	-1	+1	+1	+1	+1
Conduction	+1	+1	-1	+1	+1	+1	-1	+1	+1	+1	+1	+1	+1	+1	-1	+1	+1	0	+1	+1	+1	+1	+1	0	+1
Radiation	+1	+1	+1	0	+1	+1	-1	+1	-1	+1	+1	+1	+1	+1	+1	-1	0	+1	+1	+1	+1	-1	+1	+1	-1
Reflection	+1	+1	+1	+1	+1	+1	+1	+1	+1	-1	-1	0	+1	+1	+1	+1	0	+1	-1	+1	+1	-1	-1	+1	+1
Matter	+1	+1	+1	+1	+1	+1	+1	0	+1	+1	-1	+1	+1	0	-1	+1	+1	-1	-1	0	+1	+1	-1	0	+1
Phase Changing	0	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	0	0	0	+1	+1	+1	+1	+1	-1	+1	+1	-1	+1
Boiling Point	+1	+1	+1	+1	+1	+1	+1	+1	0	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	-1
Expansion	-1	+1	0	+1	+1	+1	+1	+1	+1	0	+1	+1	+1	+1	+1	+1	-1	0	+1	+1	+1	0	0	+1	+1
Evaporation	+1	+1	-1	+1	+1	+1	0	-1	+1	+1	0	-1	+1	+1	+1	+1	+1	+1	0	-1	0	+1	0	-1	+1
Condensation	-1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	-1	+1	+1	+1	+1	+1	-1	+1	+1	+1	+1	0
Freezing	+1	+1	+1	0	0	+1	+1	+1	-1	+1	-1	+1	-1	-1	0	+1	-1	+1	-1	+1	+1	0	-1	+1	+1
Cooling	+1	-1	0	+1	+1	+1	-1	0	+1	+1	+1	+1	+1	+1	0	+1	0	+1	+1	+1	+1	+1	+1	+1	+1
Melting	-1	-1	0	+1	-1	+1	+1	+1	+1	+1	0	+1	+1	+1	+1	+1	+1	+1	0	0	+1	+1	+1	+1	+1
Fuel	0	+1	+1	0	+1	+1	+1	+1	+1	+1	-1	+1	+1	+1	+1	+1	+1	+1	-1	+1	+1	+1	-1	+1	+1
Total Score	15	17	13	15	19	20	17	17	18	19	14	20	19	14	16	20	16	18	14	17	17	15	13	16	18
%	68	77	59	68	86	91	77	77	82	86	64	91	86	64	73	91	73	82	64	77	77	68	59	73	82
Average													76												

+1: Correct   -1: Incorrect   0: Not on the Map   S1: Student 1   Contd…

Concepts	S26	S27	S28	S29	S30	S31	S32	S33	S34	S35	S36	S37	S38	S39	S40	S41	S42	S43	S44	S45	S46	S47	S48	S49	S50
Heat	-1	+1	-1	+1	0	-1	+1	+1	+1	+1	0	+1	0	+1	0	+1	+1	+1	-1	+1	-1	0	+1	+1	+1
Temperature	+1	+1	+1	+1	-1	+1	0	+1	0	-1	-1	0	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
Unit of heat	+1	+1	+1	+1	+1	0	+1	+1	+1	+1	+1	+1	-1	-1	+1	+1	+1	+1	+1	+1	-1	+1	-1	-1
Unit of Temperature	+1	-1	+1	0	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	-1	+1	+1	+1	+1	+1	+1	+1	+1
Kinetic Energy	+1	+1	+1	+1	+1	-1	-1	0	+1	+1	0	+1	0	+1	+1	0	+1	+1	+1	0	+1	+1	+1	+1	+1
Heat Energy	-1	+1	+1	+1	+1	+1	+1	+1	0	0	+1	0	+1	0	0	-1	+1	+1	+1	+1	0	+1	0	-1	0

Electrical Energy	+1	+1	+1	-1	0	-1	+1	+1	0	-1	+1	0	-1	+1	+1	+1	+1	+1	+1	-1	+1	+1	+1	+1	+1
Heat Transfer	+1	0	+1	+1	+1	+1	0	-1	+1	+1	0	+1	+1	+1	+1	+1	+1	-1	+1	+1	+1	0	0	+1	+1
Convection	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	-1	+1	+1	+1	+1	+1	+1	+1	0	-1	+1	-1
Conduction	0	+1	-1	+1	+1	0	+1	+1	+1	+1	+1	-1	-1	+1	-1	+1	-1	+1	-1	+1	+1	-1	+1	-1	+1
Radiation	+1	+1	+1	+1	+1	+1	+1	0	+1	-1	+1	-1	+1	-1	0	+1	+1	+1	+1	-1	+1	-1	+1	+1	+1
Reflection	+1	-1	+1	+1	-1	0	+1	+1	-1	-1	+1	-1	+1	+1	+1	+1	+1	+1	+1	+1	-1	+1	+1	+1	-1
Matter	+1	0	-1	+1	+1	-1	0	+1	-1	+1	+1	+1	-1	+1	+1	+1	+1	+1	-1	+1	+1	+1	+1	-1	+1
Phase Changing	+1	+1	0	-1	+1	+1	+1	+1	+1	+1	-1	-1	+1	0	-1	+1	+1	+1	0	+1	+1	+1	+1	0	+1
Boiling Point	+1	+1	+1	+1	-1	+1	+1	-1	+1	+1	-1	+1	+1	+1	+1	+1	+1	+1	+1	-1	+1	+1	+1	+1	+1
Expansion	0	+1	+1	+1	+1	0	+1	+1	0	0	+1	0	+1	+1	+1	-1	+1	+1	+1	+1	+1	+1	+1	+1	+1
Evaporation	+1	+1	+1	+1	+1	+1	-1	+1	0	+1	+1	0	+1	-1	-1	+1	-1	+1	+1	+1	+1	0	+1	0	+1
Condensation	+1	+1	+1	+1	0	+1	+1	+1	+1	+1	+1	0	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	0	+1	+1
Freezing	-1	+1	0	+1	+1	+1	-1	0	-1	0	+1	+1	+1	+1	+1	+1	+1	+1	0	+1	+1	+1	+1	0	+1
Cooling	+1	+1	0	+1	+1	+1	0	+1	+1	+1	0	+1	+1	+1	+1	+1	+1	+1	0	0	-1	+1	+1	+1	+1
Melting	-1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	0	-1	+1	+1	+1	+1	+1	-1	-1	+1	+1
Fuel	+1	+1	+1	+1	+1	+1	0	0	-1	+1	0	-1	+1	+1	0	+1	0	+1	+1	+1	+1	0	+1	+1	+1
Total Score	16	18	16	19	16	14	16	16	13	15	13	11	16	16	15	18	18	21	16	17	18	13	17	14	18
%	73	82	73	86	73	64	73	73	59	68	59	50	73	73	68	82	82	95	73	77	82	59	77	64	82
Average													73												

+1 : Correct   -1 : Incorrect   0 : Not on the Map   S26 : Student 26

Table 1.5 Comparison of answers of related multiple-choice items with concept map answer

	1		4		5		6		7		8		9		10		11
	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC
S1	1	+1	1	-1	1	+1	1	+1	1	-1	1	+1	0	-1	1	+1	0
S2	1	+1	1	+1	1	+1	1	+1	1	+1	0	0	0	+1	1	+1	1
S3	1	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	0	0	1
S4	0	0	1	-1	1	0	1	0	0	-1	0	-1	1	+1	1	+1	1
S5	1	+1	1	0	1	+1	1	+1	1	0	1	0	1	0	1	+1	0
S6	0	+1	1	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	0	0
S7	1	0	1	+1	1	+1	1	+1	1	+1	0	+1	0	+1	1	+1	1
S8	1	+1	0	-1	1	0	1	0	0	-1	1	0	0	-1	0	0	1
S9	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1
S10	1	-1	1	0	1	+1	1	+1	1	0	0	+1	1	0	1	+1	1
S11	1	+1	1	+1	1	+1	1	+1	1	+1	0	0	1	+1	1	+1	1
S12	0	+1	0	-1	1	0	1	0	1	-1	1	+1	1	-1	1	+1	1
S13	0	0	1	+1	0	+1	1	+1	1	+1	1	+1	0	+1	1	-1	1

S14	1	+1	0	+1	1	+1	1	+1	0	+1	1	+1	1	+1	1	+1	1
S15	1	-1	1	+1	1	-1	0	-1	1	+1	0	0	1	+1	1	+1	0
S16	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	0	+1	1	+1	0
S17	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	-1	1
S18	1	-1	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1
S19	1	+1	1	0	1	-1	1	-1	0	0	0	-1	1	0	1	+1	1
S20	1	+1	0	-1	1	+1	1	+1	1	-1	1	+1	1	-1	1	+1	0
S21	0	+1	1	-1	1	+1	1	+1	1	-1	1	+1	1	-1	1	+1	1
S22	1	+1	1	-1	0	+1	1	+1	1	-1	1	+1	1	-1	1	+1	1
S23	1	+1	1	+1	1	+1	0	+1	0	+1	1	-1	1	+1	1	+1	1
S24	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1
S25	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	0	+1	1
Pearson r	0.4		0.4		0.9		0.5		1		0.4		0.4		0.9		0.4

Table 1.6Comparison of answers of related multiple-choice items with concept map answer

Map-Related Concepts

	1		2		3		4		5		6		7		8		9		10		11		12	
	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM
S26	1	+1	0	0	1	+1	1	+1	1	+1	1	+1	0	+1	1	+1	1	+1	1	-1	0	-1	0	-1
S27	1	0	1	-1	1	-1	1	0	0	+1	1	0	0	0	1	0	0	0	1	+1	0	+1	1	+1
S28	1	+1	1	+1	1	0	1	-1	0	-1	1	-1	1	-1	1	-1	0	-1	0	+1	1	+1	1	+1
S29	1	+1	1	-1	0	-1	0	+1	1	+1	1	+1	1	+1	0	+1	1	+1	1	-1	1	-1	1	-1
S30	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1
S31	1	0	0	0	1	0	1	0	1	0	1	0	1	0	0	0	1	0	1	+1	1	+1	1	+1
S32	1	+1	1	+1	1	+1	0	0	0	0	0	0	1	0	1	0	1	0	0	-1	1	-1	1	0
S33	0	+1	1	+1	1	+1	1	+1	1	+1	0	+1	0	+1	1	+1	1	+1	0	-1	1	-1	1	+1
S34	1	0	1	-1	1	-1	1	-1	1	-1	1	-1	0	-1	0	-1	0	-1	1	+1	1	+1	1	+1
S35	1	-1	1	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	0	+1	1	0
S36	0	+1	1	+1	1	+1	0	+1	0	+1	1	+1	1	+1	0	+1	1	+1	1	-1	0	-1	0	+1
S37	0	+1	0	+1	1	+1	1	-1	0	-1	0	-1	1	-1	1	-1	1	-1	1	-1	1	-1	0	-1
S38	1	+1	1	-1	1	-1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	0	1	0	1	+1
S39	1	0	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	0	+1	0	-1	1	-1	1	0
S40	1	+1	1	+1	0	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	0	-1	1	-1	1	+1
S41	1	+1	1	+1	1	+1	0	-1	1	-1	1	-1	1	-1	1	-1	1	-1	0	-1	1	-1	0	+1
S42	1	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	0	+1	0	0
S43	1	+1	1	+1	1	+1	0	+1	1	+1	0	+1	1	+1	1	+1	1	+1	1	-1	1	+1	1	+1
S44	0	+1	1	-1	1	-1	1	+1	0	+1	1	+1	1	+1	1	+1	1	+1	0	+1	1	+1	1	-1
S45	0	-1	1	+1	0	+1	1	-1	0	-1	1	-1	1	0	1	-1	0	0	1	0	1	0	0	+1
S46	1	+1	1	+1	1	+1	0	+1	1	+1	1	+1	0	+1	1	+1	1	+1	1	0	0	0	1	0
S47	1	-1	1	+1	1	+1	0	+1	1	+1	1	+1	0	+1	1	+1	1	+1	0	+1	1	+1	1	+1
S48	1	+1	0	0	1	0	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	0	0	+1	1	+1
S49	1	+1	1	+1	1	+1	0	+1	0	+1	0	+1	1	+1	0	+1	0	+1	1	+1	1	+1	1	-1
S50	1	-1	1	+1	1	+1	1	+1	0	+1	0	+1	1	+1	0	+1	1	+1	1	+1	1	+1	1	+1
Pearson r	0.4		0.4		0.5		0.6		1		0.7		0.5		0.7		0.5		0.4		0.4		0.7	

Table 1.7Comparison of answers of related multiple-choice items with concept map answer
Map-Related Concepts

	1		2		3		4		5		6		7		8		9		10		11		12	
	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM	MC	CM
S1	1	+1	1	+1	1	+1	1	-1	1	+1	1	+1	1	-1	1	+1	0	-1	1	+1	0	-1	1	+1
S2	1	+1	1	+1	0	0	1	+1	1	+1	1	+1	1	+1	0	0	0	+1	1	+1	1	+1	1	+1
S3	1	+1	1	+1	1	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	0	0	1	+1	1	+1
S4	0	0	0	0	1	-1	1	-1	1	0	1	0	0	-1	0	-1	1	+1	1	+1	1	+1	0	-1
S5	1	+1	1	+1	1	0	1	0	1	+1	1	+1	1	0	1	0	1	0	1	+1	0	0	1	0
S6	0	+1	0	+1	0	+1	1	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	0	0	+1	1	+1
S7	1	0	1	0	0	+1	1	+1	1	+1	1	+1	1	+1	0	+1	0	+1	1	+1	1	+1	1	+1
S8	1	+1	1	+1	1	0	0	-1	1	0	1	0	0	-1	1	0	0	-1	0	0	1	-1	0	-1
S9	1	+1	1	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1
S10	1	-1	1	-1	1	+1	1	0	1	+1	1	+1	1	0	0	+1	1	0	1	+1	1	0	1	0
S11	1	+1	1	+1	1	0	1	+1	1	+1	1	+1	1	+1	0	0	1	+1	1	+1	1	+1	1	+1
S12	0	+1	0	+1	1	+1	0	-1	1	0	1	0	1	-1	1	+1	1	-1	1	+1	1	-1	1	+1
S13	0	0	0	0	1	+1	1	+1	0	+1	1	+1	1	+1	1	+1	0	+1	1	-1	1	+1	1	+1
S14	1	+1	1	+1	1	+1	0	+1	1	+1	1	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1
S15	1	-1	1	-1	1	0	1	+1	1	-1	0	-1	1	+1	0	0	1	+1	1	+1	0	+1	1	+1
S16	1	+1	1	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	0	+1	1	+1	0	+1	1	-1
S17	1	+1	1	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	-1	1	+1	1	+1
S18	1	-1	1	-1	1	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1
S19	1	+1	1	+1	1	-1	1	0	1	-1	1	-1	0	0	0	-1	1	0	1	+1	1	0	0	0
S20	1	+1	1	+1	1	+1	0	-1	1	+1	1	+1	1	-1	1	+1	1	-1	1	+1	0	-1	1	+1
S21	0	+1	0	+1	1	+1	1	-1	1	+1	1	+1	1	-1	1	+1	1	-1	1	+1	1	-1	1	+1
S22	1	+1	1	+1	0	+1	1	-1	0	+1	1	+1	1	-1	1	+1	1	-1	1	+1	1	-1	0	+1
S23	1	+1	1	+1	1	-1	1	+1	1	+1	0	+1	0	+1	1	-1	1	+1	1	+1	1	+1	1	+1
S24	0	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1
S25	0	+1	0	+1	0	+1	1	+1	1	+1	1	+1	1	+1	1	+1	1	+1	0	+1	1	+1	0	+1
Pearson r	0.4		0.4		0.4		0.4		0.9		0.5		1		0.4		0.4		0.9		0.4		0.4	

XII.   FINDINGS

- It has been found that the post-test achievement scores of students of control group were significantly higher than their pretest achievement scores.
- It has been found that the post-test achievement scores of students of experimental group were higher than their pretest achievement scores.
- A significant difference has been found between the means scores of post test for the achievement test administered on the control group and experimental group both at 0.05 and 0.01 levels. The difference between the mean scores of the students of the two groups are quite significant showing the effectiveness of the learning through Concepts Maps over Lecture method and proving that concepts Maps play positive role in enhancement of learning basic concepts of science.
- It has been found that the correlation between Maps score and the scores on the maps related to multiple choice items on the unit test varied from 0.04 to 1, which inference that correlations are generally high.
- It has been found that there is a significant difference between the mean scores of pretest and posttest for the achievement test administered on the experimental group is significant at 0.01 levels.

XIII.   CONCLUSION

The result revealed that the experimental group performed better than the control group in all achievement areas i.e. overall, by levels of cognitive domain and by the type of content .Students liked the Concept Maps program and benefitted from it. They found it to be better mode of instruction than the conventional method i.e. the lecture method.

XIV.   EDUCATIONAL IMPLICATIONS

The present study has the implications for the science teachers and teaching of science.

- If the teaching is supplemented with Concept maps, it can prove to be more effective in enhancing achievement.
- Quality computer which include colorful animation, graphics display from a versatile and effective alternative change in instructional strategy.
- Concept Maps helps in professional development of teaching and learning and individuals involved in the programs for teacher education. It can be infused in the learning process so as to acquire the knowledge and skill efficiently.
- Using concept map as a tool in science classes will help student to develop better understanding of the important concepts, developing interrelationship and creating meaning schemes and constructing knowledge bases.
- The teachers to focus on making connections between facts and fostering new understanding in students by

allowing , inspiring and guiding their students on their learning path.

- For leading the students on the path of acquisition of new learning, solving difficult and complex problem or discovering the facts related to a concept, it is quite advantageous to put students in situations that might challenge their previous conceptions and creating contradictions to encourage them on discovery path for their individual efforts or engage in discussion with their individual efforts or engage in discussion with their peers, teacher or elders.
- Since students have to construct their own meaning and discover the knowledge on their own, constructivist learning outcomes does not fit in the traditional evaluation pattern .It calls for flexible, comprehensive and continuous program to the constructive and create output of the learners for providing timely assessment, motivation and assistance to the learners in getting them engaged in the task of constructing and discovering the knowledge by themselves.

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