EFFECT OF CONCEPT-MAPPING IN SCIENCE ON SCIENCE ACHIEVEMENT, COGNITIVE SKILLS AND ATTITUDE OF STUDENTS

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The use of concept maps as a teaching strategy was first developed by J D Novak in the early 1980's. It was derived from Ausubel's learning theory which places central emphasis on meaningful learning. Many researches have been carried out to study effect of concept mapping in different subjects and at different levels. This paper studies the use of concept maps as a strategy to enhance meaningful learning and to improve upon the process skills of students in science. The results of the study reveal that concept mapping as an instructional tool has had an effect on the achievement of students and their cognitive skills in science. The students also reflected a positive attitude towards concept mapping as an effective instructional tool.

THEORETICAL FRAMEWORK OF THE STUDY

In order to improve instructional methods carried out in the classroom and improvement of students' learning, there have always been a search for more potential ways of instruction. One of the strategies that has evolved as a useful tool in leading students towards meaningful learning is 'Concept Map'. Concept mapping is seen as a useful tool for helping students learn about the structure of knowledge and the process of knowledge production or meta knowledge. In contrast to students who learn by rote, students who employ meaningful learning are expected to retain knowledge over an extensive time span and find new related learning progressively easier.

The use of concept maps as a teaching strategy was first developed by J.D.Novak in the early 1980's, derived from Ausubel's learning theory which places central emphasis on the influence of students' prior knowledge on subsequent meaningful learning. Concepts maps are diagrammatic representations which show meaningful relationships between concepts in the form of propositions which are linked together by words, circles, and cross links. Concepts are arranged hierarchically with the Super ordinate concepts at the top of the map, and subordinate at the bottom which are less inclusive than higher ones. "Cross links" are used to connect different segments of the concepts hierarchy, which indicate syntheses of related concepts, a new interpretation of old ideas, and some degree of creative thinking.

In recent years, along with the various innovative methods ,constructivism in the classrooms as an interpretative process involving individual's constructions of meanings in science is being suggested. New constructions are built through their relations to prior knowledge and it is a pedagogic challenge for teacher to focus on students' learning with understanding. To learn science from a constructivism

philosophy implies direct experience with science as a process of knowledge generation in which prior knowledge is elaborated and changed on the basis of fresh meaning negotiated with peers and teacher. Concept mapping stimulates this process by making it explicit.

This research paper is an outcome of an ERIC project, NCERT which aimed at investigating the use of concept mapping as a strategy to enhance meaningful learning and to improve upon the process skills of students in science.

OBJECTIVES OF THE STUDY

To develop and implement concept mapping as a strategy in the selected few units of science for VIII standard students and study its effect on the achievement , concept attainment, and the process skills of students belonging to different intelligence groups.

To study the attitude of students towards concept mapping in science.

To study the gender differences in science achievement, process skills and attitude towards concept mapping.

DESIGN AND SAMPLE OF THE STUDY

The study was of quasi-experimental in nature where in non-randomized pre and posttest design was used. The intact classes of eighth standard as a whole were considered as experimental (47) and control group(42) for the study, from two local schools of Mysore city.

TOOLS USED IN THE STUDY

Raven Progressive Matrix was used to group the students according to their intelligence. An achievement test based on selected units of the eighth standard syllabus ,a process skills test and a concept attainment test were developed to measure the students' achievement , process skills and attainment of concepts in science. An attitude scale was developed to measure students' attitude towards concept mapping.

PROCEDURAL DETAILS OF THE STUDY

The lessons in the selected units of science were developed based on constructivist model which included i) planning student exploration ii) explanation iii) expansion and iv) evaluation., The tools and the lessons were tried out and Item analysis was carried out in case of achievement and process skills test., The tools were administered to both experimental and control groups as pre-test The project was implemented to the students of Experimental Group during which they were oriented about the steps involved in concept mapping followed by the implementation of the science lessons. Concept maps were evolved during the process of instruction along with the explanation. Concept maps were developed at the review stage on the blackboard with the help of students. The student constructed maps in groups as well

as individually, were made to be presented and discussed. The concept maps were used as assessment tools in all the units.

The data obtained was analyzed descriptively and inferentially by calculating percentages, mean, SD and "t" values and ANOVA.

ANALYSIS OF THE STUDY

Effect of concept mapping on science achievement

H 1: The experimental group students perform better than the control group students on achievement test in science

Table 1: Mean, S.D and 't' values obtained on pre-test and post-test achievement in science by experimental and control groups

Group	N	Pre-test			Post-test		
		Mean	SD	't'	Mean	SD	't'
Experimental	47	35.28	9.73	0.67	61.17	12.20	9.66*
Control	42	36.79	11.03		38.53	9.87	

H 2: There is no difference between students of different abilities in their pre and post test achievement in science

Table 2: Mean, S D and 't' values obtained on pre-test and post-test achievement in science by experimental group with different abilities

Abilities Group	N	Pre test		Post test		't'
		Mean	σ	Mean	σ	
Grade 1	2	42.5	3.54	84.2	3.54	8.33*
Grade 2	15	39.67	8.02	65.44	9.18	12.34*
Grade 3	13	33.08	8.22	60.89	4.65	10.91*
Grade 4	17	32.25	11.24	54.9	14.56	7.39*
Total	47	35.28	9.73	61.17	12.20	16.30*

* Significant at 0.01 level

Effect of concept mapping on process skills

H 3: There is no difference among the experimental group students with different abilities in their process skills.

Table 3: ANOVA test on process skills of experimental group students belonging to different grades of intelligence

Process Skills test		Sum of Squares	Df	Mean Square	F	Significance
Pre Test* Grade	Between Groups	495.574	3	165.191	2.118	0.112
	Within Groups	8353.544	43			
	Total	3849.119	46	77.989		
Post Test* Grade	Between Groups	456.822	3	152.274 101.225	1.504	0.227
	Within Groups	4352.678	43			
	Total	4809.500	46			

H 4: The experimental group students perform better on process skills in the post test.

Table 4: Mean, S.D and 't' values obtained on pre and post process skills test

Group (N)	Process Skills	Pre Test		Post Test		't'
		Mean	σ	Mean	σ	
Experimental Group (N=47)	Observation	39.6	21.5	64.0	13.60	7.40*
	Inference	40.0	00	74.2	11.73	20.0*
	Hypothesis	52.0	19.04	67.0	20.22	4.03*
	Interpretation	52.0	21.11	77.0	21.20	5.74*
	Reasoning	62.0	19.21	77.0	16.45	4.11*
	Prediction	48.0	19.9	64.0	17.09	4.76*
	Cause-effect Relationships	40.0	13.48	59.2	13.63	9.20*
	Total	47.6	9.15	67.89	10.23	13.52*

* Significant at 0.01 level

H 5: The experimental group students perform better than the control group students on post process skills test in science

Table 5: Mean, S.D and 't' values obtained on pre- and post- process skills test in science by experimental and control groups

Group	N	Pre test			Post test		
		Mean	SD	't'	Mean	SD	't'
Experimental	47	47.6	9.15	2.77*	67.9	10.23	6.34*
Control	42	54.21	12.78		55.3	8.89	

* Significant at 0.01 level

Effect of concept mapping on Attainment of science concepts

H 6: There is no difference among the students of different abilities belonging to experimental group in their pre and post concept attainment

Table 6: ANOVA of pre and post concept attainment in science

	Sum of Squares	Df	Mean Square	F	Significance
Pre Concept* Grade Between (Combined)	677.302	3	225.767	2.699	05
Within Groups	3601.986	43	83.767		
Total	4279.288	46			
Post Concept* Grade Between (Combined)	589.762	3	196.587		
Within Groups	3132.340	43	72.845		
Total	3722.102	46			

H 7: The experimental group students perform better than the control group students on post concept attainment test

Table 7: Difference between experimental and control group on concept attainment

Group	N	Pre test		Post test		't'
		Mean	SD	Mean	SD	
Experimental	47	46	9.64	54.56	8.99	8.98*
Control	42	48	7.31	49.8	7.49	1.62

* Significant at 0.01 level

Attitude towards concept mapping

H 8: There is no difference among the students of different abilities in their attitude towards concept mapping

Table 8: Difference among students of different abilities in their attitude

	Sum of Squares	Df	Mean Square	F	Significance
Att* Grade Between (Combined)	1329.574	3	443.191	2.609	.064
Within Groups	7133.579	42			
Total	8463.152	45	169.847		

MAJOR FINDINGS OF THE STUDY

The analysis of data revealed that the experimental group students had performed better when compared to the control group on the achievement test, process skills and concept attainment test on the post test occasion. This was evidenced through the "t" values obtained for achievement test (9.66); process skills (6.34) and the concept attainment test (4.40).

The analysis of students (experimental) attitude towards concept mapping revealed that almost 90% of them had a very positive attitude.

The F values obtained (5.921) showed that there is a difference between and within the different intelligence groups of the experimental group in their post-achievement test implying that the concept mapping strategy has had a differential effect on students belonging to different intelligence groups. Similarly, the F value obtained

for concept attainment test was found significant implying that there is a difference within and between the students of different intelligence in their concept attainment ability. But there was no difference found either between or within the different grades of students in their performance of process skills.

There was no difference observed between girls and boys in their achievement, process skills, concept attainment and in their attitude towards concept mapping.

Based on the results of this study, it is concluded that there is a need to include concept mapping with the constructivist basis as one of the major approaches to teach science in schools and provide workable strategies to help students "learn how to learn".

References

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