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Effectiveness of Concept Mapping Strategy For Teaching Selected Concept of Biology to Ninth Class Students in Terms of Achievement and Reaction

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Introduction

Science and technology are those two main areas which directly and indirectly influence Education and Society. The objectives of Education are framed basically on the basis of society's needs, thinking and futuristic demands and thus they are ever changing. There is a drastic change in the total scenario of Education. The aims of education are not only to provide bookish knowledge to child but also initiate higher order of understanding in them so that child becomes able to face upcoming challenges of his life. The shift leaded a path of evolvement of various innovations. These innovations emerged to overcome the globalised challenges of Education.

Innovation is a result of development of science, technology and on going educational researches that have been going continuously. Research works in field of education were conducted for developing many new tools and techniques. These tools and techniques help in systematic arrangement and representation of information for making teaching learning process effective and meaningful for learners. These all tools and techniques are scientific in nature. Some of them are Computer Assisted Instruction, role play, mapping strategy, blended-learning and e-learning, mobile learning, web based instruction, audio-video tutorials, community collaboration content management system, programmed learning materials, models, modules, discussion methods, seminars, excursion and Concept Mapping Strategy.

Concept Mapping

Concept mapping is a new technique for providing instruction to students. It is a network of knowledge which posses networking of concept and it's sub concepts enclosed in nodes and link with each other either by single or double arrow lines having phrasal words (linking words).This linking words and nodes combine to form a meaningful information. Concept map have one main concept and group of sub concepts. Each node has a single concept name and it may be group of words that is may be more than one but not in a sentence form. Concept mapping is depending on one's creativity because the way of representation and arrangement of concepts with linking words vary from individual to individual.

Joseph D Novak: Concepts maps are graphical tools for organizing and representing relationship between concepts indicated by a connecting line. Linking two concept words on the line referred to as linking words or linking phrases specify the relationship between two concepts. Concepts and propositions are usually organized hierarchically from most general, most inclusive to most specify.

Rationale

In a 21st century the educational researchers gave their full attention and potential for making teaching –learning process effective and meaningful. For this many innovations took place due to which number of teaching

strategies emerged to make learning meaningful. Concept mapping strategy is one of them. Many researches have been conducted on concept mapping strategies for measuring its effectiveness either comparing it with other teaching methods or as a assessment tool and find its correlation with different psychological factors and got fruitful results. Some of researches are as follows- Pankratius (1990), Horton et al. (1993), Coleman (1998), Mc Clure (1999), Chang, Sung & Chen (2002), Zittle (2002) Wikramasinghe (2004), Rao, P.M.(2004), Mauri and Ahoranta (2004), Kinchin and Hay (2005), Meers (2006), Saouma BouJaoude and May Attieh (2008) developed Concept Maps and studied its effectiveness. Many researchers have been conducted on comparison of Concept Mapping Strategy with conventional Method. Some of these are cited here. Jegede, Alaiyemola and Okebukola (1990); McCagg and Dansereau (1991); Hall and Dansereau and Skagg (1992); Esiobu and Soyibo (1995); Hall and O'donnell (1996); Czerniak and haney (1998); Markow and Lonning (1998); Nicoll, Francisco and Nakhleh (2001); Wheeler (2004); Pranita (2004); Hsu (2004); Gopal,P.(2004); Ahuja (2006), Fred Nyabuti Keraro Samuel W.Wachanga & William Orora, (2007); Shailja (2009) and Chacko Sheela (2012) developed the Concept Maps and studies its effectiveness in comparison with Conventional Method. Lehman, Carter & Kahle (1985); Spaulding (1989); Yekta and nasrabadi (204); Kharatmal (2009) and Oloyede, Olufunlayo; Adeyoe (2009); Dammani, K. (2011) and Amita (2015). Thus there is a need of studying effectiveness of concept mapping strategy in context to biological concepts in terms of achievement and reasoning in science. This is one of the reasons for choosing this topic for dissertation.

Another reason is that science is a subject which provides a great scope for administering its new innovations and products for solving problems related to each aspect of life including teaching learning process. Among all subjects, science is that one which is more close to our life and concerned with our daily routine work. Science is a more practical and less subjective in nature beside this having numbers of factual information in it which cannot be alter by anybody and is required to learn as it is. Science has many sub branches and Biology is one of them which deal with the study of living beings in context to physiological, metabolic, immunology, nutrition, origin of life, genetics, environment, biodiversity etc. These all possess factual information and required to learn as it is. At secondary level students face problem related to learning and understanding of biological concepts. Most of the time students just memorize concept instead of understanding them due to which learners show less interest towards biological concepts and keep distance from learning of biology. If biological concepts taught in an easy way and in such a way that it become interesting for learners, the learning will improve. There are many concepts in biology which required certain logics for their better understanding. If these logics will be taught to students then concepts will be learned and understood in easy way. By using this strategy students can retain more information for long time and also makes it meaningful for them. Concept mapping strategy based on logical learning of concepts. By using concept map student and teacher both together make learning of biology concept effective. Hence it is another reason for selecting this topic for dissertation.

Concept mapping strategy is that strategy in which concepts are arrange logically and sequentially with linking words. These combinations of concepts with linking words and line create a map of concept that is information in the form of sign and picture. According to laws of learning stated in learning theories of educational psychology brain retrieve and store information in the form of sign for a longer period of time. Concept mapping strategy indirectly relates with the meaning of theory of formal discipline in educational psychology and work

accordingly. Not only students but also people can store any information in the form of sign and recall respected sign at the time of their utilization in day to day activities. Concept map strategy provides scope of utilization of educational psychological theories, educational innovations and teaching of biology concept simultaneously. Hence it also becomes a reason for selecting this topic for dissertation.

Statement Of Problem

The present study was entitled as-
Effectiveness of Concept Mapping Strategy for Teaching Selected Concept of Biology to Ninth Class Students in Terms of Achievement and Reaction

Objectives

The objectives of the present investigation were as follows

- To develop concept map on selected biological topics for ninth class students.
- To compare mean achievement scores of experimental group at pre and post stage.
- To compare mean achievement scores of experimental group students taught through concept mapping method with the control group students taught through traditional method by taking pre achievement in biology as covariate.
- To study the reaction of students towards concept mapping strategy.

Hypotheses

Hypotheses of the present investigation were as follows

- There is no significant difference between mean achievement scores of experimental group at pre and post stage.
- There is no significant difference between the mean achievement scores of experimental group taught through concept mapping method and control group taught through traditional method by taking pre achievement in biology as covariate.
- There is no significant difference between the mean achievement scores of control group and experimental group at post stage.

Methodology

Following methodology were used by investigator for present study:

Sample

For the present study sample was selected randomly by using random sampling technique. A list of 34 M.P.Board affiliated Schools of Indore city was prepared. Out of which any 10 schools were selected through lottery system. Then two schools were selected from the selected10 schools. One school took as a control group whiles other as an experimental group. From both the groups 35 students of class ninth were selected for the present study.

Tools

For the present study following tools were used-

- **Concept maps –** Concept maps was developed by an investigator on the selected topic of biology subject such as Habitat, plant and animal adaptation, ecosystem, sustainable agriculture, nutrition.
- **Achievement test -** A multiple choice question test was developed by an investigator on the five selected topic of biology for present study. It was comprised of 40 multiple choice questions; 90 minutes were given to students for solving achievement test. Students were asked to selected or mark only one option which was best in their knowledge.
- **Reaction scale-** students of experimental group were taught through concept maps. For knowing the reaction of students, a reaction scale was developed by investigator. Investigator included fifteen statements which covered different aspects of concept mapping strategy. Against each statement five choices were given that is Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (D) and Strongly Disagree (SD.) Students were asked to tick the option which was best in their knowledge. Some

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statements are positive in nature whiles some are negative in nature.

Design

The present study was experimental in nature. It was employed non-equivalent control group design.

Layout:-

O_1 X O_2
O_1 - O_2

Where O_1= Observation of pretest
X = Treatment given to experimental group
O_2 = Observation of posttest
= No treatment

Procedure

For the present study first of all permission was taken from the principals of selected schools. In the first day of both schools orientation related to experimental study was given to the students. Beside this, students of experimental group were also oriented about the concept map. Before starting the experiment, pre achievement test was administered on both groups. During experiment, students of experimental group were taught through concept map developed on selected topics of biology subjects of class ninth whereas students of control group were taught by using traditional method. While teaching the selected concepts of biology in the classroom their concept maps were also developed and explained by investigator. Students were also allowed to discuss with investigator as well as with them to clarify their doubts regarding concepts. Total 29 days of treatment were given to the students of experimental group. Daily two periods were taken by investigator for giving treatment. The duration of one period was 35 minutes. After completion of treatment a post achievement test was administered on both groups. At the end for knowing the reactions of students of experimental group towards concept mapping strategy, a reaction scale was administered on them.

Analysis Of Data

The major objective of the present study was to find out the effectiveness of concept mapping strategy for Teaching Selected Concept of Biology to Ninth Class Students in Terms of Achievement and Reaction. For achieving this objectives different tools like achievement test and reaction scale were used for collection of data then after collected data were analyzed by using correlates t-test, ANCOVA and percentage.

Effectiveness Of Concept Mapping Strategy In Terms Of Achievement

The first objective of the present study was "To compare mean achievement scores of experimental group at pre and post stage."The pre and post test obtained marks were analyzed by using correlated t-test and the result is summarized in table1.7.1.

Table 1.7.1 Summary of paired sample t-test for Achievement

Test	N	Mea	SD	r	t-
Pre Achievement Test	**35**	**14.63**	**3.84**	**0.523**	**9.678****
Post Achievem	**35**	**22.86**	**5.83**		

**** Significant at 0.01 level of significance.**

From the table 1.7.1 is clear that the observed t value of achievement with SD 3.84 is 9.678 which is less than the critical value 2.58 at two tailed 0.01 level of significance. Hence, it is significant at 0.01level of significance. Therefore null hypothesis "There is no significant difference between mean achievement scores of experimental group at pre and post stage" is rejected. It means that marked difference present between the pre and post achievement scores of students.

Further from the table 4.1 it is evident that the mean scores of post achievement test is 22.86 which is significantly greater than the mean scores of pre achievement test that is 14.63. It

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shows significant difference between the scores of students at pre and post stage. Thus concept mapping strategy was found effective in terms of achievement of students.

Effectiveness Of Concept Mapping Strategy In Terms Of Achievement Of Experimental Group And Control Group By Taking Pre Achievement As Covariate

The second objective of present study was "To compare mean achievement scores of experimental group students taught through concept mapping method with the control group students taught through traditional method by taking pre achievement in biology as covariate". The collected data at pre and post stage for both control and experimental group was analyzed by employing ANCOVA and the result is summarized in table1.7.2.1

Table 1.7.2.1 Summary of one way ANCOVA of Achievement in Biology by taking pre achievement

Source of variances	SS	df	MSS	F	Sig.
Treatment	1881.68	1	1881.683	84.17	0.000**
Error	1497.81	67	22.355		
Total	4563.77	68			

**** Significant at 0.01 level of significance**

From the table 1.7.2.1 it is clear that the observed value of F with df (1,68) for treatment is 84.17 whose significant value is 0.000,which is less than the 0.01. Hence, it is significant at 0.01level of significance. Therefore null hypothesis "There is no significant difference between the mean achievement scores of experimental group taught through concept mapping method and control group taught through traditional method by taking pre achievement in Biology as covariate" is rejected. It means that significant difference present between the scores of both groups that is experimental group and control. For knowing the difference estimated marginal means of both group will be calculated.

Table 1.7.2.2 Summary of estimated marginal mean of Achievement

Treatment	Estimated Mean
Concept mapping strategy	22.55
Traditional Method	12.14

From the table1.7.2.2 it is clear that the estimated marginal mean scores of experimental group which were taught through concept mapping strategy is 22.55 which is significantly greater than the estimated marginal mean 12.14 of control group which were taught through traditional method. It means that the achievement in biology of students of experimental group is greater than that of students of control group. From this discussion it can concluded that the treatment in the case of experimental group was found effective. Hence concept mapping strategy was found effective as compare to traditional method.

Effectiveness Of Concept Mapping Strategy In Terms Of Reaction Of Students

The third objective of present study was "To study the reaction of students towards concept mapping strategy ".Here reactions of students have been analyzed by counting individual's response under five categories such as strongly agree (SA), Agree (A), undecided (UD), Disagree (D) and strongly Disagree (SD) and then percentage was calculated. The result is presented in Table 1.7.3.

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Table 1.7.3 student's reaction towards concept mapping strategy

S. No.	STATEMENT	SA	A	UD	D	SD
1	Concept map provides more information in fewer words.	22 (70.96%)	8 (25.8%)	1 (3.2%)	0	0
2	Concept map helps in learning difficult concepts easily.	20 (64.51%)	9 (29%)	1 (3.2%)	1 (3.2%)	0
3	Concept map helps all the students to learn a concept in accordance with their pace of learning.	15 (48.38%)	8 (25.5%)	3 (9.67%)	5 (16.1%)	0
4	While learning with help of Concept map, Students get distracted and hence loss their concentration.	0	1 (3.2%)	5 (16.1%)	5 (16.1%)	20 (64.51%)
5	Concept map makes learning interesting.	18 (58.06%)	12 (38.7%)	0	1 (3.2%)	0
6	Concept map encourages higher order of thinking.	21 (67.7%)	5 (16.1%)	3 (9.67%)	2 (6.45%)	0
7	It takes much time to make concept map.	4 (12.9%)	4 (12.9%)	1 (3.2%)	20 (64.51%)	2 (6.45%)
8	Concept map required specific skills in the students.	3 (9.67%)	2 (6.45%)	11 (35.48%)	8 (25.5%)	7 (22.58%)
9	Concept map develops creativity in the student.	21 (67.7%)	8 (25.5%)	0	1 (3.2%)	1 (3.2%)
10	Concept map explains the concepts more clearly and deeply.	15 (48.38%)	8 (25.5%)	2 (6.45%)	6 (19.35%)	0
11	Concept mapping is the complex process.	5 (16.1%)	18 (58.06%)	2 (6.45%)	11 (35.48%)	5 (16.1%)
12	Concept map generates illusions in the student.	1 (3.2%)	3 (9.67%)	3 (9.67%)	13 (41.93%)	21 (67.7%)
13	Concept map develops interaction in the class.	14 (45.16%)	9 (29%)	3 (9.67%)	3 (9.67%)	2 (6.45%)
14	All the students are not able to make concept map.	3 (9.67%)	4 (12.9%)	3 (9.67%)	9 (29%)	12 (38.7%)
15	When learn with the concept map, the concept is learned by the student for longer period of time.	24 (77.41%)	5 (16.1%)	2 (6.45%)	0	0

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From the table 1.7.3 it is clear that for the statement "Concept map provides more information in fewer words."70.96% students were strongly agree and 25.8% students were agree while 3.2% students were not sure about it.64.5% students were strongly agree with statement "Concept map helps in learning difficult concepts easily." and 29% students were agree but 3.2% students were not decide about it. For statement "Concept map helps all the students to learn a concept in accordance with their pace of learning."48.38% students were strongly agree and 25.8% students were agree while 9.67% students were not decide about it and 16.1% students were disagree with this statement.64.5% students were strongly disagree with statement "While learning with help of Concept map, Students get distracted and hence loss their concentration.",16.1% students were not decide anything with respect to this statement while 64.5% students were strongly disagree and 16.1% students were disagree .58% students were str4ongly agree and found concept map interesting for learning concepts of biology 38.7% students were agree with this statement while 3.2% students were disagree. For statement six that is "Concept map encourages higher order of thinking."67.7% students were strongly agreed; 16.1% students were agreed and 6.45% students were disagreed while 9.67% students were not sure about it.64.51%students were disagreed with statement "It takes much time to make concept map." and 6.45% students were strongly disagreed but 12.9% students were strongly agreed and agreed while 3.2% students were not sure about it. For eighth statement that is "Concept map required specific skills in the students." 35.48% students were not sure but 9.67% students were strongly agreed; 6.45% students were agreed while 25.8% students were disagreed and 22.58% students were strongly disagreed. 67.7% students were strongly agreed with statement "Concept map develops creativity in the student." and 25.8% students were agreed but 3.2% students were disagreed and strongly disagree this statement. 48.38% students were strongly agreed; 28.5% students were agreed with statement "Concept map explains the concepts more clearly and deeply." while 19.35% student were disagreed and 6.45% students were not sure. For the eleventh statement that is "Concept mapping is the complex process." 58.06% students were agreed and 16.1% students were strongly agreed while 35.48% students were strongly disagreed; 16.1% students were disagreed and remaining 6.45% students were not sure. 67.7% students were strongly disagreed and 41.93% students were disagreed with statement "Concept map generates illusions in the student." while 3.2% students were strongly agreed and 9.67% students were not sure. For statement "Concept map develops interaction in the class." 45.16% students were strongly agreed; 9.67% students were disagreed 6.45% students were strongly disagreed and 9.67% students were not sure. 38.7% students were strongly disagreed with statement "All the students are not able to make concept map." And 29% students were disagreed; 6.45% students were strongly disagreed and 9.67% students were not sure. For statement "When learn with the concept map, the concept is learned by the student for longer period of time." 77.41% students were strongly agreed and 16.1% students were agreed while 6.45% students were not sure.

From this it is clear that for the positive statements most of the students gave their favorable reaction towards concept map. Majority of students were strongly agree with positive statements and few were with negative statements. Some were agreed and few students were not sure towards positive and negative statements.

Findings Of The Study

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The findings of the present study are as follows-

- The concept mapping strategy for teaching biological concepts was found to be significantly effective in terms of achievement of class ninth students.

- On comparing mean achievement scores of experimental group and control group by taking pre achievement as covariate; concept mapping strategy was found to be significantly effective than traditional method.

- Concept mapping strategy for teaching biological concepts to ninth class students was found effective in terms of reaction.

Discussion Of The Result

Discussions on the result are as follows

A The first finding which emerged from this study is "The concept mapping strategy for teaching biological concepts was found to be significantly effective in terms of achievement of class ninth students." the following reason may be responsible for such findings.

As concept map provide all essential information related to a particular concept on one page and also show inter relationship present between them which helps students for learning biological concepts easily. Hence concept mapping strategy found to be effective.

- Students learn theoretical concepts more easily with the help of concept map and memorized them for longer period of time. Hence concept mapping strategy found to be effective.

- Concept map developed on selected topic may be well developed, represented and described by investigator. Consequently the students understood concept map clearly. Hence concept map strategy found to be effective.

All the above reasons show that the treatment was effective in terms of achievement.

A The second finding which emerged from this study is "On comparing mean achievement scores of experimental group and control group by taking pre achievement as covariate; concept mapping strategy was found to be significantly effective than traditional method". The following reason may be responsible for such findings-

- Control group students may face difficulty in learning biology concept which is written in paragraph form while experimental group students learn concept in graphical form. Hence concept mapping strategy found to be effective.

- Explaining skill of teacher and command of teacher on subject also affect the achievement of the students of both groups may affect achievement of students. Hence concept mapping strategy found to be effective.

All the above reasons show that the treatment was effective in terms of achievement of experimental group and control group by taking pre achievement as covariate.

A The third finding which emerged from this study is "Concept mapping strategy for teaching biological concepts to ninth class students was found effective in terms of reaction". The following reason may be responsible for such findings-

- Students found concept map was interesting for learning concept as it provide more information in less word and help them to learn concepts for longer period of time.

- Students get benefited for preparing notes at their own level.

- From the table 1.7.3 it is cleared that maximum number of students were strongly agree with positive statements of concept map.

From the above reasons it is clear that the reactions of students towards concept mapping strategy were favorable. Hence concept mapping strategy was found effective in terms of reaction.

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Educational Implications

The present study has several implications for all those persons who are related to the field of education. Now a day's more emphasis is given on meaningful learning .For this purpose concept map provides a guideline to students, teachers, curriculum developer, educational institution, text book writers, government and non government organizations, parents and researchers.

➢ Students:

Through concept map, students can represent and collect informations related to a particular topic on one page. Concept map guides students in searching relationship among all sub concepts and main concept. It also provides guideline for linking previous knowledge with new knowledge. Students can represent their knowledge more precisely and meaningfully with the help of concept map.

➢ Teachers:

Teacher can use concept map as a teaching tool, assessment tool for knowing students achievement and understanding, as a diagnostic tool. Teacher can also use concept map as an evaluation tool for evaluating the understanding of students on taught content. Teachers can also assess previous knowledge of students through concept map.

➢ **Curriculum planner:**

Curriculum planners develop a concept map during planning on a particular topic or subject. For this concept map can be developed at two levels such as macro level and micro level. At macro level concept map can be developed on all units included in a subject at a particular level while for a particular topic or chapter a concept map can be prepared along with content as well as all essential attributes of curriculum such as teaching methodology, values developed by content, related activities and duration of activity.

➢ Text Book Writer:

A concept map can be very useful for text book writers. Through concept map text book writer can summarize the chapter more effectively and beautifully which will help students, teachers and parents in understanding and focusing on main information given in the chapter. Text book writers can also used concept map in his text book as an evaluation tool in the same way as cross word is used by them at the end of chapter. It may be useful in all the subjects.

➢ Parents:

These days parents are more concerned about the education of their children; they are very curious and interested in knowing strengths and weaknesses of their child. Concept map developed by child helps parents to get acquaint with the level of understanding of their child.

➢ **Researchers:**

Researchers can use concept map during early stage of writing report of their work. Through concept map researchers can prepare a rough draft of their work which helps them in writing their report. Researchers can also develop concept map before starting their work by including all relevant informations related for their work; again it will act as a guide for the researchers in conducting their research work.

➢ **Educational institutions:**

During supervision institute require to give presentation of all works and activities which are either done or being run by them throughout the year. They can developed concept map at macro level for introducing their institute by including all aspects regarding institute and at micro level for annual and monthly academic planning and activities.

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