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Using Concept Mapping to Improve Students' Academic Achievement in Biology at Secondary Level

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Abstract

New efforts in teaching should be to help students learn 'how to learn' so that they have a better chance to grasp the major ideas in science disciplines and also to help them learn how knowledge is constructed ,partly to help them understand the nature of science. Concept Mapping is the process of categorical structuring of information in a graphic form that is concept maps. Concept mapping method involves the teaching with the help of concepts. The main aim of this study was to explore the effect of Concept mapping method on students' academic achievement in Biology at secondary level. Pre-test Post-test control group design was used. Experimental group was taught through Concept mapping method and Control group was taught by the Activity Oriented Method. The findings of the study indicated that Concept mapping method is more effective than the Prevailing method. More over the students also expressed that Concept mapping method helped in the development of the abilities of comprehension, comparison, generalization and deduction.

Keywords*: Concept mapping method Activity Oriented Method, Academic Achievement etc.*

Introduction

Concept learning is considered important for it helps in the application of generalized meanings of words and expressions that are used in different situations. Concept is a generalized idea of meaning about a class to things. It is a symbolic construction that represents some common and general feature or features of objects and events. Based on the theoretical framework established by educational psychologists, Novak created the concept mapping technique. The fundamental idea of the theory is that human learning becomes meaningful (as opposed to rote) when new information is purposefully and intentionally connected to an already-existing body of prior knowledge (Novak, 2006). Additionally, according to Novak, the mind arranges knowledge in a top-down, hierarchical manner, starting with higher level abilities and working down to lower level ones. In contrast, rote (or memorised) learning results in a weak and unstable structure that degenerates rapidly since new concepts are arbitrarily and verbatim introduced to the learner's framework. People's perspectives of the world alter as a result of meaningful learning. According to Novak (2006), it is observed that rote learning pupils are able to remember new material but are unable to apply the knowledge in different contexts. Simple concepts are introduced to students initially, followed by complicated ideas connected in a hierarchical fashion, in order to provide an ordered body of knowledge in a meaningful way that takes into account the learner's cognitive map. This allows for proper learning to occur in a sequential and integrated manner. Concept mapping is a graphical method of linking statements about an issue or topic and organizing and displaying knowledge in networks of concepts (Novak & Canas, 2006). Concept mapping consists of concepts that are typically denoted by various forms of circles or boxes, with connecting lines between concepts signifying links between concepts. Arrangements of pictures or graphics that address a particular topic are called concepts. When it comes to portraying the organization of knowledge in a way that is psychologically consistent with how people interpret meaning, they are helpful resources. As the simplest symbolic construction by which humans classify or categorize reality, or make sense of and assign meaning to their surroundings, is what Mouton (1996) characterizes as a notion. Although symbols are occasionally employed, Novak and Gowin (1994) showed that the majority of thoughts have a single word as their label. A proposition is a set of two or more concepts joined by a labeled connection, and it forms the basis of any concept mapping. According to Novak (2010), a proposition is a significant statement about an item or occasion. The organisation of knowledge in long-term memory is represented by a concept map, which connects propositions to create a hierarchical and branching structure. The most inclusive and general concepts are placed at the top of the map, while the more specific and less general concepts are arranged below. Including "crosslink" is one of the key

components of Concept Mapping. Cross-links illustrate the relationship between an idea in one mapping-represented domain of knowledge and another mapping-represented domain of knowledge. According to Novak (2000), cross-links in the production of new knowledge frequently signify innovative strides on the side of the information creator. Giving concrete instances of things or events is the last component of the Concept Mapping framework. They are useful in elucidating the meaning of a certain notion. They usually don't belong in ovals or boxes because they are particular things or events rather than abstract ideas. Context mapping is a tool used to investigate how students' achievement is elevated by meaningful learning. Pearson and Snyder (2008) suggest that concept mapping, as an educational method, can enhance academic attainment since it parallels the shift from teacher to learner. Most students learn best, according to educators and experts nowadays, when they apply what they have already learned to new information and draw connections between it and their prior knowledge. It is necessary for students to create their own knowledge because of this. Rather than teacher-centered techniques, which are dominated by the teacher, Sakiyo and Jebson (2008) argued that learner-centered teaching methods produce appropriate learning outcomes.

Rationale of the study

In a world based on science and technology the progress of a country depends on how well it applies the available scientific knowledge for practical use. Hence science should be taught in such a way as to enables the children to apply the knowledge gained in the classroom in real life situations. The way of imparting knowledge and its ultimate effect on the learner is more important than the quality of subject matter. In this context the method of teaching deserves special attention. Recalling material from biology lesson instructions is improved by concept mapping. Concept mapping has been suggested by Kinechin (2000) as a useful tool for teaching and learning biology in secondary schools. The key thing to remember is that the process of creating concept maps requires learners to actively engage in the learning process and sets the foundation for their comprehension of a particular subject. According to Nowruzi, Khiabani, and Nafissi (2010), facilitators can identify learners' cognitive deficits and offer remedial comments by using this information about learners' understanding. In contrast to students who learnt via rote memorization, Lambiotte and Dancereau (2001) found that students who created idea maps had a wider knowledge base and were therefore better able to solve problems. Additionally, they discovered that students with little prior knowledge learnt more effectively through idea mapping than through traditional lecture-based instruction .Writing skills among students have also been demonstrated to improve with concept mapping. The amount and quality of thoughts produced, arranged, and related have all improved as a result of this enhancement. Concept mapping has been widely endorsed and applied in a variety of ways in science education. It has been employed to assist educators and learners in developing a structured knowledge base centred around a particular subject or discipline .Additionally, middle level students' acquisition of scientific content has benefited from its application (Novak & Gowin, 1994; Adlaon, 2002; Dhaaka,). The results of these research show that idea mapping is a useful strategy for improving students' understanding of science-related content. Furthermore, when students are given greater opportunities to participate in the learning process by applying their concept mapping skills, they outperform their peers who have only been exposed to traditional lecture-style instruction (Nnamdi & Okechukwu, 2006). It has also become evident that there is a relationship between students' achievement on achievement tests and their idea mapping proficiency. Another effective method for bridging the typical gap between theories and practice is concept mapping. Concept mapping also facilitates learning by providing access to representation in a particular setting. Research in education has attempted to determine why certain students get a profound and significant comprehension of the subjects they are studying, while others merely have a cursory knowledge of the content. In most cases, in order to pass the test, students must memorize and replicate the material. In such an environment students' academic achievement, cannot be attained. Often this kind of learning leads to students' poor academic achievement. One factor contributing to the low performance of the students is the teacher's use of ineffective biology method of instruction. Concept mapping is one tactic that may be used to encourage kids to advance their biological academic performance. Hence an attempt has been done to explore the effectiveness of Concept mapping method over the prevailing method in the teaching of Biology at secondary level

Major Objective of the Study

To compare the effectiveness of Concept Mapping method and Activity oriented Method in teaching Biology at Secondary Level

Hypothesis

The hypothesis formulated for the present study is-

The Concept Mapping Method will be more effective than Activity oriented Method in teaching Biology at Secondary level

Methodology in brief

Since the main purpose of the study was to test the effectiveness of Concept Mapping Method over the Activity Oriented Method in teaching Biology ,the Experimental method was adopted for the present study. A pre-test Post-test Parallel Group Design was selected for the study. The study was based on a sample of 80 students of class VIII from Govt. High school, Punalur, Kollam, Kerala. The tools used were1) Lesson transcripts based on Concept mapping method 2) Lesson transcripts based on Activity Oriented method and 3) Achievement Test. The Lesson transcripts were prepared to teach the unit 'Life Mysteries in Little Chambers' according to Concept Mapping Method and Activity Oriented Method. The three phases of Concept Mapping Method includes Presentation of the Concept Map, Presentation of learning Task and Strengthening Cognitive Structure. The 79 students were divided into two groups. The first group was treated as the Experimental group who were taught by Concept mapping Method. The second group was treated as the control group and the pupil in this group were taught by Activity Oriented Method. After completing the Experimental treatment, the same achievement test was given to all the two groups. The marks obtained were subjected to appropriate statistical techniques to determine the effectiveness of Concept Mapping Method over Activity Oriented Method.

Analysis and Interpretation of Data

The investigator administered the various tools and collected the score obtained for the two groups and analyzed to test the significance. The details are summarized in the tables below:

I Pupil's Performance in the Achievement Test: before Experiment

Table 1: Values of Various statistics calculated for the Pre-test scores of pupils in the Control (AOM) and Experimental groups(CMM)

Statistics calculated	Control group	Experimental group
Arithmetic mean	15.98	19.25
Median	15.75	18.25
Mode	15.61	16.55
Standard deviation	5.05	6.5
Skewness	0.137	0.46

The Mean of the scores obtained for control and experimental groups are 15.98 and 19.25.The Median for both the control and experimental groups are 15.75 and 18.25.The Mode for the control and experimental groups are 15.61 and 16.55.This shows that, the pupils in both groups did not achieve high scores in the pre-test which indicate that, both the groups had only limited knowledge on the topic selected for the study. The Standard deviation for both the groups are 5.05 and 6.5 ,since these obtained standard deviations for Control and Experimental groups are not high, it can be inferred that the scores in both the groups do not scatter very much. The skewness values of Control and Experimental groups show that the distribution is positively skewed and that there is a clustering of scores at the lower end of the distribution in both the groups. The above results indicate that, Control and Experimental groups did not achieve high marks in pre-test.

II Pupil's Performance in the Achievement Test: after the Experiment

The post test scores obtained for the Control and Experimental groups were classified and calculated various measures of Central tendency, Standard deviation and Skewness. The values of various statistics given in Table 2

Table 2: Values of Various statistics calculated for the Post-test scores of pupils in the Control (AOM) and Experimental groups (CMM)

Statistics calculated	Control group	Experimental group
Arithmetic mean	29.89	41.87
Median	28.65	42
Mode	29.37	44.95
Standard deviation	7.15	6.95
Skewness	0.52	0.05

The values of Mean, Median and Mode indicate that, the students in the experimental group attained good achievement when they studied with the help of Concept maps. Whereas, the achievement of students in the control group who were taught by the existing method of teaching was not very satisfactory. The values of skewness obtained for control and experimental group reveal that, the distribution is positively skewed and that the scores clustered at the lower end of the distribution in both the groups.

III Comparison of Pre-test scores of pupils in the Experimental (CMM) and Control group (AOM)

The pre-test scores of the Experimental (CMM)and Control groups were classified and Arithmetic mean and Standard deviation were calculated. The difference between scores of two groups CMM and AOM was tested for significance by finding the critical ratio. The data and results of test of significance are given in the Table 3

Table 3: **Data and Results of Test of significance of the Pre-test scores of pupils in the Experimental and Control groups**

Groups	No of Pupils	Mean	SD	t test	Level of Significance
CMM	39	19.37	6.33	1.77	Not Significant
AOM	40	16.25	4.96		

The value of Critical Ratio obtained is 1.77 which is not significant (C.R=1.77:P>0.05).This shows that there is no significant difference between the means of the pre-test scores of pupils in the Experimental (CMM) and Control groups. Therefore the two groups do not differ significantly in their performance

IV Comparison of Post-test scores of pupils in the Experimental and Control groups (CMM and AOM)

The post-test scores of the Experimental and Control groups were classified and calculated Arithmetic and Standard deviation. The difference between the mean scores of the two groups was tested for significance by finding the critical ratio. The data and results of test of significance are given in Table 4

Table 4: Data and Results of Test of significance of the Post-test scores ofpupils in the Experimental (CMM) and Control groups (AOM)

Groups	No of Pupils	Mean	SD	t test	Level of Significance
CMM	39	42.12	7.38	8.02	Significant at 0.01 level
AOM	40	29.43	7.05		

The obtained value of Critical Ratio is highly significant (C.R=8.02,P<0.01).This indicate that, there is significant difference between the means of post-test score of the two groups learned through Concept Mapping Method and Activity Oriented Method of teaching. Since the mean score of the pupils who learned through CMM is higher than the pupils who learned through Activity Oriented Method, the Concept Mapping Method is better than the Activity Oriented Method in the teaching of Biology.

V Comparison of Pre-test and Post-test scores of pupils in the Experimental group (CMM)

Table 5: Data and Results of Test of significance of the pre-test and post-test scores of pupils in the experimental group (CMM)

Groups	No of Pupils	Mean	SD	t test	Level of Significance
Pre-test	39	19.37	6.33	14.81	Significant at 0.01 level
Post-test	39	42.12	7.38		

The obtained value of Critical ratio is highly significant (C.R=14.81;P<0.01).This indicates that, there is significant difference between the means of Pre-test and Post-test scores of the Experimental group before and after teaching through Concept Mapping Method

Major Findings of the Study

1. The pretest scores of pupils in the Experimental (CMM)groupand Control group(AOM) group showed that, both the groups were almost similar in their achievement in Biology.(Mean for CMM=19.37;Mean for AOM=16.23;cr=1.77:P>0.05)
2. The comparison of means of Post-test scores of pupils in the CMM and AOM groups showed that there is significant difference in the performance of the two groups after the experiment,(Mean for CMM=42.12,Meanfor AOM=29.45;C.R=8.02;P>0.01.The results revealed that the Experimental group (CMM)was found superior to the control group(AOM)in the Post-test achievement in biology

According to the study, biological topics taught to students using Concept mapping outperformed those taught by Activity Oriented Method. It follows that there were notable differences in the students' performance according to the study's instructional strategies. This result is consistent with that of Akeju, Simpson, Rotimi, and Kenni (2011), who discovered a substantial difference with respect to the Experimental and Control groups, favouring the idea mapping group. As a useful teaching aid for biology, Dhaaka (2012) suggested idea mapping. Likewise, Yezka and Nasrabadi (2004) asserted that the Concept Mapping Method fosters both students' academic success and meaningful learning.

Conclusions Based on the Study

- From the above findings, it is clear that the use of Concept Mapping Method is more effective in enhancing achievement in biology as compared with the prevailing method.
- The teaching using Concept Mapping Method enables the teacher in grabbing the attention of the students for longer period of time compared to conventional ways of teaching.
- Concept Mapping Method help children to understand the various processes involved in scientific method.
- According to this study, the Concept Mapping Method helps pupils succeed academically in biology. Accomplishment in school does not equate to knowing enough to pass tests; rather, it refers to developing a deep comprehension of the subjects covered in class.

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