

The Effect of Using Concept Mapping in Teaching on the Achievement of Fifth Graders in Science

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ABSTRACT This study investigates the effect of using the concept mapping strategy in teaching on the achievement of fifth graders in science. To achieve this goal, eighty students were randomly selected then divided in to two groups: - an experimental group was taught by using concept mapping, and control group was taught by traditional method. Data were collected using the following two instruments:-a number of teaching situations which planned by concept map and achievement scale of (25) items. To answer the questions of the study, analysis of variance were used. The study shows that using the concept map shows greater effect on academic achievement. The researcher recommended that should be used the concept mapping in science teaching and more studies should be conducted about the effect of this method including other instructional variables.

INTRODUCTION

Teachers are always looking for innovative ways and instructional methods to help students improve their outcomes in subject matter materials. Effective instruction is often designed based on learning theories. Many researchers have voiced their concern about the pedagogical effectiveness of education software which are available and the importance of integrating learning theories in instruction.

Ausubel's learning theory is one important cognitive theory which emphasizes meaningful learning. Ausubel (1968) proposed that meaningful learning occurs when new knowledge is consciously linked to relevant concepts possessed by learner based on the learning Ausubel's theory.

Concept maps were first suggested by Joseph Novak, who has studied the education field as an aid for learners to increase understanding (Richardson 2005). The strategy was born out of the constructivist theory of learning which holds that the learner constructs or builds his own knowledge as opposed to the previous one (Basso and Margarita 2004).

Ausbels advocates the use of the advanced organizer which is based on the idea that the teacher is given a short description to the new material before the lesson to prepare the student to accept the new material (Reece and Walker 2003).

Concept map is visualized through a graphical representation. Concepts are usually depicted by

circles or boxes, forming the nodes of the new work by labeled links (Buzzetto and More 2007).

Juall and Moyet (2005) maintain that concept maps are an educational technique that uses diagrams to demonstrate the relation of one concept or situation, by linking a central concept to another one, to another one, to help the learners to understand the central concept better. So concept maps are presented as a pyramids seen from above and they are arranged hierarchically with the super ordinate concept at the top of the map and subordinate at the bottom which are less inclusive than higher ones (Ahlberg and Vukko 2004).

Novak and Canas (2006) see that concept maps are graphical tools for organizing and representing knowledge. They include concepts closed in circles or boxes of some types and relationships between concepts indicated by connecting or linking two concepts or words on the line, referred to as linking words or linking phrase .

The advantages of the concept maps are:-

1. Concept maps can be used as advanced organizer to improve learner's achievement (Kommers 2004) .
2. Provide teachers with a meaningful and practical structured approach
3. Aid the development of deep meaningful teaching moving towards critical thinking rather than surface approaches
4. Concept maps also allow students to reflect their own misunderstanding and take ownership of their learning (Fitzgeraled 2006)

5. Organize their thoughts and visualize the relationships between the key concepts in a semantic way (Pill 2005).

Novak (1998) mentioned that the process of concept mapping can reduce the need for rote memory and make learning more meaningful Johnston and Otis (2006) suggested that concept mapping should be treated as very personal learning tools .

There were many studies dealt with in this field. Esiobu and Soyibo (2006) investigated the efficiency of concept and Vee mapping in achievement in ecology and genetics. Total of 808 tenth grade students were involved in the study. The results showed that the experiment is better than the control group.

Boujaouda and Attieh (2008) conducted a study about the effect of using concept maps as study tools on achievement in chemistry. The results showed that the female achieved higher scores than male on chemistry tests.

Candan (2006) investigated the effect of concept mapping on primary school students' understanding of the concepts of force and motion, the result showed that there was significant difference between the means scores of experimental and control group and no difference between genders.

In the study of Willerman and Harg (2006) which aimed to determine if concept map used as an advanced organizer can improve the science achievement of eighth-grade students, Eighty two (82) students in four science classes participated in this study, two classes as experimental. The result showed that concept map can provide the classroom teacher with meaningful and practical structured approach for using advance organizers in their classes.

Nicoll et al. (2001) investigated the effect of construction of concept maps on freshman chemistry students' achievement and the ability to link concepts. Positive results were achieved for both variables

Qais (2006) examined the effect of concept mapping on the science achievement of sixth-grade. Research findings revealed that there were statistically significant differences between the scores of the experimental group and those of control group regarding the use of concept maps.

It could be noticed that all the previous studies indicated the effectiveness of the concept maps in instruction .

The problem of the study emerged from the

fact that many students try to learn science, but they are often unsuccessful in there learning. It seems that many of them do not construct appropriate understandings of fundamental science concepts throughout their educational experiences, and it is known that students show a negative attitude toward science, and students have difficulties in perceiving science topics which contain isolated concepts (Cavas 2000). Research has shown that many students lack the necessary knowledge and skills in science and technology to function in the modern world (American Association for the Advancement of Science-AAAS 1989)

This study aims at investigating the effect of using the concept mapping method in teaching on the academic achievement of fifth grade in science (FGS) by comparing the scores of tests of the two groups, one was taught by concept mapping and the other was taught by traditional method.

The study attempts to answer the question:

Is there any effect the using concept map method in teaching on the academic achievement of fifth grader in science (FGS)?

METHODOLOGY

The sample consisted of eighty (80) fifth grader from four groups at Tafila public schools in south of Jordan were randomly selected and divided in to two groups: - an experimental group (male = 20, female = 20) taught by using concept mapping, and control group (male = 20, female = 20) taught by using the traditional method.

Instruments

The data are collected by using the two instruments:

1. Concept mapping for two main concepts:-

A. Water: symbolic, components, uses, states, evaporation, condensation, freezing, etc

B. Matter: definition , states , shapes , volume, mass, the following steps of concept mapping for (a+b) are :- preparation, generation of statements, (Structuring of statements, Representation of statements, Interpretation of maps , utilization of maps) appendix (A) presents examples of the concept maps .

2. Achievement test

The dependent variable in this study is the

students' science achievement, the test was used to measure the students' achievement at the end of the study

The achievement test was constructed by the researcher; twenty five short answer items fill in the space, each question is out of one mark, the total is 25 marks.

To check the validity (the test has a content validity if it measures knowledge of content domain of which it was designed to measure knowledge) to make sure that the items were at the different levels of Blooms Taxonomy. Three curricula and instructional faculty members, two science supervisors and three science teachers were asked to check the validity items, based on their suggestions, some items were modified.

The researcher assured the reliability – reliability refers to the degree to which a test is consistent and stable in measuring what it is intended to measure – by using test re-test and it was 0.81 . (Appendix B presents examples of the questions used in achievement test).

Data Analysis

This study takes into account the following variables:

Independent variables:

1. Gender with levels (male and female)
2. Teaching method with levels (concept mapping and traditional)

Dependent variable:

Students Achievement

The researcher used the statistical package of social science (spss) means, standard deviation, and Two – Way ANOVA.

Procedure

The treatment took place during October and November in the first term of the school year 2008/2009. The study extended over eight weeks, the materials covered are water and matter. At the end of the treatment period, the students were - tested (Appendix), A different teacher taught each section ,One of them taught the experimental group in which students were trained to construct concept maps , the other taught the control group

in which students covered the same chemistry content.

RESULTS

The researcher used the science grades students' from previous class to compare the students levels, table 1 shows means and standard deviations (Sd) of the scores used in the study for the control and experimental groups. The means of experimental group was sixty (60) and Sd 16.6 while the mean for control group was fifty six (56) and Sd 17.6, out of maximum possible score of 100. A t-test for independent samples showed that there were no significant differences between the two groups.

Because there are no significant differences between two the groups , it is assumed that the two groups are equivalent means.

Table 2 presents the means and standard deviation of the achievement test results for the control and experimental groups.

Students in the experimental group taught with the concept maps, show greater achievement than the students in the control group taught with the traditional method. For example according to the achievement test, the mean of experimental group 14.96 but that of control group 13.13.

A two-way analysis test was carried out to test whether the experimental and control groups differed significantly on the test achievement in science as shown in table 3 .

Table 2: Means and standard deviations of the variables used in the study for the control and experimental groups

<i>Variables</i>	<i>Group and sex</i>	<i>Scores</i>
Mean	Experimental (males)	14.39
	Experimental (females)	15.57
	Experimental (males and females)	14.96
	Control (males)	13.33
	Control (females)	12.92
	Control (males and females)	13.13
Standard Deviation	Experimental (males)	14.98
	Experimental (females)	14.44
	Experimental (males and females)	14.73
	Control (males)	14.28
	Control (females)	14.47
	Control (males and females)	14.35

Table 1: Means and Standard Deviations and t-test of the scores of previous class

<i>Groups</i>	<i>Means</i>	<i>Standard Deviation</i>	<i>T - test</i>	<i>F</i>
Experimental	60	16.6	1.132	0.262
Control	56	17.6		

Table 3: The analysis of variance for group-sex interactions in the science achievement test

Source	SS	df	MS	F
Group	125.4	1	125.4	0.015*
Gender	5.250	1	5.25	0.617
Gen x gro	22.98	1	22.9	0.29

An independent two-way analysis shows that there was a statistically significant difference between the mean scores of experimental and control group, ($F = 0.015$, $p < 0.05$). On the other hand, there was no statistically significant difference observed between male and female students based on the post-test results ($F=0.617$, $P < 0.05$), and there is no significant interaction between group and gender.

DISCUSSION

There were statistically significant differences in achievement of (FGS between the experimental group and the control one due to the method in favor of concept maps strategy, this result agrees with the results of almost all the previous studies like Esiobu and Soyibo (2006), Boujaouda and Attieh (2008), Candan (2006), Novak (1998) mentioned with regard to the concept maps' strategy, in addition to what (Fitzgerald 2006), (Kommers 2004) revealed, another result of this study is that there is no statistically significant difference observed between genders, This result agrees with Candan (2006), but it is incongruous with Boujaouda and Attieh (2008).

CONCLUSION

The results show that the experimental group achievement –which was taught by concept map method is significantly better than the achievement of control group. Using the concept map method has a greater effect on the academic achievement of the fifth graders than that of the traditional method.

The results of the study support using concept mapping as a teaching tool to engage the students in constructing and altering their own knowledge structures.

Students indicate that the concept mapping can help students to understand, integrate concepts and also enhance their interests in learning

Concept mapping encourages the participant group to stay in task, with its pictorial repre-

sentation and its participant-oriented features. Concept mapping can be a powerful method to organize complex problems.

RECOMMENDATIONS

Finally, the study recommends the use of concept mapping in teaching scientific concepts and designing instructional software. More researches should be conducted to test further effects of concept mapping as instructional method with a larger number of students, in different types of schools, and for different age groups.

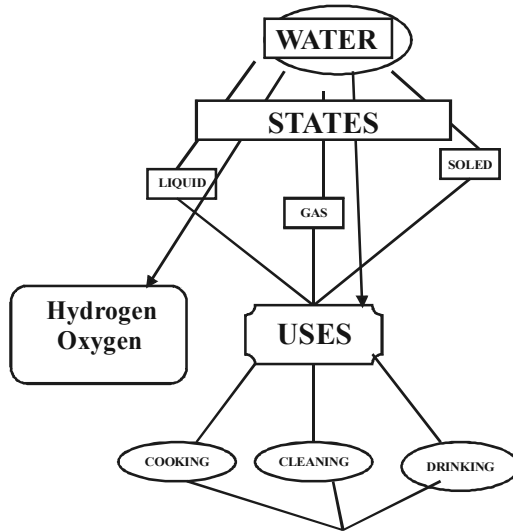
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APPENDIX - A

Example of concept maps

**APPENDIX - B**Example of items
Complete each sentences

- Matter with definite shape or volume is _____.
- The amount of space an object takes up is its _____.
- If matter has a definite volume, but no definite shape, it is in a _____ state.
- Matter with a definite shape and volume is a _____.
- The amount of matter in an object is its _____.
- All matter is made up of _____.
- Size and color are examples of _____.
- Anything that has mass and volume is _____.
- Symbolic of water is _____.
- The components of water are _____ and _____.
- The _____ heats the water in the _____ (or other large body of water).
- The uses of water _____ and, _____.
- Water vapor emitted from plant leaves is called _____.
- Water vapor cools and _____ on tiny dust particles in the air.
- _____ comes from clouds in the form of rain.
- Groundwater _____ streams.