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Influence of using the strategy of concept maps in learning fractions

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Abstract

This paper is about concept maps and how they can assist in the learning of concepts of mathematics. First the paper presents the theoretical background and working definitions for concept maps. Then this study examines the impact of using concept maps in learning of fractions. Results of this study indicated that using this strategy was effective in learning of fractions for fourth-grade students. This result confirms the effectiveness of the strategy of concept maps in teaching because it includes activities that link the concepts to help students understand new concepts and link them to previous ones.

Keywords:Concept maps, Fraction, Learning, Mathematics education.

Introduction

One of the modern trends in teaching is the use of teaching strategies conducive to learning with meaning and knowledge by linking new concepts pertinent to old ones. In addition to the evolution witnessed in the modern world, Novak [1] has developed the idea of the hierarchical concepts based on Oozbil's theory which goes that the student stores new information under higher and more comprehensive concepts called Concept Maps. Some studies have demonstrated that concept maps yield positive results when used for all levels of students' achievements as well as for students with learning difficulties [2, 3, 4, and 5]. Concept maps facilitate the storage and retrieval

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when needed in the form of a single image, and they are better than dispersed ideas and discrete concepts which are not linked to a specific map. Educators and researchers reported that there is a relationship between students' specializations and the ways of writing the concept maps [6]. It is beneficial here to present the theoretical basis for the concept maps and their importance, use and design and, more importantly, how to grade them by reviewing the standards known for grading.
Concept maps are diagrams that show relationships between concepts as a branch of knowledge, which may consist of one or two dimensions. Considering the theoretical background for concept maps, we find that it is derived from Oozbilś theory (learning with meaning) and is considered as an input to it.
Furthermore, it is one of the major theories that have affected the curriculum and teaching methods as well as those scholars concerned with the learner's prior knowledge and the integration of the learner's new information into prior knowledge, which helps in retaining information for a long period of time. These results constitute the foundation of Novak's [1] of concept maps and the two dimensional representations of the relations between concept expressed in hierarchical sequence of the names of concepts and the words that connect them. Concept maps can be used as an assessment tool to evaluate what the student has learned and as a diagnostic tool for assessing student learning. As Bolte [7] explained there are several uses of concept maps in teaching mathematics. It can be used as a diagnostic tool at the beginning of the school year to assess the students' previous knowledge before teaching. It can also be used as teaching method during the presentation of the lesson to ensure the correct building of concepts and their interrelationships with each other. Furthermore, the strategy can be used as an evaluative method by introducing a project for all academic concepts studied in the unit or chapter. Bolte also stressed the importance of using the map as a way to introduce a topic in math. As the most important pillars of the educational process are the teacher and learner, Chiou [8] stated that this strategy is important for the because it links the new concepts with the old ones in the previous structure enables him/her to understand the difference between core information and marginal information and. Hence, select appropriate example to illustrate the concept.
In addition, the strategy is important in making the learner an attentive listener who actively classifies and arranges concepts rather than merely receives information. Furthermore, educators capitalize on this strategy as a way to increase the academic achievement of students [4]. Wilcox and Sahleff [9] pointed out the importance of helping learners to choose appropriate activities and examples for the new concept in the future both in the classroom work or homework, which constitutes one of the important means to assist in learning. Moreover, the strategy helps the teacher to assess students' understanding of the organizational structure being studied and pinpoint the misunderstanding in order to correct it. Finally, the strategy helps to provide a classroom atmosphere in which learners are actively engaged in group discussions, which enables the teacher to achieve higher cognitive levels of Bloom's taxonomy. Novak [1] have detailed the steps of building the concept map as follows:

1. Select the item or topic for which the concept maps to be drawn, like a certain text or a paragraph, etc.
2. Choose the keywords or phrases that contain objects or events, through close reading of the lesson.
3. Prepare a list of the important concepts, arranged in descending order according to the general and abstract.
4. Design the map by arranging the concepts according the general.
5. Link the interrelated concepts by using lines and give names for each line by using the certain from of preposition or adjective.

From this review of previous literature, a number of conclusions can be drawn as follows:

- The use of strategy of concept maps as an evaluative tool, a teaching strategy or a corrective method in homework helps students in understanding new concepts.
- The use of the strategy of concept maps develops the capacity of link new concepts with previous ones.

As it was said in the introductory section of this paper, in spite of relative long history of researches dealing with this topic, this study aims to explore the effect of the use of the strategy of concept maps on the students' achievements mathematics of fourth grade normal students and those with learning difficulties in Arak schools when teaching the "fractions".

So the main aim of research is:
"How effective is the use of the strategy of concept maps on the level of achievement of normal students and students with learning difficulties when teaching the fractions?"

The Study Procedural Terminology

Concept Map

It is a two-dimensional diagram which shows the sequential relations between the concepts of a branch of knowledge derived from the conceptual construction of this branch of knowledge.

The traditional method

the teaching method used in most schools, in which the educational process focuses on the teacher and the academic content more than student, according to the way

in which the content is presented in the textbook. This method is often based on explanation and illustration and the use of the teaching aides available.

Normal students

The students who are enrolled in public school and aged between 9-10 years old. They don't suffer from learning difficulties which impede their learning of school subjects. Students with learning difficulties: It is a baffling. Children who suffer these difficulties have capabilities that would eclipse certain weaknesses in their performance. They seem normal and quite intelligent. They have no physical defects which might suggest that they differ from other children.

Method

The present study uses the experimental approach with a pre-test and post-test. According to this approach there are two equal groups in terms of all variables.
One of these groups is the control group which is taught using the traditional method, and the other is the experimental group.
The publication of the study consisted of all male and female normal students and those with learning difficulties who are registered in Arak public schools. The ample of this was randomly selected. It consisted of 196 fourth grade students.
A mathematics achievement test was prepared to measure student achievement in fractions. The test included the content of the unit that was taught to the sample of the study which consisted of fourth grades. The test was prepared in accordance with test procedures followed in the design of achievement tests. The validity of content was verified by a group of specialists teaching mathematics, and the required amendments were made after that. In its final from, the test consisted of 23 multiple-choice, with four choices for each question. The test was reviewed by a group of specialists in teaching mathematics to verify its content validity, and then amendments were made by rephrasing some of the questions to make sure they are suitable for fourth graders. The researcher also verified the validity of the test statistically by using the internal consistency criterion which is concerned with the relatedness of test vocabulary to each other.
The test was administered to the same to verify its stability.
Reliability was calculated using the Test-Retest method on a sample of 19 students. The researcher gave the test to the students and then retested them after two weeks until stability coefficient reached 0.87.

Table 1:

Sample	Control Groups		Experimental		T-Test Value	Significance Level
	Mean	SD	Mean	SD		
(I)	3.21	1.93	3.28	1.62	0.13	0.897
(III)	3.23	1.70	3.26	1.89	0.08	0.939
(II)	3.10	1.79	3.19	1.97	0.16	0.870
(IV)	3.41	1.47	3.35	1.90	0.12	0.904

Results and Discussion

The aim of research: "The use of the strategy of concept maps in teaching the fractions for fourth grade normal students and students with learning difficulties is effective in increasing the students' achievements among those students in understanding the fractions.
To test this problem, the researcher conducted four comparisons to investigate, which are:
1. Finding out the differences between the experimental groups and control groups in the pretest to ensure that the groups are equal in their level of students' achievements of the fraction unit before using the strategy concept maps with students of the experimental groups.
In this item, the researcher used the t-test for independent samples to examine the differences between both the experimental group and control group in the corresponding level of student achievement in fractions.
The test showed there were no statistically significant differences between of the experimental groups and control groups in the pretest of fractions. (Normal males: $T(55) = .13, p = 0897$, normal female students: $T(40) = .16$, $p = .870$, male students with learning difficulties: $T(50) = .80, p = .939$, female students with learning difficulties: $T(43) = .12$, $p = .904$). These results have shown in Table 1, where
(I). Normal males students
(II). Normal males students
(III). Male students with learning difficulties
(IV). Female students with learning difficulties

2. Finding out the differences between the pretest and posttest for experimental and control groups individually, to identify the change in the achievement of students in these groups on fractions unit after teaching the unit.
In this item, the researcher separated students of the experimental group from students of the control group, and then the researcher administered the non-independent Paired samples t-Test for each group separately, to find out the differences between the performance of students in the pretest and posttest on the unit of fractions.
The test results showed that there were statistically significant differences in the average of total score the test on the unit of fractions between the pretest and post test for all the experimental groups in favor of the performance on the post test (normal male students: $T(28) = 20.41, p < .001$, normal female students: $T(20) = 11.10, p < .001$,

Table 2:

Group	Group Type	Pretest		Posttest		T-Test Value	Significance Level
		Mean	SD	Mean	SD		
Control Group	(I)	3.21	1.93	7.11	3.21	5.98	0.001
	(II)	3.10	1.79	7.62	3.28	6.38	0.001
	(III)	3.23	1.70	5.85	2.57	4.62	0.001
	(IV)	3.41	1.47	5.83	2.98	2.95	0.008
Experimental Group	(I)	3.28	1.62	10.83	1.26	20.41	0.001
	(II)	3.19	1.97	9.95	1.88	12.34	0.001
	(III)	3.27	1.89	9.08	2.06	11.10	0.001
	(IV)	3.35	1.90	7.91	3.80	4.95	0.001

Table 3:

Sample	Control Groups		Experimental		T-Test Value	Significance Level
	Mean	SD	Mean	SD		
(I)	7.12	3.21	10.83	1.26	5.80	0.001
(III)	7.62	3.29	9.95	1.88	2.83	0.007
(II)	5.85	2.57	9.08	2.06	5.00	0.001
(IV)	5.73	2.98	7.91	3.80	2.14	0.038

male students with learning difficulties: $T(25) = 12.34, p < .001$, and female with learning difficulties: $T(22) = 4.95, p < .001$).

Results also showed that there were significant differences in the average total score for the test on the unit of fractions between pretest for all the control groups in the favor of the performance on the posttest (normal male students: $T(27) = 5.98, p < .001$, normal female students: $T(20) = 6.38, p < .001$, male students with learning difficulties: $T(25) = 4.62, p < .001$ female students with learning difficulties: $T(21) = 2.95, p = .008$).

These results indicated that students in all experimental groups and control groups increased their performance in the achievement test on the unit of fractions after the unit was taught to them. See Table (2). **3.** Finding out the differences between the experimental groups and control groups in the posttest to identify the differences among such groups in the final achievement of the fraction unit after teaching the experimental groups using the strategy of concept maps and teaching the control groups using the traditional method. In this item, the researcher used the t - test Independent Samples t - Test to examine the differences between the experimental group and control group in the corresponding level of student achievement in the post test on the unit fractions. Results showed that there were statistically significant differences between the experimental group and the control group in the achievement on the posttest of unit of fractions for the benefit of the experimental groups. (Normal male students: $T(55) = 5.80, p < 0.001$, normal female students: $T(40) = 2.83, P = 0.007$, male students with learning difficulties: $T(50) = 6.85, p < 0.001$, female students with difficulties Learning: $T(43) = 2.14, (p = 0.038)$. This indicated that the performance of students on the posttest of the unit of fractions in the experimental groups was better than the performance of their counterparts in the control groups. See Table (3).

Table 4:

Sample	Control Groups		Experimental		T-Test Value	Significance Level
	Mean	SD	Mean	SD		
(I)	3.21	1.93	3.28	1.62	0.13	0.897
(III)	3.23	1.70	3.26	1.89	0.08	0.939
(II)	3.10	1.79	3.19	1.97	0.16	0.870
(IV)	3.41	1.47	3.35	1.90	0.12	0.904

4. Finding the differences in the degree of positive change (increase of academic achievement of the fractions unit) that occurred among students of the experimental group and those of control group, in order to verify the effectiveness of using concept maps to increase academic achievement of fractions.
Due to the fact that there was a positive change among students of the experimental groups and the control groups seen in the increase of their performance on the unit of fractions, which is attributed to effectiveness of the traditional method used with the control groups and of the strategy of concept maps used with the experimental groups, the researcher examined the degree of improvement in the experimental groups and control groups to verify the effectiveness of teaching using concept maps, and, therefore, the researcher used the (T) Independent Samples t- Test to examine the differences between the experimental group and control group in the corresponding level of improvement on the unit of fractions.
Results showed that there were statistically significant differences between the there experimental groups and the corresponding control groups (normal male students, normal female students, and male students with learning difficulties) in degree of positive change of the experimental groups.
(Normal male students: $T(55) = 4.93, p < 0.001$, normal female students: $T(40) = 2.39, p = 0.021$, male students with learning difficulties: $T(50) = 4.34, , p < 0.001$).
However, there were no statistically significant differences between experimental groups and control groups for female students with learning difficulties: $T(43) = 1.85, p = 0.071$)).
This indicated that using the concept maps in teaching was effective in improving the achievement of normal students as well as male students with learning difficulties, while the strategy was not as effective in improving the performance of female students with learning difficulties for the same unit. See Table (4).

Conclusions

The present study aimed at answering the question concerning the effect using concept maps in teaching on the improvement of the students-Normal students and those with learning difficulties regarding fractions. Finding showed that using the strategy of concept maps in teaching fourth grade students the unit of fractions. Was effective in increasing academic achievement of male and female normal students as well as male students with learning disabilities, While it was not as effective in teaching female students with learning difficulties, because there were no significant differences

when comparing the experimental group with the control group. This confirms the effectiveness of the strategy of concept maps in teaching it includes activities that link the concepts to help students understand new concepts and link them to previous ones [1,7,9,11,12] . As for female students with learning difficulties, the study demonstrated that there were no significant differences between the experimental group and the control group. These results are consistent with the finding of the study by Harton and et al [11], which showed that out of nineteen studies on the effectiveness of the use of concept maps, only one concluded that there was no effect with regard to gender. The paper concludes that, teachers should be urged to use this strategy in teaching various of mathematics. And it is recommendation to preparing pre-service as well as in service training courses for teachers to be updated with the new developments in education and designing educational software of concept maps.

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