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STUDY OF CONCEPT MAPS USAGE EFFECT ON MEANINGFUL LEARNING FRONTIER IN BLOOM'S TAXONOMY FOR ATOMIC STRUCTURE MENTAL CONCEPTS

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Abstract. Ever since it was introduced by Joseph D. Novak, 'concept map' has continued to inspire a wide range of research. Concern with different aspects of this notion continues to stimulate an expanding body of literature, thereby adding new dimensions to the applicability of this framework to different aspects of teaching. The idea of applying this notion, as an originally first one of the kind, grew out of attempts to introduce a new creative method for teaching chemistry. The primary focus was on mental concepts in atomic structures contained in the chemistry textbook for second-grade Iranian high school students. Concept map and concept mapping are the two phenomena that are held to be dominantly involved in learning these structures. Therefore, the study addressed the effect of concept map usage on developing meaningful learning. Results indicated that significant differences between the scores of students who received concept mapping type instruction as opposed to those who didn't. Differences were also observed across genders. We examined meaningful learning frontier in the bloom's taxonomy with designing of the test's questions based on the bloom's taxonomy. Findings from test items based on Bloom's taxonomy suggested that meaningful learning frontier occurs from the application level above in the taxonomy. Implications of this study are expected to contribute to active learning process on the learner's part and pave the way for joint contributions from other fields, broader studies, and more enlightening results.

1 Introduction

Based on the Ausubel meaningful learning theory (Ausubel, 1960) Prof. Joseph D. Novak at Cornell University presented concept map as an instructional technique in the 1980's (Coffey et. al., 2003). According to Novak (1982), concept maps are tools for organizing and representing knowledge (Novak, 2004). Thence the use of concept maps has expanded rapidly since their introduction in the 1970's by Dr. Joseph Novak (Novak and Gowin 1984). Concept maps are two-dimensional, visual representations of the relationships between concepts representing individual knowledge, collaborative group consensus, and corporate memories (Cañas, Hill et al. 2004; Coffey, Eskridge et al. 2004).

From the beginning of genesis of concept map idea up to now, many researcher have been performed about efficacy of using this idea as an active education strategy, so that up to the present time, different dimensions of its use have been revealed.

Unfortunately, no step had been taken to use this educational strategy in the education system of us country before doing the research. For this reason, we decided to express dimensions of concept maps and the efficacy of its usage in increasing the educational achievement grades of students in an applied research, and also draw in sciences education; meantime, we are going to detect the new dimensions of its use.

For this reason, in one applied research with semi-empirical method by designing an operational teaching model on the basis of concept map, we have examined the efficacy of using this idea in learning the abstract concepts the atom structure unite for the first time in Iran.

2 Theoretical Framework

Our group Theoretical Framework based on this question that:" can the usage of concept map in teaching-learning process be effective for accessing learners to bloom's taxonomy levels and determine a definite frontier between these levels? (high order thinking skill). One way to describes high order thinking skill is using Bloom's taxonomy, the well known instructional model developed by Benjamin Bloom.

In 1956, Benjamin Bloom (Bloom, 1956) headed a group of educational psychologists who developed a classification of levels of intellectual behavior important in learning. Bloom identified six levels within the cognitive domain, from the simple recall or recognition of facts, as the lowest level, through increasingly more complex and abstract mental levels, to the highest order which is classified as evaluation. It categorizes thinking skills from the concrete to the abstract—knowledge, comprehension, application, analysis, synthesis, evaluation. The ones considered higher-order skills are analysis, synthesis, and evaluation.

3 Methodology

The present research was performed in ninety-minute sessions based upon the design of concept map in classes of experiment group. The methodology was similar in each four classes and teachers used the concept map as an advance organizer before teaching on the basis of one similar model, and they expressed concepts and relationship between them while designing different questions. In next stage, the course was presented in form of simultaneous use of concept map and teaching. At the end teaching the concept maps presented were summarized and integrated for learners by the use of concept map. Finally, the students were asked to present the lesson by choosing a number of concepts from presented lesson that they draw the concept map of these concepts individually. Yet, they could complete their work by using the software Inspiration8 at home and discuss about it with teacher and their friends in determined groups by web. In order to practice a collaborative concept mapping, in this manner, they made the framework of their mind themselves. After finishing the session of research performance the skill of experiment groups students in concept mapping had increased significantly compared to the beginning of research in such a way that they expressed to use this method in order to learn the concepts of their own lessons and also suggested their friends using it (see in bottom figures)

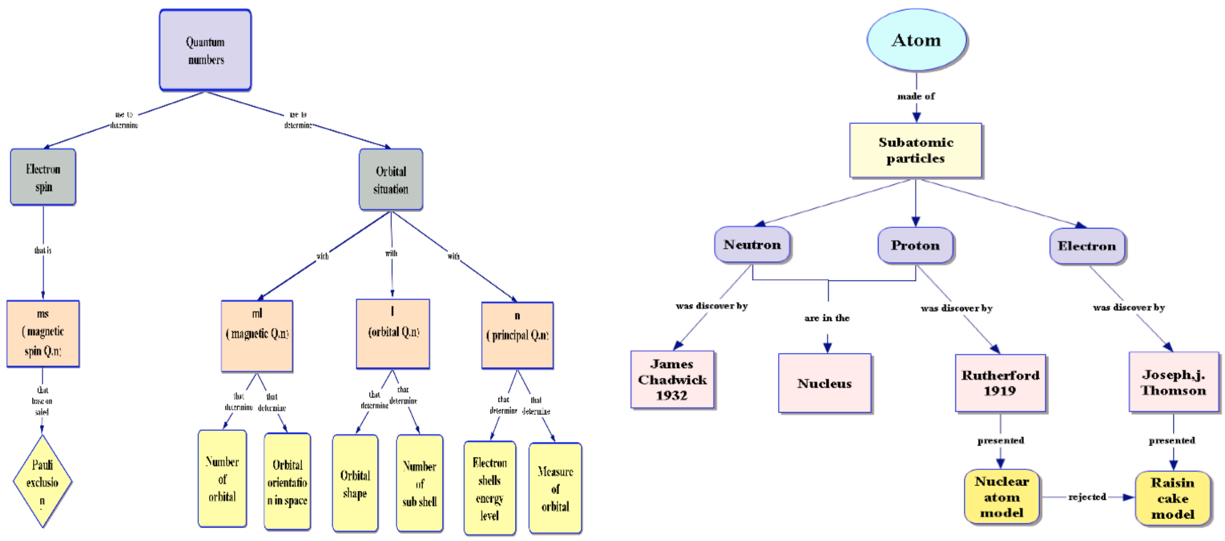

Figure 1.concept maps was provision by experiment group

4 Evaluation tools

The pre- Test and post- Test with similar question were used. They are designed according bloom's taxonomy levels. Samples of these questions are presented in table 1.

Sample of experiment group Questions	Level of bloom taxonomy
1. from which area possibility of electron are more than other area? a) The level of energy b) Orbital c) The electron's layer d) The electron sublayer	knowledge
2. The **nd** sublayer with.......electrons and the **np** sublayer with ......electrons are fulled? a)10-6 b) 6-10 c) 6-6 d) 10-10	comprehension
3. The pauli exclusion's principle according to which quantum's numbers are state? a) m_l b) L c) m_s d) n	analysis
4. which of the below sets are belonged to specified electron in the following orbital which are placed in the second sublayer? n=2, L=2, m_s=-1/2 b) n=3,L=1,m_s=+1/2 b) n=2, L=1,m_s=+1/2 d) n=3, L=2, m_s=-1/2 p_x p_y p_z	synthesis
5. The **magnetic's quantum's number** for a electron is **+1** ,so which of the following case is possible for this electron? a) n=1 b) m_s=-1/2 c) Exist in **p** layer d) L=3	evaluation
6. the **p** sublayer has ....the same level of orbital energy,that are different in their quantities......... a) 5- m_l b) 3- L c) 5 – L d) 3- m_l	application

Table 1. Sample of experiment group Questions

5 Results and discussion

According our results, the efficacy of using concept maps to increase the achievement test grades of students in experiment groups compared to control groups are observed. In order to, the independent T test method was used (table 2).

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
POS_PER	Equal variances assumed	4.595	.034	-5.008	163	0.000	-2.61	0.52	-3.63	-1.58
	Equal variances not assumed			-5.054	160.151	0.000	-2.61	0.52	-3.62	-1.59

Table 2. Independent T test of the means of grades of difference the post-Test from pre-Test

The obtained results are intended to verification of first question of research. However , In order to study of the second question (main question of research) that "have the students under the concept maps plans been more successful for access to high bloom's taxonomy levels compared to students of control groups? ". Descriptive statistics of levels means have been presented in table 3. The results of independent T test have also been presented in table 4.

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
Knowledeg	control	87	7.03	.86	9.17E-02
	experiment	82	7.00	.89	9.82E-02
Comprehension	control	87	2.37	.68	7.33E-02
	experiment	82	2.52	.65	7.20E-02
Application	control	87	2.30	.72	7.69E-02
	experiment	82	2.43	.67	7.37E-02
Analysis	control	87	2.21	.82	8.83E-02
	experiment	82	2.60	.65	7.13E-02
Synthesis	control	87	.59	.50	5.31E-02
	experiment	82	.83	.38	4.18E-02
Evaluation	control	87	.90	.75	8.02E-02
	experiment	82	1.71	.58	6.37E-02

Table 3. Descriptive statistics of degree of student's access to bloom levels

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Knowledeg	Equal variances assumed	1.506	.221	.257	167	.797	3.45E-02	.13	-.23	.30
	Equal variances not assumed			.257	165.408	.798	3.45E-02	.13	-.23	.30
Comprehension	Equal variances assumed	.443	.507	-1.521	167	.130	-.16	.10	-.36	4.66E-02
	Equal variances not assumed			-1.523	166.976	.130	-.16	.10	-.36	4.63E-02
Application	Equal variances assumed	.327	.568	-1.199	167	.232	-.13	.11	-.34	8.27E-02
	Equal variances not assumed			-1.202	166.974	.231	-.13	.11	-.34	8.23E-02
Analysis	Equal variances assumed	3.982	.048	-3.420	167	.001	-.39	.11	-.62	-.17
	Equal variances not assumed			-3.444	161.706	.001	-.39	.11	-.61	-.17
Synthesis	Equal variances assumed	50.788	.000	-3.568	167	.000	-.24	6.81E-02	-.38	-.11
	Equal variances not assumed			-3.596	160.269	.000	-.24	6.76E-02	-.38	-.11
Evaluation	Equal variances assumed	5.638	.019	-7.858	167	.000	-.81	.10	-1.01	-.61
	Equal variances not assumed			-7.918	160.851	.000	-.81	.10	-1.01	-.61

Table 4. Independent T test of means of student's access to bloom levels.

As seen in table 4, a meaningful difference is not observed between knowledge, understanding and application levels in control and experiment groups but a meaningful difference is observed in three high levels of bloom's taxonomy, which are analysis, synthesis and evaluation. Thus it can be judged about the frontier between levels.

6 Conclusion

The study of results obtained from the present research showed that the use of concept maps and concept mapping in learning-teaching process causes the increase in the grades of student's achievement test compared to other passive and conventional methods. It also causes the students of experiment groups are more successful than other students under conventional curriculum for the access to high levels of bloom's taxonomy (analysis, synthesis and evaluation). So that the meaningful difference is observed between three low levels and three high levels of bloom's taxonomy and there is a definite frontier between them which confirm students access of experiment groups to meaningful learning intended by the learning psychology of David Ausubel.

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