



Comparison of the Effect of Conceptual Map and Traditional Instruction on Cognitive Learning Levels in the Course of Thinking and Media Literacy

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Abstract

This study aimed to compare the effect of using conceptual map and traditional instruction on cognitive learning of Senior high school students in thinking and media literacy course. This is a quasi-experimental research using experimental and control groups. Three classes were chosen randomly (one for conceptual map teaching, one for the combination of lecture-based and conceptual map teaching (combined) and one as the control group). In the combined group, learners were taught through conceptual mapping while the experimental group was exposed to both teacher-made conceptual map and combined method in eight sessions and the control group experienced traditional instruction. All the three groups completed the teacher-made academic achievement test in both levels of knowledge and high level of thinking. The validity of the instrument measured through S. H. Lawshe formula was 0.78 and the reliability measured through Kuder - Richardson was 0.807. In order to analyze the data, covariance analysis was used. The findings of this study showed that the instruction was not effective at the level of knowledge, but there was a significant difference in the high level of comprehension which means that the highest effect was observed in the lecturing and conceptual mapping group (combined) while the lowest effect was attributed to the control group.

Keywords: Bloom cognitive levels, concept map, meaningful learning, presentation and construction of concept map

Introduction

In today's world, it can be said that education is still one of the most important issues of the day. As new theories flourished in education, educational methods also found their way into classrooms one after another. The goal of educational science activists is to create structures that promote learning and provide answers to questions and problems. Accurate knowledge of learning will help us to choose the best way in the teaching-learning process (Savadpour & Rezaei, 2014, cited in Zamani & Amani, 2019, p. 16). On the other

hand, students are constantly challenged due to the increase in knowledge and the vast amount of information they have to process and learn. When the focus shifts from learning how to read to learning to learn, students are expected to spend more time learning new material from textbooks. Therefore, it is necessary to create a good study method to address these needs (Merchi & Wanker, 2012, cited in Zamani & Amani, 2019, p. 16).

One of the serious needs in today's fast-paced world, where the volume and speed of change and transformation is unprecedented in all human ages, is to shape educational developments and innovations because this can be regarded as one of the most effective areas that enables us to reduce our distance

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from global developments and changes. Unfortunately, in educational institutions, instead of using active teaching methods, too much emphasis is placed on the information accumulation in the mind and the strengthening of memory, as well as the transmission of information and knowledge to the minds of learners. This requires that the teachers use the methods which are different from the methods they have been taught. This means that they need to actively and thoughtfully involve students in the learning process. 'Lecture' is the most common teaching method that educates all learners with the same conditions despite individual differences. In this educational method, the description and explanation of phenomena by the teacher has a major role and is teacher-centered. The main purpose of this method is simply to transfer knowledge (Fathi Azar, 2009; cited in Zarei, 2018, p. 4). On the other hand, the complexity and the problems related to students' learning and behaviors also force teachers to change their teaching and behavior style and seek to improve the quality of teaching. To make this qualification, they use the findings of various humanities sciences and look at their teaching and role with a broader perspective, which has led to the formation of new teaching approaches (Mohammadi, Yar Mohammadi Wasel, Kordnoghabi, & Jamshidi Moghadam, 2015, p. 140).

Thus, in new educational approaches, the transfer of knowledge through the teacher and the book to the pervasive memory and repetition of what has been learned has substituted with the construction of knowledge through meaningful learning. This change has taken place from the replacement of behaviorism with the view of cognitivism, and especially the view of constructivism (Brandzford, 2001, p. 384). Constructivism has been formed as part of the contemporary cognitive movement due to dissatisfaction with traditional education. According to the theory of constructivism, people personally create their own schemas or mind maps. In the new learning, these schemas expand and are revised or reconstructed. Constructivists state that previous knowledge is used as a framework for acquiring new learning, and basically the nature of our thinking and knowledge affects how we learn and what we can learn at all. In constructivist-based teaching methods, students learn meaningfully at high level (Wena, Tsai, Link, & Chang, 2004, p. 239).

Potelle and Rouet (2003), along with other methods of measuring the level of knowledge and understanding of their subjects, used the method of drawing a concept map for educational content. When students prepare a concept map of a topic, they find

that there are many possible connections between the concepts, so that they have a mental challenge in choosing these concepts and expressing the relationships between them. Such a process involves what Bloom (1989) called "high-level cognitive functions". In preparing the concept map, high-level cognitive functions such as analysis, composition and evaluation are constantly used. This shows how a concept map can be considered as a powerful evaluation tool.

This comparison refers to high level cognitive goals of Bloom. Therefore, in Bloom's classification, educational goals are first divided into three general categories as cognitive domain, emotional domain, and psych-motor domain, and each of these domains includes a number of classes. In this section, we only describe the cognitive domain. The cognitive domain encompasses knowledge, information, abilities, and mental skills. In other words, cognitive domain goals refer to issues that engage with mental and intellectual activities such as memorizing and understanding, reasoning and judging. Considering the relevance and the importance of cognitive levels, they can be classified as:

Knowledge: Knowledge involves recalling the detailed and general issues related to methods, processes, patterns, structures, or situations.

Comprehension: It means understanding the material through which one finds out what the main purpose of the material is. Understanding is a step above knowledge because in knowledge the learner is simply asked to learn what he has already learned without interference, but in understanding, the learner must understand them in addition to memorizing the material.

Application: Using abstract content, general ideas, executive rules, general methods in special and objective situations such as the ability to use the principles and rules of learning in classroom teaching; using mathematical formulas.

Analysis: The breaking of an issue or subject into its components or constituent elements so that the hierarchy of ideas is clearly shown and the relationships between unstated ideas are identified, such as the analysis of the relationships in a subject.

Combination: Putting together elements and components to create a unified whole and produce a design or structure that did not previously exist in its current form. Combination is the mental activity known as creativity like producing a unique work, or producing a map.

Evaluation: Judging the value of the content and issues for specific purposes. Judgment based on internal evidence such as the ability to show the

logical mistakes of a discussion and also on the basis of external criteria such as the ability to compare a work with the best known criteria in that work (Seif, 2015, pp. 458-463).

On the other hand, concept map is one of the educational strategies and a subset of organizational strategies, which is closely related to the philosophy of constructivism, and can also facilitate meaningful learning (Sun, 2004, p. 165). Conceptual mapping is one of the most active teaching methods that can help teachers cultivate creative and thoughtful students. The theoretical framework of the concept map is based on Azubel's meaningful learning. According to him, learning occurs when the learner is able to organize and relate new concepts and information to his or her mental cognitive structures. Based on Azubel's theory of meaningful learning, Novak and Guin developed the conceptual map teaching method. A concept map is a visual representation of the meaningful relationships between concepts. A concept map consists of cores and relationships. In nodes, it is a concept, phrase, or question that connects to other nodes through the relationships. The linking lines between the nuclei may represent relations such as the relation of similarity (synonymy of the two concepts), the relation of characterization (defining the hierarchy) and composition (representing the parts and components of the concept) (Sun, 2004, p. 164). Concept maps are usually prepared in a hierarchical manner, that is, more general and comprehensive content is placed at the top, and the closer we get to the bottom, the more detailed the concepts and content (Novak, 2010, p. 279).

Azubel's theory of meaningful verbal learning: In the 1960s, David Azubel proposed his theory of meaningful learning. One of the key concepts that Azubel mentioned in his theory is cognitive changes that take place through learning, form the basis of learning. In this theory, constructivism refers to the general knowledge of the individual in a specific scientific and educational field. The cognitive construction of each individual is like a hypothetical pyramid in which more general and general concepts are placed at the top of the pyramid, and the closer we get to the bottom, the more detailed the concepts become. Thus, in the learner's mind, an organization of cognition is formed, which Azubel called cognitive construction. Azubel believed that if new theories are related to existing concepts and propositions in learner's cognitive construction, they are learned and maintained efficiently. If the new material conflicts with the existing cognitive structure, the presented material will not be understood and learned. In his view, meaning arises when the learner is able to

actively interpret experiences and relate them to his or her cognitive construction. Azubel distinguished between "meaningful and parrot-like learning" (Saif, 2015, p. 166). Three conditions are necessary for meaningful learning:

1. The content intended for teaching should be clear and understandable to learners;
2. Homework should potentially be meaningful for the learner; and
3. There should be a connection between what the learner already knows and what is new (Novak & Canas, 2007, p. 30).

Some teachers use concept maps as an educational strategy to create deeper learning in learners. The concept map allows the experience and understanding of the past to be considered when forming a new concept within the conceptual framework. Concept maps are also used in various disciplines as methods of presenting material. They are suitable ways to organize information related to a topic. Concept map shows both teachers and students to pay attention to a number of key ideas when working on learning tasks (Mesrabadi, 2005, p. 14).

Regarding the importance of using a concept map, it can be said that constructivist theory is one of the important frameworks that plays an important role in forming and guiding educational reviews and activities. Although there may be different forms of constructivism, constructivism in general emphasizes that people actively build knowledge, and in the process of construction, social interactions between individuals are of fundamental importance (Tsai, 2000, p. 200). Therefore, in this view, students are encouraged to rely on their personal activities in learning, the previous knowledge is considered and sometimes even criticized, and the interaction between students and the teacher is easy; therefore, in constructivist learning environments, students engage in meaningful learning and high-level intellectual skills. At the same time, teachers and learners can benefit from the use of concept maps based on a constructivist perspective as an educational-learning strategy (Mesrabadi, Fathi Azar, & Ostovar, 2009, p. 17).

The results of most studies on the use of concept map by the students have shown that when group members prepare a concept map during a group discussion, a significant increase is observed in learning among group members (Akbakula & Jaged, 1989; Roth, 1992). In their 'Effective Teaching' book, Muijes and Reynolds (2005) introduced a concept map as an effective educational strategy that can be used to create a structure of content in the minds of learners. Since scientific concepts are unorganized, the teacher

must use new and organized methods to teach scientific concepts, not just a scattered list of scientific materials and concepts, and it must be said that the concept map method is appropriate to achieve the goal (organizing the content) (Fellows, 1994).

In summary, research in the field of concept map has shown that education with the help of concept map increases learning, retention and retrieval of information and this leads to a significant increase in learning (Allah Karami, Azad, Babamoradi, & Afshin, 2018; Ashuri et al., 2014; Bardel & Mahmoudi, 2020; Bressonington, Wong, Lam, & Chin, 2017; Canas & Novak, 2008; Chen, Huang, & Chou, 2019; Collins, Brady, & Robert Nyenhuis, 2020; Ghanbari, 2015; Hall & Odanell, 1996; Hassanpour & Sheikhzadeh, 2019; Khajavi & Nahas, 2019; Mesrabadi, Hosseini Nasab, & Fathi Azar, 2009; Mesrabadi & Ostovar, 2009; Radfar & Nakhoda, 2018; Sakio & Vaziri, 2015; Taei, 2015; Watson & Barla, 2016).

In this research, an attempt was made to compare the method of teaching through concept maps with the traditional method in terms of the amount of high-level learning of Bloom. Admittedly, traditional teaching methods, such as teacher-centered classes, are very difficult and costly for in-depth, sustainable education and a large number of learners. In summary, research on traditional methods has shown that this method is less effective than active methods (Jouzai & Sadipour, 2013; Kardan Halvaei, Hatami, & Fathi Azar, 2016; Mesrabadi et al., 2005).

Today, our schools across the country are increasingly in need of reform of teaching methods; minor reforms in current teaching methods do not solve the current problems and shortcomings of school education, so the teaching methods in schools are changing in the direction of these changes. Teachers are looking for the best program to show evidence of the positive effects of new teaching methods on students' academic achievement. Making a concept map is one of the new teaching methods. Concept maps prepared by students themselves are very suitable tools for identifying shortcomings. The students' learning is considered and the teacher recognizes the points that the students did not understand well due to the right and wrong connections in these maps. Undoubtedly, conceptual maps are very powerful tools for learning, learning and evaluating concepts, especially in various scientific topics such as thinking and media literacy course, and its peripheral effects include increasing learning depth, achieving higher levels of cognition and abstract thinking. Concept maps can be drawn both through pen and paper and through advanced computer software. Encouraging students to draw concept maps

leads to engaging their minds with the concepts and logical relationship between them, and this is of great value in the process of teaching and learning and the method of achieving better cognition and metacognition. Therefore, the purpose of this study was to compare the effect of instruction through concept maps and traditional method on high levels of cognitive learning in the course of thinking and media literacy.

Method

The design of the present study was applied in terms of purpose and in terms of the process of a quasi-experimental design with pre-test and post-test with the comparison group.

Participants

The statistical population consisted of all male students of the tenth year of high school in district one of Shiraz in the academic year 1398-1399 including 3494 people. In this study, due to special research limitations in terms of specific conditions for controlling influential variables, administrative issues, satisfaction of participants and the need to keep the effects of the teacher constant, non-probabilistic purposeful sampling type was used. In this method of sampling, the researcher, based on his / her knowledge of the characteristics of the community, non-randomly selected 3 pre-formed classrooms in which 61 students were studying. Then, the three classes experienced different instruction randomly in the form of two experimental groups and a control group: one class experienced a combined method (lecturing and construction of concept map), another class experienced teacher concept map method and the third one was taught through traditional method.

In this study, in order to maximize the homogenization of the experimental and control classes, all three classes were located in the same school and one teacher was teaching in all three classes. Also, the mean scores of the participants in each group were examined and there was no significant difference between the means of the groups. A research method was used to control teacher-related characteristics such as teaching abilities, motivation methods, and willingness to cooperate. Also, due to the similarity of the teacher, efforts have been made to ensure that all three groups have the same conditions in terms of instruction. The researcher-made academic achievement test was also used to measure academic achievement.

Instruments

Academic Progress Test: A teacher-made academic achievement test was used to measure the students' cognitive range. Students' levels of knowledge and high-level comprehension were measured using Bloom criteria. The academic achievement test was prepared by three experienced teachers from the content of chapter one to the beginning of chapter 5 of thinking and media literacy textbook of the tenth grade of high school considering different levels of Bloom's cognitive domain in two parts of knowledge level and level of comprehension.

In order to determine the validity of the academic achievement test, content validity was used. To determine the content validity of the test, considering the method of SH-Lawshe, the judgment of experts on the extent to which the test questions represent the content and objectives of the program were used which amounted to 0.78. In this study, to determine the reliability of the test, 20 students of other classes who had previously passed this course were tested and the value of the test reliability calculated by Kuder-Richardson 20 was 0.807. This value was 0.791 after the test.

Teacher's Concept Map: Concept maps used in the experimental group classes were prepared considering all the conditions of preparation of a good concept map and in consultation with teachers from the chapters of the 'Thinking and Media Literacy' textbook. Maps prepared were used in different parts of the training, such as the pre-training stages (as a pre-organizing tool), the in-training stage (as a content presentation tool) and the post-training stage (as a lesson summary tool).

Procedure

In this study, the participants were divided to two experimental groups (a combined concept map class and a teacher-made concept map class) and a control group. The research process details are explained in the following steps.

1- Preparation stage: In this stage, preparations for the experimental phase were provided. After identifying the samples, the necessary coordination was done and the content was identified and concept maps were prepared for the textbook with the help of the researcher and educational colleagues. Then, during two sessions, the teacher of the experimental classes received the necessary training regarding the objectives of the project and how to teach based on the concept map to implement the mentioned method with the necessary preparation and awareness.

2- Conceptual map preparation stage for the textbook: In this stage, concept maps were prepared for the textbook using Cmap Tools software, version 6.8 and later, it was reviewed by the researcher and three experienced teachers of thinking and media literacy lesson.

3- Execution stage: The present study was performed in 8 session lasting 90-minute in the three classes. During these sessions, learners in one group experienced lecturing, one group experienced both lecturing and construction (combined) and the control group was taught the same educational material simultaneously but in different ways. The details of the implementation in the experimental groups are as follows: In the first experimental group (lecture), before the teaching started, the teacher installed the concept map poster next to the board and used it regularly in all stages of the training. The teacher first asked the learners to look at the concept maps to create a background of the subject in mind. The teacher then summarized the topics with reference to a concept map. At this stage, during the training, the maps were used as a tool for presenting the content, and after the explanations, the position of the presented materials as well as its relationship with other contents in the maps was shown. After the training, concept maps were used as a lesson summary tool. In the combined experimental group, in addition to all the steps described in the lecture group, after the end of the lesson, students were asked to draw the taught material individually and in groups on a piece of paper in the form of a concept map. Also, before drawing the concept map, the learners were taught how to prepare it.

4- Test implementation stage: In this stage, after the training, the experimental and control groups were tested without prior notice.

Findings

Before analyzing the research hypothesis through the analysis of covariance, the assumptions of analysis of covariance were evaluated. The results of the Kolmogorov-Smirnov test confirmed that the data were normal. The results of the Box's and Leven tests also confirmed the assumption of equivalence of covariance matrices and the assumption of equivalence of dependent variable variances.

Research Hypothesis: The use of concept maps is effective in creating meaningful learning (learners achieving high levels of Bloom) in high school students (Shiraz District 1) in thinking and media literacy course compared to the traditional method of instruction.

To test the research hypothesis, the analysis of covariance was used and the results were as follows.

Table 1.

Descriptive Statistics of Knowledge and Comprehension Levels in the Studied Groups

Levels	Groups	Mean	Standard deviation	Number
Knowledge Levels	Combined	6.95	0.83	20
	Teacher-made	7.25	0.64	20
	Control	6.95	0.8	21
Comprehension Levels	Combined	28.1	2.07	20
	Teacher-made	23.05	2.01	20
	Control	20.8	1.63	21

The results of the MBox's test showed that the assumption of homogeneity of the covariance matrix is established ($F = 729, 625, sig = .625$ and $P < .05$). In other words, there is the equivalence of the covariance matrices of the dependent variables between the different groups.

Table 2 shows the results of multivariate tests (Pillais, Lambda Wilkes, Hotelling, and the largest Trace Root). Based on the results of the table, regarding the teaching method, it is observed that the values of F in all 4 tests are at the significance level of $P > .05$. Therefore, there is a significant difference between the groups.

Table 2.

Results of Multivariate Tests

Effect (trace)	Tests	Value criteria	F	Hypothesis freedom degree	Freedom degree of error distribution	Significance level	Shared eta values
Teaching methods	Pillai	0.898	15.218	6	112	0.001	0.449
	Wilk's Lambda	0.182	24.637	6	110	0.001	0.573
	Hotelling	4.053	36.475	6	108	0.001	0.670
	Roy's largest root	3.941	73.941	3	56	0.001	0.798

According to the findings of Table 2, the results show that the independent variable was effective on the dependent variable in all four tests. Given that the results of the Box's and Leven tests confirm the assumption of equality of covariance and variance

matrices, respectively and we can also determine from the square value of the Wilkes lambda test (.573) that the independent variable determines more than 57% of the total variance.

Table 3.

Results of Between-groups Tests

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Squared	Eta
Teaching methods	Knowledge	2.174	2	1.087	2.274	0.112	74	
	Comprehension	580.28	2	290.144	105.026	0.001	787	

The results of Table 3 considering the effects of variables among the participants are the most important results of the multivariate analysis of covariance, which shows that the effect of teaching methods did not make a significant difference between levels of knowledge ($F = 2.274, sig = .112$ and $P > .05$). But there is a significant difference between the high

levels of comprehension ($F = 80.727; sig = 0.001$ and $P > .05$). Therefore, the research hypothesis is confirmed, that is, the concept map method has been more effective in learning higher levels of cognition than traditional ones and by referring to Table 1 and comparing the average levels of knowledge and higher level of comprehension in the teaching methods of

concept maps and traditional one, higher level of comprehension has increased in all three groups.

Discussion and Conclusion

Findings of this study show that the teaching based on concept map (presentation and construction) has a positive effect on increasing students' academic achievement scores in thinking and media literacy course. As stated in the findings obtained from learners achieving high levels of Bloom (meaningful learning), a significant difference was seen between the mean scores of academic achievement of students in experimental groups (combined and teacher-made concept maps) compared to the control group. Analysis of the data showed that the learners of the combined experimental group were successful in achieving high levels of Bloom (higher-level of comprehension). However, no difference was observed between the three groups comparing the performance of learners at low levels of Bloom (knowledge level).

Regarding the theoretical framework, the results obtained in this study show that the concept map differs from the lecture or conventional method only in the dimension of meaningful learning (perception and application, i.e. high levels of Bloom); That is, the existence of a significant relationship between concepts and the constructivist approach has led to a deeper and higher understanding of Bloom's cognitive domain. In the process of constructing a concept map by students, important concepts and the relationships between them play an important role in their acceptability through organizing information on a regular basis, and this leads to a deep and abstract understanding of a concept and its relationships with other concepts which improves meaningful learning (Taghizadeh, Fathi Azar, & Azar Bakhsh, 2018).

The noteworthy point of this study was the effect of these two types of teaching methods on cognitive learning levels including two levels, knowledge and meaningful learning (comprehension and application). The concept map method was more effective than the lecture method on meaningful learning for learners. The reason for this difference lies in the nature of the concept map. Because the conceptual map is to provide an image of students' interpretations of ideas and concepts, it allows learners to notice errors in their comprehension, and their motivation to learn increases, leading to students taking responsibility for learning; Thus, in the conceptual map, the learner plays an active role in learning, and on the other hand, because the arrangement of concepts in the conceptual map is hierarchical and this form is very similar to the

arrangement of information in human long-term memory, it leads to long-term retention of information (Hatami, Mirzaei, & Abbasi, 2009).

The findings of this research are consistent with those of Mani and Zamani (2019), Abbasi (2008), Radfar and Nakhoda (2018) Rahmani et al. (2005), Vosoughi (2009), Sarhangi et al. (2010), Pia, Blasco and Portero (2011) and inconsistent with Habok's (2008) research.

It seems that the use of concept map method promotes students' cognitive learning and its effect on meaningful learning levels (high level of comprehension) of students is greater than the lecture method. Therefore, it is recommended to the authors of educational books and teachers use this instructional method in courses that require higher level learning and problem solving, deeper learning, more understanding, more sustainable learning, faster review and more informed learning.

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