The effect of concept mapping on English language academic achievement and meaningful learning of high school students

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Abstract: This study investigates the effect of concept mapping as a learning strategy on academic achievement and meaningful learning of English language in third grade of high school students .61 high school female students were randomly assigned to experimental and control group in Karaj and their academic achievement by quasi experimental design with pre-test and post-test was studied. The research instrument was a teacher-made academic achievement test, in which the high levels of cognitive questions (analysis, synthesis, and evaluation) were used to evaluate the meaningful learning. The results were analyzed with t test, and showed that concept mapping strategy has a positive effect on academic achievement (t=2.28, df=59, p=0.026) and meaningful learning (t=7.875, df=41.549, p= 0.0001) in students of English language.

Introduction

Learning and academic achievement have always been focused by educational systems. Bruner, the theorist of discovery learning believes that the educational theories should address the question of how to learn better and more. Accordingly educational psychologists have proposed some learning strategies for a better learning; these learning strategies teach learning methods and accurate studying .

Park (1995) defines learning strategies as the mental activities that people use to help them acquire, organize and remember incoming more efficiently.

These strategies include recognizing important information, note taking, summarizing and meaningful learning (Pressley, 1982; Weinstein, 1988). One of new strategies based on Ausubel's meaningful learning is of concept mapping.

According to Ausubel (1968) meaningful learning means relating new subjects to previously learnt ones in individual's cognitive structure. Cognitive structure involves an organized set of principles, concepts and information that the individual has learned and is a hypothetical pyramid in which more general concepts and subjects are placed at the higher places and more detailed subjects are placed in the lower level of the mentioned pyramid. If the learner relates the new subjects to the ones learnt before in his/her cognitive structure, the learning is regarded as meaningful; however, if the new information is acquired through repeating, practice and without relating it with the previous subjects, his/her learning is regarded as rote learning.

Applying concept map is one the effective ways for relating the new subjects to the existing cognitive structure (Irvine, 1995). Concept map was proposed to confront the non-meaningful learning and as a result of Novak and his colleagues research to find a way to offer the concept perception.

Although concept maps have been widely and successfully used as a powerful educational tool in different fields of education (Rueda, 2009), research shows that most of the application have been in the scientific and technological areas, and less attention has been dedicated to humanistic science such as literature, history and teaching second language.

In Iran educational system, despite the fact that English language is instructed from first grade of guidance school up to the end of high school, students apply meaningful learning very limitedly and the results of language institutions, final exams and overall university exam shows low level of language learning and also limited ability in applying English language.

Although research theories and backgrounds support concept map as an effective method on meaningful learning, not enough steps have been taken to apply this teaching-learning method in classrooms.

Concept Map

Concept maps are the tools for organizing and showing knowledge. They include the concepts which are normally placed in circle or rectangular and link

the relationship between the concepts or propositions by linking lines and statements. Linking statements on the lines, mark the type of the relationship between the two concepts, propositions include two or more concept which are linked by one word and make up a meaningful sentence (Novak, 2008).

Concept maps can be applied as learning strategy (Novak, 2004, Quinn et al, 2004), teaching strategy (Marangos and Alley, 2007) and assessment tool (Novak, 2008, Williams, 2004).

Concept maps are applied in teaching and learning in different methods, one of the major methods of applying concept map is making the maps by the learners.

In the process of concept mapping, the learner links the new material to familiar ones in his cognitive structure and shows it in terms of a graphic design by combining, linking and hierarchically organizing the concepts; this process contributes to meaningful learning.

Concept map is a powerful tool in facilitating meaningful learning (Novak and Canas, 2006, Canas et al, 2003) and due to presenting a pattern and framework to create and organize the knowledge, that not only permit utilization of the knowledge in new contexts, but also the retention of the knowledge for long periods of time . (Novak & Wandersee,1991)

concept mapping as a learning strategy changes the learning direction from teacher-based to student-based by activating the learner in learning process; therefore, causes an improvement in academic abilities and proficiency (Laight, 2004, Peterson and Snyder, 1998) and also increasing the students' marks (Marangos, 2000).

One of the powerful uses of concept maps is not only as a learning tool but also as an evaluation tool (Novak, 2008,Rebich and Gautier, 2005), they reveals not only what learners understand, but also the gaps in their knowledge (Ebener et al, 2006) and their misunderstandings (Novak and Canas, 2006).

According to Quinn (2004), concept maps can an alternative for traditional methods of assessment., they show how knowledge is perceived and organized in learners' mind (Kinchin et al, 2000), this is the advantage of concept map as opposed with contemporary objective tests which mostly measure the abilities related to recalling and recognizing. Concept maps are applied for assessment in different ways; for example the students are asked to draw the concept map of the instructed materials or complete the unfinished concept mapping; in this project we have applied both methods to assess students' knowledge.

Research has proved the effectiveness of concept maps on meaningful learning (Novak, 2003, Trifone, 2006), retention and retrieval (Hall and, O'Donnell 1996), perception and understanding (Kimber et al, 2007), academic achievement (Brussow and Wilkinson, 2007, Hauser et al, 2006), English comprehension and learning second language (Dias, 2010, Conlon, 2008, Liu et al, 2010, Marriott & Torres, 2008, Vakilifard & Armand, 2006, Ojima, 2006, Bahr & Dansereau, 2001, Chularut and Debakar, 2004, Koumy and Salam, 1999,).

Individuals, whose native language is not English, require techniques to learn better, retain longer and apply the language in new situations. Furthermore, the teachers are seeking educational methods that help the students to be activated in learning process and also their achievement. Among effective factors on learning and teaching language, teaching-learning strategies have important role in learning; there are many related strategies among which we have focused on concept map.

Research Background

Since 1976 that Novak proposed concept mapping, concept maps have been used widely in different fields. The studies have shown the significant effect of concept mapping on meaningful learning (Horton et al. 1993, Novak & Canas, 2006, Novak, 2010). Most of the conducted studies have been on first language. But a few studies have been done on second language which some of them are presented bellow.

In a study by Chularut & DeBacker (2004), the effect of concept mapping on academic achievement, self-efficacy and self-regulation of students in English classes as a second language have been investigated. The subjects of the study were college and high school students that enrolled for English classes. The findings of the study showed that a group of students that used concept mapping, achieved higher scores in English achievement, self-efficacy and self-regulation in comparison to control group.

Moreira & Moreira (2011) used concept mapping in a research in foreign language class as an instrument for text comprehension of course books and achieving meaningful learning. The findings of the study showed that text concept mapping is significant in students' meaningful learning and students got self-confidence in using learned concept mapping in new situations.

Liu (2010) investigated the effect of concept mapping with the help of computer on reading comprehension as L2 of college students in Taiwan. The results suggested that concept mapping strategy not only causes reading comprehension improvement, but also improves other reading strategies using.

Dias (2010) used concept maps for improving Bachelor students' English reading comprehension as L2 in Brazil. The findings showed that concept map strategy is significant in reading comprehension improvement. Moreover, the students not only learned how to create maps with Cmap tools, but they also their independence in using knowledge organizing method increased.

Armand & Vakilifard (2006) studied the effect of concept mapping on French reading comprehension, French as L2. The results of the study showed that experimental group did better in reading comprehension exam in comparison to control group.

Ojima (2006) in a case study investigated the impact of concept map strategy as a pre-task planning on writing skill of three Japanese students. The results showed that concept mapping improved writing skills of English learners on the basis of its complexity and reflectivity in which English was L2.

It should be mentioned that most of the studies in the field of concept map strategy have been done by academic researchers and these studies have been their academic projects. In the present study the concept maps in official classes of teachers have been used.

Research goals and hypothesis

This research aims at studying the impact of concept mapping strategy on academic achievement and meaningful learning of English language among students in third grade of high school in Karaj. Research hypothesis include:

H1: Concept mapping has positive effects on students' academic achievement of English language.

H2: Concept mapping has positive effects on students' meaningful learning of English language.

Methodology

Design

The methodology is a quasi experimental design with a pre-test and a post-test. Concept mapping as a learning strategy was regarded as the independent variable; meaningful learning and academic achievement were regarded as the dependant variable and were assessed through an academic achievement test. The experimental group was instructed by concept map strategy and the control group was instructed by current methods of teaching, asking and answering. To control the effective factors on the students in control and experimental group from high school grade, field of study, previous year average, gender and age the school of studying and teachers have the same conditions.

Participants

61 female students in third grade of high school in Karaj who were studying during the school year 2010-2011 were selected through purposive sampling and were randomly assigned in experimental and control groups. Their field of study was literature and human science. Official restrictions and also not intending to interrupt current educational schedule were the reasons why we applied purposive sampling.

Research tools

1- Instructional materials

English language book 3 was selected as the instructional material. This book is reading base one, 65% of which is composed of reading, comprehension and vocabulary. The book is composed of 6 lessons, each including a 6 to 7 paragraph - reading, vocabulary, language function, grammar and pronunciation. The focus of the research was reading comprehension.

2- Concept maps

For each lesson a concept map was designed by the researcher and teacher using the software Cm tools. The maps were approved by a linguist expert and four experts of the English teaching group. The maps were of hierarchical type in which major and more general concepts were placed in higher locations and special and more detailed concepts were placed in lower place. These maps were regarded as the standard maps.

Measurement tool

Teacher-made academic achievement test and criterion referenced were used to assess academic achievement and meaningful learning. The test questions were designed based on Bloom's classification of cognitive domain (1956) in levels of knowledge, understanding, application, analyzing, composition and assessment. The test included multiple choice, short-answer, matching, open and concept map questions. Concept map and analyzing, synthesis and assessment level questions were applied to assess the meaningful learning. The following steps were taken to propose the academic achievement test.

1- Setting the instructional objectives of each lesson

2- Designing the table of book contents

In this stage the proportion of each part of the content, reading, vocabulary, language function, grammar and pronunciation was specified based on the allocated time and volume and then the proportion of each part in the number of the related questions was determined.

3- Designing goal-content double entry table

The table included two entries; the row of the table showed sections of the each lesson, the columns

showed the levels of Bloom's cognitive classification and the table cells showed the proportion of each part of the test's total score. In order to certify content validity of the academic achievement test, the questions were designed based on goal-content table and after final designing of the questions; the test was approved by five experts in English language experts.

Test reliability was 0.93 based on Kuder-Richardson 20, which is at a good level.

4-   Assessment of the Questions

The test questions were studied by five experts in English language educational group and some corrections were done.

Furthermore, the test was primarily performed for the students of two classes (40 students), coefficients of difficulty and discrimination were calculated and the weak questions were revised and corrected.

Procedure

The research was performed in 4 steps:

1-   Preparation Stage

In this stage, activities such as instructing the teacher, preparing the lesson plan, preparing the concept maps, preparing academic achievement test and selecting the sample were performed.

2-   Pre-test:
Before exposing the students to any instruction, the students were given a proficiency test as a pre- test which was a teacher made test.

3-   Implementation
Concept mapping group

Instruction by concept map method was performed through 12 (60-minute) sessions, every two weeks during a school year. In the first session, the students learned about concept map, its features, how to plan it and some related examples. In second and third sessions after instructions, the students made concept map individually and with the aid of teacher and researcher. In the following sessions after instruction they were assigned to create the concept map, regarding the following stages:

- Selecting the major concept of the text (using a question on the topic of the text).
- Listing some text concepts and arranging them from more general to detailed
- Specifying the relationship of the concepts

- Linking the concepts to each other by directed and non-directed lines
- Adding a word or statement to the line to present the relationship between the concepts
- Hierarchically organizing the concept mapping

In the following sessions the students made the maps as homework. The process of the other sessions included collecting students' maps, assessing the previous learning based on the concept mapping (two or three students presented their maps), returning the previous maps through oral and written feedback and also instructing the new lesson. 1 point was allocated to each concept map as a part of class activity.

Control Group

The control group students were instructed the same lesson through the contemporary methods of teaching, asking and answering.

4-Assessment Stage (post-test)

At this stage both groups took the academic achievement test to measure their achievement (the allocated time was 90 minutes).

Results

Mean, standard deviation and *t-test* were used to statistically analyze the data and research hypothesis. To discuss the differences between two groups' English post-test, first the differences between two groups in pre-test were compared with a t-test. The results show that there is no significant difference between them (0.05<p)

Table 1- the results of t-test to compare the control and experimental groups in the Pre-test Scores

Group	N	Mean	Standard Deviation	T	Degree of Freedom	Significance
Experimental	31	7.74	2.29	1.55	57	0.124
Control	28	6.89	1.83			

Regarding the first hypothesis of the research, "applying concept mapping effects of students' academic achievement of English language", the results of the t-test to compare the two groups, are presented in table 2. Because the level of significance of the table (0.026) is less that 0.05 Alfa, the research hypothesis regarding the impact of concept mapping on academic achievement of English language is approved. Since the mean of the experimental group which was exposed to independent variable is 13.19 and the mean of the control group which wasn't

exposed to this variable is 11.31, this increase can be attributed to the impact of the independent variable.

Table 2- the results of t-test to compare the control and
experimental groups in language learning achievement

Group	N	Mean	Standard Deviation	t	Degree of Freedom	Significance
Experimental	32	13.19	3.5	2.28	59	0.026
Control	29	11.31	2.9			

Regarding the second hypothesis, "concept mapping effects on students' meaningful learning of English language", the results of *t-test* to compare the two groups, are presented in table 3. Regarding the fact that the level of significance in the table (0.0001) is less than 0.05 Alfa (p<0.05), the research hypothesis is approved regarding the impact of concept mapping on English meaningful learning. Since the mean of experimental group which was exposed to the independent variable was 13.53 and the mean of the control group which wasn't exposed to this variable was 6.95, this increase of the mean can be attributed to the impact of the independent variable.

Table 3- The results of t-test to compare the control and experimental groups in meaningful learning of English language

Group	N	Mean	Standard Deviation	t	Degree of Freedom	Significance
Experimental	32	13.53	4.36	7.875	41.549	0.0001
Control	29	6.95	1.7			

Results and Discussion

Applying concept map as a learning strategy was effective improvement of educational function and meaningful learning in language learning. The students in the concept mapping group got better scores in academic achievement test compared to the control group. When students participate actively in building the knowledge and are encouraged to present their perception of the information and educational materials in terms of concept mapping, their academic performance is improved. The results of this research are in accordance with that of (Dias, 2010, Vakilifard & Armand, 2006, Chularut & Debakar, 2004, Brussow & Wilkinson, 2007, Trifone, 2006, Mesrabadi et al , 2008).

Regarding the impact of concept mapping on meaningful learning, the results show that the concept mapping students' scores has significant difference in

higher cognitive levels (analysis, synthesis, assessment). This shows the impact of concept mapping in facilitating the meaningful learning. The results of the research are in accordance with the findings of Moreira, & Moreira, 2011, Liu et al, 2010, Conlon, 2008, Ojima, 2006, Erdem et al, 2009, Novak, 2003, Novak and Canas, 2006.

Meaningful learning means that the learner can organize the information and bring them in his/her knowledge framework. Drawing the concept mapping requires understanding, recognizing the main concepts, linking the concepts with previous ones, establishing new bonds and organizing the concepts. This process causes meaningful learning and applying higher level cognitive functions.

During concept mapping using in reading comprehension, the learners learned and used learning strategies like recognizing important information, summarizing, reviewing, expanding and organize and the concepts and text structures and presenting the concepts in the form of showing. And also finding out the topic and the concepts of the text causes the concentration of the students and reviewing the text for several times. Therefore, it causes the transformation of the information to long-term memory, retaining and recalling the materials.

Creating the concept map help learners to retrieve old information already learned and combine them with new knowledge to learn more new vocabulary and concepts and also their use in new situations. On the other hand, the process of creating concept map requires the activating of learner in learning process and interaction with instructional materials. Activating the learner in the process of learning causes the improvement of academic learning and increasing the students' scores (Laight, 2004, Peterson, A.R. & Snyder, P.J. 1998, Marangos, 2000)

Creating the concept map is a feedback for both the teacher and students to recognize the knowledge and understanding the subject and point out the learning deficiencies. Furthermore assessing the students' learning by the map and considering a score for drawing the concept mapping was an external motivation for the students and they recognized the impact of the mapping on deeper understanding of the text and on their ability to better retain and recall the vocabularies.

This research showed the impact of concept mapping on deep and meaningful learning of English language, achieving higher cognitive levels, learners' being activated in learning process; it is suggested that learners apply the concept map to deepen and strengthen their learning and teachers improve students' learning and academic achievement using

concept map as a teaching strategy, learning task and assessment tool.

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Reference

Ausubel, D. P. (1968). Educational Psychology: A Cognitive View. New York: Holt,Rinehart and Winston.

Bahr, S., & Dansereau, D. (2001). Bilingual Knowledge Maps (BiK-Maps) in Second Language Vocabulary Learning. Journal of Experimental Education, 70(1), 5-24.

Bloom, B. S. (1956). Taxonomy of educational objectives; the classification of educational goals (1st ed.). New York: Longmans Green.

Brüssow, S.M.& Wilkinson, A.C.(2007). Generative Learning and assessment Strategies:An Investigation into Concept-mapping. *Assessment design for learner responsibility* 29-31 May http://www.reap.ac.uk

Chularut,P.& DeBacker, T.K. (2004). The influence of concept-mapping on achievement,self-regulation, and self-efficacy in students of English as a second language. *Contemporary Educational Psychology* 29(3), 248-264.

Cañas, A. J., Coffey, J. W., Carnot, M. J., Feltovich, P. J., Feltovich, J., Hoffman, R. R., & Novak, J. D. (2003). A Summary of Literature Pertaining to the Use of Concept Mapping Techniques and Technologies for Education and Performance Support. Pensacola, FL: Institute for Human and Machine Cognition. www.ihmc.us

Conlon, T. (2008). Practical Text Concept Mapping: New Pedagogy, New Technology. In A. J. Cañas, P. Reiska, M. K. Åhlberg & J. D. Novak (Eds.), Concept Mapping: Connecting Educators. Tallinn, Estonia & Helsinki, Finland: Tallinn University.

Dias, R. (2010). Concept map: a strategy for enhancing reading comprehension in English as l2. Proc. of Fourth International Conference on Concept Mapping. J. Sánchez, A. J. Cañas, J. D. Novak, Eds. Viña del Mar, Chile.

Ebener, S. Khan, A., Shademani, R. Compernolle, L., Beltran, M., Lansang, M.A. &Lippmana, M. (2006). Knowledge mapping as a technique to support knowledge translation. *Bulletin of the World Health Organization* 84, 636-642.

Erdem ,E. Yılmaz, A. Oskay, O.O. (2009). The effect of concept mapping on meaningful learning of Atom and bonding . *Procedia Social and Behavioral Sciences* 1 (2009) 1586–1590

Hall, R. & O'Donnell, A. (1996). Cognitive and affective outcomes of learning from knowledge maps. *Contemporary Educational Psychology,* 94-101.

Hauser, S., Nückles, M. & Renkl, A. (2006) . Supporting concept-mapping for learning from text. Proceedings of the 7th International Conference on Learning Sciences, Bloomington, Indiana. International Society of the Learning Sciences 243 – 249.

Horton, P.B., McConney, A.A., Gallo, M. Woods, A.L. Senn, G.J. & Hamelin, D. (1993). An investigation of the effectiveness of concept mapping as an instructional tool. Science Education, 77(1), 95-111.

Irvine, L. (1995). Can concept mapping be used to promote meaningful learningin nurse education? *Journal of Advanced Nursing,* 21(6), 1175−1179.

Kimber,k , Pillay, H , Richards, C. (2007) . Technoliteracy and learning : An analysis of the quality of knowledge in electronic representations of understanding . *Computers & Education 48*. 59–79

Kinchin, I., Hay, D. & Adams. (2000). How a qualitative approach to concept mapanalysis can be used to aid learning by illustrating patterns of conceptualdevelopment. *Educational Research*, 42(1), 43-57.

Koumy, E., & Salam, A. (1999). Effects of three semantic mapping strategies on EFL students_ reading comprehension. (ERIC Document Reproduction Service No. ED 435 193).

Laight, D.W. (2004). Attitudes to concept maps as a teaching/learning activity in undergraduate health professional education: influence of preferred learning style. *Medical Teacher 26*(3), 229-233.

Liu, P. L., Chen, C.J., Chang, U.J. (2010). Effects of a computer-assisted concept mapping learning strategy on EFL college students' English reading comprehension. Computers & Education, 54, 436–445.

Marriott, R. C. V., & Torres, P. L. (2008). Enhancing Collaborative and Meaningful Language Learning through Concept Mapping. In T. Sherborne, S. J. Buckingham Shum & A. Okada (Eds.), Knowledge Cartography (pp. 47-72): Springer London.

Marangos, J, Alley,S . (2007). Effectiveness of concept maps in economics: Evidence from Australia and USA . *Learning and Individual Differences* 17, 193–199

Marangos, J. (2000). The effectiveness of collaborative problem solving tutorials in introductory microeconomics. *Economic Papers*, 19(4), 33−41.

Mesrabadi ,J. Fathi Azar ,E . Ostevar , N .(2008). The efficacy of provision of concept maps preparation through per-planned individual and cooperative metods as an instructional strategy. *Quarterly journal of Educational Innovations* ,No.24, 83-92.

Moreira, M. M. & Moreira, S. M. (2011). Meaningful learning: use of concept maps in foreign language Education. Aprendizagem Significativa em Revista/Meaningful Learning Review – V1(2), pp. 64-75.

Novak, J.D. (2008). Concept Maps : What the heck is this? Excerpted, rearranged (and annotated) from an online manuscript byJoseph D.Novak, Cornell Universit ,original manuscript was revised in 2008.available at: http://cmap.ihmc.us/Publications/ResearchPapers/TheoryCmaps/TheoryUnderlyingConceptMaps.htm

Novak, J. D. & Cañas A. J.(2006) . The Theory Underlying Concept Maps and How to Construct Them, Technical Report IHMC CmapTools , Florida Institute for Human and Machine Cognition. available at: http://cmap.ihmc.us/Publications/ResearchPapers/TheoryUnderlyingConceptMaps.pdf

Novak, J. D. (2003) . The promise of new ideas and new technology for improving teaching and learning. *Cell Biol Educ 2*: 122-132.

Novak, J. D., & Wandersee, J. (1991). Coeditors, special issue on concept mapping. *Journal of Research in Science Teaching*, 28(10).

Novak, J.D. (2004). Reflections on a Half-Century of Thinking in Science Education and Research: Implications from a Twelve-Year Longitudinal Study of Children's Learning. *Canadian Journal of Science, Mathematics, & Technology Education 4(1)*,23-41.

Ojima, M. (2006). Concept mapping as pre-task planning: A case study of three Japanese ESL Writers. System, 34 (4), 566-85.

Park, S. (1995). Implications of learning strategy research for designing computer-assisted instruction. *Journal of Research on Computing in Education, 25*(4), 435–456.

Peterson, A.R. & Snyder, P.J. (1998). Using Concept Maps to Teach Social Problems Analysis.Paper presented at the Annual Meeting of the Society for the Study of Social Problems on 20 August. Columbus State Community College, San Francisco. 5-28.

Pressley, M. (1982). Elaboration and memory development. *Child Development*, 53, 296–309.

Quinn H.J., Mintzes J.L. & Laws, R.A. (2004). Successive Concept-mapping. *Journal of College Science Teaching 33(3),* 12-16.

Rebich, S. & Gautier, C. (2005). Concept-mapping to Reveal Prior Knowledge and Conceptual Change in a Mock Summit Course on Global Climate Change. *Journal of Geoscience Education 53(4*), 355-365.

Rueda, U., Arruarte,A., Elorriaga, J.A., Herran,E.(2009). Learning the attachment theory with the CM-ED concept map editor. *Computers & Education.52*, 460–469

Trifone, J.D . (2006). To What Extent can Concept Mapping Motivate Students to Take a More Meaningful Approach to Learning Biology?. *The Science Education Review, 5(4),* 2006

Vakilifard, A. & Armand, F. (2006). The effects of concept mapping on second language learners' comprehension of informative text. Proceedings of the second international conference on concept mapping, San José, Costa Rica.

Weinstein, C. E. (1988). Elaboration skills as a learning strategy. New York: Academic Press.

Williams, M. (2004). Concept-mapping - a strategy for assessment. *Nursing Standard 10(19),*33-38.

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