COGNITIVE STRATEGIES INSTRUCTION: ATTITUDES TOWARD LEARNING AND ACADEMIC FUNCTIONING IN SCIENCE

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Abstract. The purpose of this study was to investigate the effect of cognitive strategies instruction on students' attitude toward learning and academic functioning of science. This research method was semi-experimental with pretest, post-test, experimental and control groups. The statistical population consisted of all boys of grade 3 in Lordegan city. The samples were 126 students, who were selected with cluster sampling method, and then 64 students were randomly set in the experimental group and 62 in control one. The experimental group had seven sessions of cognitive strategies. The results of covariance analysis showed that cognitive strategies instruction has a positive effect on academic functioning of science. Also, attitude toward learning has been increased through cognitive strategies instruction.

Keywords: cognitive strategies, attitude toward learning, academic functioning

Introduction

During the recent decades, educational specialists have paid more attention to effective factors on academic achievement and attitude toward learning. Students' academic achievement has been affected by knowledge structure and learning processes. Among these learning processes, learning strategies (cognitive and meta-cognitive) have the most influence on learning (Hatti & Timperley, 2007). The learning strategies application has the most effect on facilitating learning, remembering and reminding processes in which cognitive strategies have the most influence on students' learning and increase their self-instruction skills, independence and learning abilities (Yang, 2005).

Most of new psychological theories believe that an important part of thoughtful behaviors are originated from cognitive strategies. The importance of these new approaches is the reason that they insist on the belief that contrary to inherent abilities which are not changing, learning strategies (cognitive and meta-cognitive) are changeable and trainable. In fact, cognitive actions in learning are flexible and obtainable (Taylor & Ivry, 2011).

There are a lot of definitions in cognitive strategies. Schleifer & Dull (2009) believe that cognitive strategies relate to the methods which directly act on learning subjects and prepare the tendency to increase information acquiring, understanding and interpreting. Cognitive processes reinforce thought processes and help to access cognitive purposes such as comprehension and memorizing. Cognitive strategies are presented as practical strategies, semantic extension and organization and lead to save and restore information (Pintrich, 2004).

Cognitive strategies are reminders, which relate new information to the past learned one (Duke & Pearson, 2002). They are methods through which learners direct their learning and thought. Learners use cognitive strategies to control their attention, help to code new information in their memory and remember it in the needed time (Hoffman & Spatariu, 2008). Cognitive strate-

gies or skills are covert and overt thought and behaviors which are related to learning success and can be changed through educational intervention. Also, these skills or strategies are defined as cognitive, emotional or behavioral activity which facilitate saving and retrieval processes and using knowledge or learned points (Dignath et al., 2008). One of the reasons in students' disability in the educational process is related to weak awareness and use of cognitive strategies. In recent years, information processing theory has been taken into consideration as one of the learning theories. Based on this theory, learning is facilitated through using cognitive strategies and students with learning problems can overcome their difficulties (Sheri, 2008). In information processing model, three activities are involved to save information and transfer them to long-term memory. They are of practice and repetition, extension and organization. There are learning strategies for each activity in which some are simple and some are complicated. They contain mental practice and repetition, explanation, semantic extension, conceptual plan and models. In fact, cognitive strategies are classified in these three groups. Cognitive learning strategies are strategies which improve learners' academic functioning through facilitating learning processes (Scruggs & Mastropieri, 1993). They are as follows: (1) *Repetition strategy (mental review)* - it is an information coding stage as a form of meaning in short-term memory and is transferred to long-term memory through repeating of the issue such as repeating easy names, repeating a lesson text, repeating by rote and diffusive practice; (2) *Extensive strategy* - learners relate what she/he knew previously and what s/he is going to learn through extensive strategy. It is created through increasing more details of new issues, making examples, or something to make the association, phraseology, summarizing; (3) *Organizational strategy* - learner imposes an organizational framework to learning issues through organizational strategy in order to create a semantic extension. This strategy consists of issues grouping

and organizing, creating hierarchies and a conceptual plan (Cohen & Macaro, 2007).

Cognitive strategies are instruments which help students in learning. Therefore, the skills and strategies can help students to be more successful learners in solving their educational problems and play an active role in their academic fate through education (Graham & Harris, 2003). Many researchers have shown there are differences among learners in cognition and application of cognitive skills. There are studies which show the relationship between learning strategies and attitude toward the study. In a research, Bouffard-Bouchard (1994) showed that clever students use cognitive and meta-cognitive strategies to do their homework. He considers their assignment as a challenge and a chance for learning. Bembenutty (2007), in a research, pointed that successful students use meta-cognitive strategies in learning but unsuccessful students use less and they cannot regulate educational purposes and select learning strategies in their research. Suarez & Fernandez (2011) showed that motivational self-regulation has direct and positive correlation with self-regulation learning strategies, in the way that we can form the students' positive motivation for learning with learning strategies instruction. Huffman (2005), in a research, explains that cognitive strategies has a positive relationship with learning and that more efficient students have more learning strategies (cognitive and metacognitive) and they are more successful in problem solving. In the relationship between students' cognitive strategy's ability with academic achievement and special deficiency in mathematics learning, Proctor (2012) pointed that there is a significant relationship between information processing speed, students' comprehending and understanding power, working memory with cognitive strategies. He showed a strong relationship between cognitive strategies and learning and reminding interest.

Parsons (2006) explained that used strategies by successful learners have a lot of similarities. Used skills of unsuccessful learners are almost lim-

ited. There are researches which show through education that cognitive skills are learnable and promotable. They believe when learners have been trained with these skills, they have shown better academic functioning (e.g., Paris, Cross, and Lipson (1984). Sporer, Brunstei, and Kieschke (2009) showed the effectiveness of learning strategies instruction on improving learning and attitude toward learning, and Shokrpour, Zareii, Zahedi, and Rafatbakhsh (2011) the effectiveness of cognitive on improving academic functioning and positive attitude toward learning. Kaberman & Dori (2008) found out that students, who receive metacognitive skills, have better progress in chemistry, are more aware of cognitive processes and have higher self-regulation. Nota Soresi, and Zimmerman (2004), Man-Chih (2006) and Dignath et al. (2008) showed that learning strategies instruction has a positive effect on academic achievement. Based on learning approaches, researches show that it can predict students' success, who use cognitive strategies. As a result of these researches in cognitive psychology, it is determined that learning and studying strategies facilitate learning and improve students' academic functioning. Also, in different parts of the world, the effectiveness of applying various methods and skills in learners' better learning has been emphasized (Boehler et al., 2001). Besides the attention to learning strategies (cognitive and metacognitive), it is important to pay attention to the students' attitude.

Attitude is a personal construct which deals with the individual's understanding situation and it is changeable. Changing attitude toward education components is very important. It is so valuable to change the negative attitude of students, who are not interested in studying, into a positive one (Mager, 1968). Attitude, as a tool for mental readiness on entrance behaviors, is learning prerequisite. If students are not interested in studying and have low level attitude and do not pay attention to the teacher's explanation, they will not do their instructional assignment seriously and will never progress (Nasser & Fresco, 2002). Thus, academic achievement has been affected by variables

such as attitudes, understanding, and economic variables, the effects of peers and parents and variables related to school. Most of these variables are related to the family and home environment. Therefore, their changes are difficult and out of educational environment control. Other variables are related to students, learning abilities, success and attitude which can influence students' academic achievement and career chance. As a whole, there is a relationship between attitude and academic achievement. Learners' academic achievement can affect attitudes and attitude can affect academic achievement. Therefore, present differences in learning behaviors in the academic process affect individuals' attitude. Different attitudes have been rooted in different factors (Hind, 2004). In recent years, emotional and attitude variables have been discussed in academic different levels as effective, prominent and stable factors on success. One of the mediators and effective factors on students' emotional and attitude variables, is studying the application of learning strategies, especially cognitive strategies, which is the subject of some researches.

Among cognitive strategies (repetition, review strategies and semantic extension), semantic extension has the most important role in learners' learning attitude. Each strategy has the role of "very much" and "much" in attitude toward learning. Yip (2007) showed that cognitive strategies as a mediating factor, mediate motivational factors and academic achievement. In this research, attitude and motivation are two important factors which distinguish successful and unsuccessful students.

Kesici, Sahin, and Akturk (2009) point that learners with positive attitude use more learning strategies than students with a negative attitude. Concerning motivation, learners who had interior motivation used more learning strategies than those who had instrumental motivation. Moreover, academic years had a significant effect on using learning strategies. It means that they are used more in the first year. Puzzifero (2008) pays attention to the importance of motivation and cognitive strategies on academic achievement and

concluded that students, who use memorizing strategies, explanation, extension and organization of educational issues more, are more successful than those who use less. Successful students acquire desirable attitudes toward educational activities through success.

The complication of learning in human beings and the difficulties of science conceptions and skills, in one hand, and some teachers' inefficiency, the ambiguity of educational purposes and other factors such as learners' interest and motivation and also students' inability and non recognition in using cognitive strategies, on the other hand, have caused learners' unsuccess in acceptable results and their hatred to science lesson. Thus, students' attitude, interest and learning strategies toward learning and educational subjects are of special importance. As a whole, one of the effective factors on experimental science attitude is students' ability in learning the concepts of this lesson. Also, one of the influenced components on learning ability is the application of learning strategies in general and cognitive strategies in particular.This paper is an attempt to study the effect of cognitive strategies instruction on the learning attitude and academic functioning in experimental science.

Research hypotheses

(1) Cognitive strategies instruction leads to academic functioning improvement in science lesson.

(2) Cognitive strategies instruction has positive effects on attitude toward science learning.

Research method

The research method is experimental with pretest, post-test, control group and experimental random selection. Cognitive strategies are independent variables and the dependent ones are academic functioning and attitude toward learning (Table 1).

Table 1. Pretest and post-test with control group

Group	Interventions	Random selection	Pretest	Independent variable	Post-test
Experimental	Cognitive strategies	R	T_1	X	T_2
Control	Control	R	T_1	-	T_2

Statistical population were all boy students in grade 3 of a guidance school in Lordegan city in 2011-2012 (N=1424). The research participants were 126 boy students in grade 3 of a guidance school in Lordegan which were selected through a cluster sampling. First, six schools and then six classes were randomly selected. Students were divided in half in two groups of experimental and control. As a whole, 64 students were selected in the experimental group and 62 - in control one.

Academic functioning test in science was planed by the researcher in grade 3 of a guidance school in which questions were selected from science book contents. Also, the scores were from 0 to 20. To assess test reliability, retest method and Cronbach alpha was used. Correlation coefficient was calculated between the first and second scores of 35 students who were not in any groups. It was 94% which was significant in 0.001 levels (p< 0.001, r= 0.94, n= 35); the second test was nine days after the first one. Cronbach alpha was 0.784 which showed the reliability was acceptable.

First the questions were made in students' level who were learned, then they were given to 14 science teachers to investigate the validity. Finally, it was approved.

Attitude toward science learning questionnaire was made by Akpinar Yıldız, Tatar and Ergin (2009) and had 21 questions. Each question was on the Lickert scale of five degrees (completely agree, agree, no idea, disagree, completely disagree). These options get the score of 1, 2, and 3, 4, 5, respectively. The negative questions get reverse scores. This questionnaire assesses

four components: a) enjoying science learning with 8 questions, b) anxiety of science learning with 7 questions, c) interest to science lesson with 3 questions, d) enjoying science experiment with 3 questions. The internal consistency of the scale was calculated for reliability through Cronbach alpha and it was 0. In the present research Cronbach alpha for attitude toward science learning was 0.87.

Instructional sessions started after fulfilling academic achievement test in science lesson and attitude toward learning questionnaire and students' and parents' satisfaction. The experimental group instruction was in 7 sessions, two sessions of one hour in each week. A M.A educational psychologist helped to teach the necessary instructions. At the end of each session the students had some assignments.

The instructional sessions of cognitive strategies are: Session 1: introduction of method and the effect of cognitive strategies on learning; Session 2: the instruction of repetition and review strategies specially for easy and complicated assignment; Session 3: the practice of repetition and review with students; Session 4: the instruction of extensive strategies and semantic expansion; Session 5: the practice of extensive strategies and semantic expansion with students; Session 6: the instruction of organizational strategies; Session 7: the practice of organizational strategies with students.

Covariance analysis was used to study the differences between experimental and control groups in academic functioning and attitude toward learning, after cognitive strategies instruction and deletion of pretest scores independent variable scores.

Findings

As it was explained, there were two groups of experimental and control. The function of these groups was measured (pretest, post-test) based on academic achievement test and attitude toward learning questionnaire, in sci-

ence, in order to judge the effectiveness of cognitive strategies instruction during the time. Thus, to clarify the position of each group in pretest and post-test, we refer to dispersion indicators.

Table 2. Mean and standard deviation of academic achievement scores and attitude toward learning in two groups of experimental and control in pretest, post-test

Variables	Groups	Pretest		Post-test	
		Mean	Standard Deviation	Mean	Standard Deviation
Academic Achievement	Experimental	11/89	2/12	15/06	1/84
	Control	11/54	2/02	11/66	2/06
Attitude to learning	Experimental	70/32	11/15	92/18	10/06
	Control	70/26	14/75	72/17	14/16

As the results show (Table 2) the mean of experimental and control group in academic achievement and attitude toward learning pretest are not different (11/89# 11/54,70/32# 70/26). Whereas in post-test, they have obvious differences (15/06# 11/66, 92/18# 72/17). Covariance analysis is used to study the effect of cognitive strategies on academic functioning. The result of Levene Test for equality of variances and Shapiro-Wilk Test for normality had been done before covariance analysis. The results showed researchers can use covariance analysis.

In covariance analysis, the effect of pretest scores from dependent variable scores is crossed out and two groups were compared based on the rest of the scores. The results are shown in Table 3.

Table 3. The results of covariance analysis of academic functioning test

The effects of variables	SS	df	Ms	F	Sig.
Academic functioning pretest	11/85	1	11/85	0/22	0/001
Group	1392/51	1	1392/51	24/22	0/002
Error	10323/25	123	57/56	-	-
Total	41042	126	-	-	-
Corrected total	11638/25	125	-	-	-

After modifying primary differences between groups in academic achievement, the results (Table 3) showed that the differences between groups in academic achievement post-test were significant (df= 1, F= 24/22, p< 0/002). It means cognitive strategies instruction have promoted academic achievement in science lesson.

Discussion

The present results show that the status of the two groups in pre-test are almost the same .There is not any significant difference between students' academic functioning pretest scores and attitude toward learning. Here, the first hypothesis (cognitive strategies instruction leads to academic functioning improvement in science lesson) have been approved. It is consistent with Yang (2005), Proctor (2012), Kaberman & Dori (2008), Dignath et al (2008), Man-Chih (2006), Nikos & George (2005), Pintrich (2004).

Students, who have learned cognitive strategies, try to practice, repeat and signify new information, related to past learned information and flexibility in studying method. When the teacher is teaching science and when they are studying it, they have better academic functioning. In other words, these students have necessary actions to learn new information and save it in long-term memory by using cognitive strategies. They almost use cognitive strategies and consider assignments as challenging and use them as a chance for learning (Bouffard-Bouchard, 1994). These students have considerable academic achievement by trying to be successful, enjoying challenging assignments and using cognitive strategies, whereas the learning of those students, who learn fewer strategies, is by rote and is done just for repeating. Since the location of this information is in short-term memory, learned issues will be forgotten, if not used. To confirm the second hypothesis, research findings have shown that the mean attitude toward learning in science lesson is more in

the experimental group than control one. The mean difference between the two groups in post-test defines the positive effect of cognitive strategies instruction; it means there is significant influence between cognitive strategies instruction and attitude toward learning. Therefore, the second hypothesis (cognitive strategies instruction has a positive effect on attitude to learning science lesson) is approved. This finding is congruent with Su & Duo (2012), Puzzifero (2008), Yip (2007), Kesici et al. (2009), Hind (2004).

To conclude: Students, who is involved in cognitive strategies of implicit learning, never do this. Therefore, this problem must be studied in how teachers can encourage students' cognitive strategies and their learning. Some teachers support the teacher's role in students' cognitive strategies. Not only affect cognitive strategies a lot of academic achievement and attitude toward learning, but also they are learnable and trainable by teachers and students. The necessity of learning strategies instruction in general and cognitive strategies in particular is observed. Students must be aware of essential issues for learning and use them in the learning process, receive internal reinforcement through success in learning instructional content and get more positive attitude toward learning. As a whole, teachers are effective in students' use of learning situation with paying attention to students' learning type, modifying on time and the influenced factors on learning, one of which is an attitude toward learning. Teachers can bring more chances to learn and prepare attractive environment for education and upbringing through making suitable conditions to promote attitude toward lesson and school and cognitive strategies (Gorham, 1988).

It is suggested, since cognitive strategies instruction has a positive effect on academic achievement and attitude toward learning, the instruction of these strategies, before starting teacher's instructional process, can affect students' academic functioning improvement. Therefore, the responsible individuals in Education must instruct the teachers with these strategies in order to

use them for their students and themselves as well. It is also suggested to study the effect of cognitive strategies on education on other variables concerning gender intervention and educational different levels. The research's limitation is with the samples, in which the participants are just boys. It must be generalized to girls and other academic levels too. The difference between present research and the previous one is that the studied variables in other researches are investigating two by two but here all three variables are at the same time and gender is not considered.

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