Comparison of Mathematics and Humanitarian Sciences Students' Metacognitive Strategies

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Abstract

The purpose of this study was to compare the differences of using meta-cognitive strategies in high school students who study in the fields of mathematics and humanities. For do this, 140 high school students were selected randomly. The Swanson's Meta-cognition Strategies Test was administrated for sample groups. The acquired means for two regroups were compared with t-test for two independent groups' method. Results indicated that two groups were meaningfully differed from each other (sig=0.01) in using meta-cognitive strategies, and mean of students in mathematics field were high. Also there was a meaningful difference in task component between two groups (sig=0.002), and the mean of students in mathematics field was higher than from students in humanities field in this component. The high school students in mathematics field use more metacognitive strategies, especially task component, than the students in humanities field.

Keywords: metacognitive strategies, students, mathematics field, humanities field

Introduction

Today, one of the main goals of education is to make the students gain the thinking skills and strategies which they will use throughout their lives, rather than storing information. A good education should be able to show the students how to learn, how to remember, how to motivate themselves and how to control their own learning, so that they can teach how to learn. For all these reasons, to investigate the process of the metacognitive skills of students is quite important (Aydin, 2011). During the last 30 years metacognition has become one of the major fields of cognitive developmental research. Research activity in metacognition began with John Flavell (Papaleontiou-Louca, 2003). Flavell (1979) described metacognition as knowledge and cognition about cognitive objects that are saying about cognitive (Yildiz et al, 2009). Metacognition is a multidimensional construct with two main dimensions: knowledge about cognition and regulation of cognition (Panaoura, & Philippou, 2007).

Some studies have indicated that metacognitive strategies may have impact on mathematical performance. Cognitive strategies are the learning tools, and metacognitive strategies are policies for monitoring and leading of cognitive strategies. So, metacognitive strategies have crucial role in successful learning. Flavell (Mohammad Amini, 2008) has pointed to the three components of metacognitive knowledge:

a. individual knowledge of one's own cognitive system: this component refers to individual knowledge about what he should know about learning and information processing, b. Individual knowledge of task: individual knowledge of task includes knowledge about nature, type, and quality of task which individual will involve with it and c. Individual knowledge of strategies: this component refers to the knowledge of cognitive and metacognitive strategies and that the person knows when and where, what strategy can be used. According to many researchers, application of cognitive and metacognitive strategies is important for signification of learning process (Gleber, 2008; Zhang, 2008; Haynie et al, 2004). Oxford (1990), says that learners who are more aware and more advanced seem to use better strategies (Hamdan et al, 2010). Metacognition include taking conscious control of learning, planning and selecting strategies, monitoring the progress of learning, correcting errors, analyzing the effectiveness of learning strategies, and changing learning behaviors and strategies when necessary (Kim et al, 2009). The use of strategies may be affected by various factors, including age, experience in learning, and cultural background (Dül, 2011). For example, (Wernke et al, 2011) argues that children around the age of ten are beginning to be able to reflect about their own abilities, their own learning, and their knowledge in a more abstract manner and that this is the basis of metacognitive processing. Between the age of eleven to twelve a considerable increase in cognitive and metacognitive processes is described, which is becoming more differentiated and more effective in twelve to sixteen year old adolescents.

Results give indirect support to the importance of promoting an active life- style for the further development and maintenance of efficient memory and cognitive processes in adulthood (Carretti et al, 2010). There is ample evidence that meta-cognitive skills, although moderately correlated to intelligence, contribute to learning performance on top of intellectual ability. On the average intellectual ability uniquely accounts for 10 percent of variance in learning, Meta-cognitive skills uniquely account for 17 percent of variance in learning, whereas both predictors share another 20 percent of variance in learning for students of different ages and background, for different types of tasks, and for different Domains)Veenman et al, 2006). Swanson (1996) believed that the strong relationship between metacognition and mathematical problem solving has important implications in understanding acuity in specific areas of knowledge such as mathematics. Briars (1984), one of the first theorists to the realm of mathematics education, stated that cognitive processes and knowledge infrastructures are the most important aspects of mathematical ability. From this point of view, processes and structures which are called mathematical ability include basic skill of information processing, content knowledge, and metacognitive knowledge (Seif, 2011). Looking at the titles of specialized lessons of students, diversity of lessons in the humanity fields are more than mathematics field. As different specialized lessons are composed of different knowledge structure, their desired learning needs to use appropriate learning strategy. For example, mathematics concepts learning and its problem solving need less repetition, recall, transcribe, mental imagery, marking and so on, and mathematics lessons involves theorems, mathematical reasoning, and also problem solving related to the theorems (Ababaf, 2008). As strategies and cognitive processes used in various fields can be different, it seems that metacognitive processes used in different fields are different. Therefore, the aim of the present study was to know that how much and what metacognitive strategies high school students who study in the fields of mathematics and humanities use.

Method

This research was descriptive study aimed to describe and evaluate the frequency and types of metacognitive strategies of students according to their fields of study. Statistical sample of the research involved 140 male and female students (70 students from mathematics and 70 students from humanities field) of high schools in Bonab in the fields of mathematics and humanities which were selected randomly by multi-stage cluster sampling. The instrument of the study was Swanson's Meta-cognition questionnaire that included 20 questions with 4 items by scoring each question between 1 and 4. The questions of this test measured 3 categories of metacognitive knowledge. In person category, a person's abilities in studying were investigated. They had tried to measure effects of age, motivation, gender, special competencies, study abilities and environmental restrictions in self category. Task category questions measured exam knowledge, story length, and speed, selection of paragraph structure goals and unfamiliarity of text. Strategy variable investigated awareness of reading again, deduction and revision (Nojbaee, 2013). Swanson (1996, 1990) conducted a factor analysis on his own test and determined three factors of metacognitive knowledge class from principal component analysis involve: variables related to person, task, and strategy features evaluation. In this study, Cronbach's alpha coefficient of 0.89 was obtained for the questionnaire.

Results

Metacognitive strategies of 140 students in humanities and mathematics field were studied in this research. Descriptive statistics of each group are shown in Table 1.

Table 1
Mean and standard deviation of students' scores metacognitive and its components according to their fields of study

	Study field	N	Mean	Std. Deviation
Total metacognition	Humanities	70	57.9	6.92
	Mathematics	70	60.61	5.15
Person	Humanities	70	14.62	3.10
	Mathematics	70	15.14	2.08
Task	Humanities	70	26.37	3.86
	Mathematics	70	28.34	3.37
Strategy	Humanities	70	16.68	3.019
	Mathematics	70	17.1	3.007

Independent t-test was used to compare the mean of scores related to metacognitive strategies of students in the fields of humanities and mathematics.

Table 2
Levene's test results for equality of variances and independent t-test for equality of means

		Levene's Test		t-test			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Total metacognition	Equal variances assumed	9.83	.002	-2.6	138	.009	-2.68
	Equal variances not assumed			-2.6	1.27	.009	-2.68
Person	Equal variances assumed	5.4	.02	-1. 5	138	.252	-.51
	Equal variances not assumed			-1.15	1.21	.253	-.51
Task	Equal variances assumed	.16	.68	-3.2	138	.002	-1.97
	Equal variances not assumed			-3.2	1.35	.002	-1.97
Strategy	Equal variances assumed	.85	.35	-.8	138	.417	-.41
	Equal variances not assumed			-.81	1.38	.417	-.41

According to Table 2, total score of metacognition ($t = -2.6$, $p < 0.01$) and task component ($t = -3.2$, $p < 0.01$) in mathematics students are more than humanity students. Finding also suggest that there were no significant difference between metacognitive components of person and strategy in both mathematics and humanities students.

Discussion

In this research with the aim of the study of metacognitive strategies used by mathematics and humanity students, mathematics students use total metacognitive strategies and knowledge of task strategy (individual knowledge of task includes knowledge about nature, type, and quality of task which individual will involve with it) more than humanity students. Bransford (1986) indicated that students whose reasoning skills are more developed are likely to be better learners (Dawson, 2008).

Weissberg, Caplan and Harwood (1991) stated that cognitive strategies which lead to more interaction of reader with text and depth such as: summarizing, the recognition of graphing organizers or semantic maps are more benefit than repetition and pure mental review, graphing organizers or semantic maps may have more benefits because they make students distinguish important ideas from unimportant ideas and understand the relationship between ideas. The mentioned strategies are cognitive strategies (Ababaf, 2008).

However, Ababaf (2008) observed that in metacognitive strategies, the strong students of both mathematics and humanity fields similarly use all metacognitive strategies. It means that, although the students of different fields of study such as mathematics and humanity use cognitive strategies differently but they use metacognitive strategies in a same way.

The present study, unlike Ababaf's (2008) study, indicated that mathematics students use more metacognitive strategies and act consciously about the nature and type of the faced task. Identifying the type of the task can be due to develop and use of cognitive abilities related to appropriate strategy selection of problem solving in these students. The problem of education is not only to teach information, but at the same time, students are required to gain some social skills. In the process of cooperative learning, students gain some social skills such as problem solving, communication skills, decision making and time management. In general, the teaching methods based on constructivist approach can be said to have positive effects on many products of cognitive and affective learning such as achievement, retention, transfer, attitude, motivation, high-level cognitive strategies, attendance, peer-relations and self-esteem. The remarkably positive effects on effective variables, besides cognitive variables, increase the importance of teaching methods based on the constructivist approach more and more (Aydin, 2011). Metacognition, like everything else, undoubtedly develops with practice (Papaleontiou-Louca, 2003).

Conclusion

The findings indicated that teaching of metacognitive strategies has been effective in learning. Although, few studies accurately compared students' metacognitive strategies according to their fields of study, but it seems that if it is detected that using which strategies or learning and study skills can enhance individual's metacognitive components, we can also use that skills or techniques in other areas and fields of the study in order to strength and improve all students' metacognitive abilities.

Limitation

The major limitation of this study was that this study was limited to Iranian community. In this community there is a negative bias towards the humanities. Parents interested in empirical or mathematical education. So maybe the competition will lead to a certain degree in that talented people are pushed into certain fields. Another limitation was the low sample size. Due to these limitations are expected to conduct research in other countries with a large sample size to obtain satisfactory results. Findings of this research suggest that students who study various disciplines have different metacognitive strategies or various disciplines reinforce different metacognitive strategies.

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