The Relationship between Metacognitive Awareness Levels, Learning Styles, Genders and Mathematics Grades of Fifth Graders

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Abstract

Previous studies have shown that students, who have high levels of metacognitive awareness, perform better achievement levels than other students. Besides, it can be said that learning styles may affect metacognitive awareness of students. In the literature, studies about metacognition focused on problem solving and learners' mathematical achievement, improvement in metacognition, and supporting some learning environments with metacognition. Therefore, in this study, relationship between metacognitive differences, learning styles, genders and mathematics grades of the fifth grade students are examined. This study was designed as descriptive study and conducted by using relational screening model. The participants consist of 330 fifth grade students from public middle schools. Data collection tools of this study are "Metacognitive Awareness Scale for Children" and "Learning Styles Scale". The data gathered through these scales were analyzed by using Statistical Package for Social Science (SPSS) 21.0. As a result, there is no statistically significant relationship between learning styles and gender. But, there is statistically significant relationship between learning styles-mathematics grades, metacognitive awareness levels (MAL)—grade levels in mathematics, MAL-gender and MAL-learning styles. Learning styles may affect individuals' way of thinking in every moment of the life. Thus, this result has a significant part in education. In fact, parents, teachers and administrators should know metacognitive awareness and learning styles. Thus, knowing these terms can be helpful to understand how the problematic and unsuccessful students show undesirable behaviors since those students' learning styles and metacognitive awareness levels are not considered.

Keywords: fifth grade students, learning styles, metacognitive awareness

1. Introduction

Despite metacognition was suggested by Flavell (1988), it is theoretically an older concept. According to Flavell (1979), metacognition is knowledge that is results of acquired experiences of individual while using cognitive process. Metacognition is a powerful tool for thinking which involves awareness, understanding and interpreting the world around individual (Anderson, Nielsen, & Nashon, 2009). In addition to this, Garner (1987) stated that metacognition is the process of thinking about one's learning and thinking styles. In this regard, metacognition can be defined as thinking about one's learning and thinking processes, and unifying these thoughts with acquired experiences. Individuals may organize and evaluate their cognitions by metacognition.

Polincsar (1986) used a metaphor about football for metacognition. A good football team has a couple of strategies to use in game. However, it is not enough to know these strategies as only theoretical. A good team chooses the suitable strategy in accordance with strengths and weaknesses of opponent team. Yet, it may not be enough. This team should evaluate whether the chosen strategy is appropriate the current condition, continuously and if it is not appropriate anymore, the team should choose a new strategy. As a learner, this type of evaluation process and trying to understand one's learning process may trigger awareness of metacognition. Metacognitive awareness is about being aware of what individual knows, controlling own mental processes, taking over the responsibility of learning, realizing own learning strategies, and planning, evaluating and using own learning and strategies (Bagceci, Dös, & Sarica, 2011; Schraw & Dennison, 1994). Since previous studies have shown that students, who have high levels of metacognitive awareness, perform better achievement levels than other students (Garner & Alexander, 1989; Maghsudi & Talebi, 2009; Martini & Shore, 2008; Pressley & Ghalata,

1989). It can be said that learning styles may affect metacognitive awareness of students. In the process of metacognitive awareness, hence, in order to acquire new knowledge and skills some processes takes place like planning about in what rate efforts are needed and how much time learners should allocate (Cao & Nietfeld, 2007; Sungur, 2007). Therefore, in this study, relationship between metacognitive awareness, learning styles, genders and mathematics grades of learners are examined.

Kolb (1984) defined learning style as a method for personal preferences regarding understanding and processing the information. Felder and Brent (2005) defined it as students' characteristics about cognitive, affective and physical behaviors in the process of acquiring, being affected by and responding information. Moreover, it can be defined as using distinctive approaches while preparing to learn or remembering new and difficult kind of information (Dunn & Dunn, 1986). These approaches of individuals may be differ from each other and they identify individuals' learning styles.

In the process of learning, each student has a different method to retrieve and process information (Kolb, 1983). McCarthy (1990) stated that some of students may realize truths by doings, some of them by thinking, other some by watching and others by feeling, and these methods specify their learning styles (Felder, 1996). Different expectations of students to the extent of variety in offered educational choices, may reflect their achievement degrees (Kuri, 1998). Since, previous studies have shown that individuals may succeed better if educational choices are appropriate their strengths and weaknesses (Dunn & Shea, 1991; Dunn & Steyenson, 1997).

Attaching importance of teachers to metacognition may create positive impact on students' learning (Hacker, Dunlosky, & Graesser, 2009). This situation may cause students to adopt different learning styles. On the other hand, it is emphasized that students' learning styles should consider while designing learning environment (Dwyer, 1996). However, some of the middle school teachers pass over this process since they generally focus on contents of lessons (Schoenbach, Braunger, Greenleaf, & Litman, 2003). Nevertheless, in order to actualize mathematical learning in desired level, the learning environment should be designed effectively (Baltaci, Yildiz, & Kosa, 2015; Chamberlin, 2004; Minotti, 2002; Yonemoto, Yotsumoto, & Taniguchi, 2006). It is important to take into consideration some abilities in design process such as; attitude towards mathematics, self-efficiency, academic self-conception (Bourquin, 1999; Chen, 2002; Migray, 2002), learning styles (Dunn R. & Dunn K., 1992; Williams, 2010), thinking process (English & Watters, 2004; Lesh & Doerr, 2003), problem posing and solving (Lester, 1994; Pativisan, 2006) must also be taken into consideration. Thus, it is possible to provide the student to understand the mathematics as it is regarded difficult by them (Lucangeli & Cornoldi, 1997; Schumann, 2003). That is one of the possible ways for student to be successful in examinations such as PISA or TIMMS (House, 2006; Caraisco-Alloggiamento, 2008).

In the literature, studies about metacognition focused on problem solving and learners' mathematical achievement (Desoete, Roeyers, & Buysse, 2001; Kramarski, 2008; Stewart, Cooper, & Moulding, 2007), improvement in metacognition (Schoenfeld, 1987; Volet, 1991; Yildiz & Ergin, 2012) and supporting some learning environments with metacognition (Blank, 2000; Kramarski, Zemira, & Arami, 2002). In case of learning styles and learning preferences, studies focused on relationships between learning styles and some other variables (Collinson, 2000; Dunn R., Dunn K., & Price, 1990; Ewing & Yong, 1993; Fowler, 2002; Loo, 2002; Rollnick, Davidowits, Keane, Bapoo, & Magadla, 2008; Spires, 1983; Yoon, 2000). In Turkey, these studies generally examined university students (Bahar, Ozen, & Gulacti, 2009; Demirel, 2006; Eren, 2002; Karataş, 2004), high school students (Otrar, 2006; Sezer, 2006; Zengin, 2008) and middle school students from 6th to 8th grades (Bicer, 2011; Yilmaz, 2011). Thus, it may be stated that studying relationship between metacognitive awareness, learning styles, genders and mathematics grades of fifth graders may provide significant contributions to literature and a new path for teachers of fifth graders. Since, inclusion of fifth graders to middle school and teaching with in-field-teacher in fifth grade have started in 2012-2013 academic year in Turkey. Hence, it is possible that these teachers may be inexperience with this grade level. Due to these reasons, aim of this study is to investigate the relationship between metacognitive awareness, learning styles genders and mathematics grades of the fifth grade students.

2. Method

2.1 Research Method

In this study, the relationship between metacognitive awareness, learning styles, genders and mathematics grades of fifth graders have been investigated. This study was designed as descriptive study and conducted by using relational screening model. Main purpose of relational screening model is to determine whether a relationship exists between variables via statistical analysis (Lodico, Spaulding, & Voegtle, 2006).

2.2 Participants

In the selection of the participant group, maximum variation sampling method was used among purposeful sampling methods. Purposeful sampling method is a sampling method to identify and select information rich cases (Patton, 2005). In this study, participants were selected by considering their socio-economic status, achievement levels and willingness.

The participants consist of 330 fifth grade students from public middle schools. Ages of the participants vary between 10-11 years old. This study was conducted with the participants in spring semester of 2015-2016 academic year. In Table 1, distribution of the students in terms of cities and genders are described.

Table 1. Distribution of the participants in terms of cities and genders

Gender	City	f	%
Female	A	60	
	B	61	51.8
	C	50	
Male	A	59	
	B	51	48.2
	C	49	
Total		330	100.0

As seen on Table 1, 51.8% of students are female and 48.2% of them are male.

2.3 Instruments

Data collection tools of this study are "Metacognitive Awareness Scale for Children" (MAS) (Karakelle & Sarac, 2007) and "Learning Styles Scale" (LS) (Simsek, 2007). The MAS is consisted of 12 items as three-point likert scale. In this scale, total point of a student indicates metacognitive awareness of student. The maximum point of this scale is 36 points. The LS was developed for children at 9-11 age group in order to determine their learning styles. This scale is consisted of 94 true-false items.

2.4 Data Analysis

The data gathered through the MAS and LS were analyzed by using Statistical Package for Social Science (SPSS) 21.0. Normality and homogeneity tests were employed. For the normality one of the requirements of parametric, skewness and kurtosis values were analyzed and of these values, for those between -1 and +1, independent samples t-test and ANOVA was conducted for data.

3. Results

Descriptive statistics related to students' learning styles were presented in Table 2 as frequencies and percentages.

Table 2. Frequency and percentage distributions of students' learning styles

Variables	Preferences	F	%
Sound Preferences	Loudness	208	63.0
	Quiet	122	37.0
Light Preferences	Gloomy	235	71.2
	Brigth	95	28.8
Temp Preferences	Warm or Cool	285	86.4
	Hot	45	13.6
Sitting Preferences	Relax	220	66.7
	Sit-back	110	33.3

Time Preferences	Dawn	85	25.8
	Morning	50	15.2
	Afternoon	89	27.0
	Evening	45	13.6
	Night	61	18.5
Eating and Drinking Preferences	Busy	221	67.0
	Snack	109	33.0
Motivation	Slothful	40	12.1
	Topnotch	290	87.9
Responsibility	Unwillingly	26	7.9
	Responsible	304	92.1
Authority Preferences	Parent Oriented	211	63.9
	Teacher Oriented	119	36.1
Working Preferences	Work Solo	135	40.9
	Pair Work	124	37.6
	Group Work	71	21.5
Formalization	Clear	134	40.6
	Obscure	196	59.4
Patience	Impatience	54	16.4
	Patience	276	83.6
Learning Variability	Same Path The Learn	116	35.2
	Different Path The Learn	214	64.8
Movement Preferences	Energetic	116	35.2
	Dummy	214	64.8
Perceptual Leaning Preferences	Visual	177	53.6
	Auditory	65	19.7
	Touchy	88	26.7

As seen on Table 2, 63% of students prefer loud environment to learn while 37% of them prefer quiet environment. For light preferences in learning environment, these rates change to 71.2% for students prefer gloomy environment, 28.8% for students prefer bright environment. In case of temperature preferences, 86.4% of students prefer warm or cool environment and 13.6% of them prefer hot environment. In sitting preferences dimension, 66.7% of students prefer relax position and 33.3% percent of them prefer sit-back while studying. For time preferences, 27% of students prefer studying at afternoon and 13.6% of them at evening. In addition, 33% of students prefer snacking while working. Besides, 12.1% of students are slothful when it comes to study. Moreover, 92.1% of them need to be remembered their responsibilities.

In case for study preferences, 63.9% of students prefer parent oriented learning while others prefer teacher oriented learning. Moreover, 40.9% of them prefer solo working and 37.6% of them prefer pair working. On the other hand, in case of formalization of learning process, 59.4% of students become obscure and need for extra explanations to learn. Besides, 83.6% students are patience and decisive when it comes to learn. In addition, 64.8% of students prefer different paths to learn. In case of movement in learning environment, 35.2 of the students are energetic during learning. Lastly, in case of preferences, 53.6% of students prefer visual learning style, 19.7% of them prefer auditory learning style and 26.7% of them prefer touchy learning style.

Result of χ^2 analysis about whether students differentiate in learning styles in terms of genders are presented in Table 3.

Table 3. Analysis of χ^2 test about differentiation in learning style with respect to gender

Learning Styles	Female		Male		χ^2	sd	p
	f	%	f	%			
Visual	102	59.6	75	47.2			
Auditory	31	18.1	34	21.4	5.46	2	.065
Touchy	38	22.2	50	31.4			

According to analysis result in Table 3, there is no statistically significant relationship between learning styles and gender ($\chi^2(2)$=5.46, p>.05).

Result of χ^2 analysis about whether students differentiate in learning styles in terms of mathematics grades are presented in Table 4. As a reminder, in Turkish educational system and in middle school level, there are five distinct grade levels from one to five.

Table 4. Analysis of χ^2 test about differentiation in learning style with respect to mathematics grades

Learning Styles	1		2		3		4		5		χ^2	sd	p
	f	%	f	%	f	%	f	%	f	%			
Visual	7	31.8	22	62.9	35	52.2	65	59.6	48	49.5			
Auditory	10	45.5	1	2.9	18	26.9	14	12.8	22	22.7	22.62	8	.004
Touchy	5	22.7	12	34.3	14	20.9	30	27.5	27	27.8			

According to analysis result in Table 4, there is statistically significant relationship between learning styles and mathematics grades with Cramer's V effect size of .185 ($\chi^2(8)$=22.62, p=.004). In case of that students' grades in mathematics are 1, 31.8% of them prefer visual, 45.5% of them auditory and 22.7% of them touchy as learning style, while in case of that students' grades in mathematics are 2, 62.9% of them prefer visual, 2.9% of them auditory and 34.3% of them touchy as learning style. In addition, in case of that students' grades in mathematics are 3, 52.2% of them prefer visual, 26.9% of them auditory and 20.9% of them touchy; for student whose grade level are 4, 59.6% of them prefer visual, 12.8% of them auditory and 27.8% of them touchy as learning style. Lastly, students, whose grade levels in mathematics are 5, 49.5% of them prefer visual, 22.7% of them auditory and 27.8% of them touchy as learning style.

ANOVA was conducted to investigate whether differences exist between students' points in MAS and grade levels in mathematics, and results of this analysis are presented in Table 5. Since, the data did not meet assumption of homogeneity of variances (Levene's test, p<0.05), Welch's F value was considered for robustness of result.

Table 5. ANOVA result about differences between points in MAS and grade levels in mathematics

Grade Level in Mathematics	N	$\overline{X}$	sd	ANOVA		Post-Hoc Scheffe	
				Welch F	p		
1	22	26.86	4.70				
2	35	32.63	3.61			1-2	1-5
3	67	31.43	4.03	11.62 (df1=4, df2=87.865)	.0005	1-3	3-4
4	109	32.95	2.17			1-4	3-5
5	97	32.33	2.87				

According to result in Table 5, there exist statistical significant difference between points in MAS and grade levels in mathematics with effect size of (eta square) 0.21 (Welch F (4, 87.865)=11.62, p<.05). In addition,

post-hoc analysis revealed that students' points in MAS, whose grade levels in mathematics are 1, are statistically different from other students. Similarly, students' points in MAS, whose grade levels in mathematics are 3, are statistically different from students, whose grade levels are 4, and ones, whose grade levels are 5 in mathematics.

In addition, in order to analyze whether any difference exists between students' points in MAS and their genders, t-test was conducted and result of this test are presented in Table 6.

Table 6. T-test result about differences between points in MAS and genders

Gender	N	$\bar{X}$	sd	t	p
Female	171	33.06	2.74	4.194	.0005
Male	159	31.47	4.09		

In the light of the result presented in table 6, there is a statistically significant relationship (t=4.194, p<.05) between female students' points in MAS ($\bar{X}$=33.06, sd=2.74), and male students' points in MAS ($\bar{X}$=31.47, sd=4.09).

Lastly, an ANOVA was conducted to investigate whether differences exist between students' points in MAS and learning styles, and results of this analysis are presented in Table 7. Similar to other ANOVA, the data did not meet assumption of homogeneity of variances (Levene's test, p<.05), Welch's F value was considered for robustness of result.

Table 7. ANOVA result about relationship between points in MAS and learning styles

Learning Style	N	$\bar{X}$	sd	ANOVA		Post-Hoc Scheffe
				Welch F	p	
Visual	177	34.90	0.85	5.66 (df1=2, df2=131.959)	.002	Between visual and auditory
Auditory	65	28.86	7.07			
Touchy	88	32.14	3.17			

According to result in Table 7, there exist statistical significant difference between points in MAS and learning styles with effect size of (eta square) 0.48 (Welch F (2, 131.959)=5.66, p<.05). In addition, post-hoc analysis revealed that students, who prefer visual learning style ($\bar{X}$=34.90, sd=0.85), are statistically different from ones, who prefer auditory learning style ($\bar{X}$=28.86, ss=7.07).

4. Discussion

In this study, students' preferences of learning styles were found in order of visual, touchy and auditory learning styles. This result was consisted with the result of Wallace (1995) who stated that students mostly prefer visual styles than auditory styles. However, Dunn R. and Dunn K. (1987) revealed that in early childhood education and primary education learning generally is based on touchy styles, and in middle schools from fifth-sixth grades learning styles change to visual and auditory styles. It may be effective in emerging these arguments that the teachers try to design the learning environments during the constructivist process instead of abstract materials. In addition, the results showed that most of the students prefer studying at afternoon. Collinson (2000) found similar results and stated that students have high energy to study at that time. Therefore, parents should motivate their children to study at these hours of day.

Students' preferences of learning styles have not changed significantly in accordance with their genders. Both males and females prefer learning styles as in order of visual, touchy and auditory. In contrast with this result, Dunn (2000) found that most of the females prefer auditory learning styles. On the other hand, some other studies have found significant results for learning styles and genders (Bicer, 2011; Honigsfeld, 2001; Severiens & Geert, 1994). However, in parallel with this result, Pieronek (1974) and Pyryt, Sandals and Begoray (1998) have not found significant results. That no difference has been found between learning styles and gender of participants can be originated from their age. There is little differences dependent on gender in terms of developmental features

in these ages (10-11) (Simsek, 2007). Therefore, in the present study, it is compatible with the expected results that there is no significant difference depending upon gender.

Results revealed that there is a significant difference between learning styles and students' mathematics grades. This result is compatible with the results of Collinson (2000) and Honigsfeld (2001). Similarly, Utanır (2008) found significant relationship between preferring learning styles as visual or auditory, and students' achievement in his study of fifth grade students in mathematics. In the light of this result, mathematics teachers should be aware of designing learning environments in accordance with learning preferences of students, and the effects of this type of design should be also discussed with the teachers. Since, Farkas (2002), Kopsovich (2003) and Wood (2000) have found that learning environment designed based on students' learning styles, can enhance students' achievement level. Lesson study may be used as a method for this discussion with the teachers and in-service training to inform the teachers about learning styles. With the help of lesson study, teachers have opportunity to administrate and evaluate planned lesson in real classroom settings (Fernandez & Yoshida, 2004; Lewis, Perry, & Hurd, 2009; Stigler & Hiebert, 1999).

Another result of the study was that there was a significant relationship between students' metacognitive awareness and mathematics grades. The results revealed that students' points in MAS, whose grade levels in mathematics are one, are statistically different from other students. Similarly, students' points in MAS, whose grade levels in mathematics are three, are statistically different from students, whose grade levels are four, and ones, whose grade levels are five in mathematics. In parallel with these results, some studies showed that students, who have high metacognitive awareness, achieve better in mathematics than other students (Coutinho, 2007; Garner & Alexander, 1989). Ataalkın (2012) studied effects of metacognitive teaching strategies based teaching on metacognitive awareness skill, academic achievement and attitudes. Ataalkın (2012) stated that there is no statistical difference between experimental and control groups in terms of metacognitive awareness. But in the literature, there are various studies, which signify this relationship, mathematics teacher should design activities to enhance metacognitive awareness in order to help students' achievement in mathematics. As a matter of fact, it is possible to read many studies emphasizing the importance of taking into consideration of the metacognitive awareness during planning the lesson for teachers (Davidson, Deuser, & Sternberg, 1994; Hacker, Dunlosky, & Graesser, 2009; Lin, 2001). Thusly, the teachers, knowing the students' metacognitive awareness, plan the education process more appropriately by emerging the students' different aspects. Furthermore, the teachers can activate the lessons more pleasurable for the students with this kind of planning.

In the light of the result about relationship between students' metacognitive awareness and gender, a significant difference found between males' and females' metacognitive awareness scores. In some studies, it was stated that females and males prefer to use different metacognitive strategies (Eccles, Wigfield, Harold, & Blumenfeld, 1993; Renniger, Hidi, & Krapp, 2014). On the other hand, different studies found that there is no or quite a little difference between females and males in accordance with their metacognitive strategies (Hyde, Fennema, & Lamon, 1990; Walberg, Harnisch, & Tsai, 1986). The difference between females' metacognitive awareness and males' metacognitive awareness may be a result of biological reasons such as hormonal functions and brain chemistry, and social reasons such as area of living, values of society and cultural factors. Since these reasons are the basis of individual differences, they may cause the differences between metacognitive awareness of females and males.

Some studies revealed that the most preferred group of learning types are cognitive, metacognitive and compensative strategies (Gorevanova, 2000). Cano, Hughes H. and Hughes G. (2000) stated the existence of a relationship between learning styles and thinking styles. However, Artzt and Armour-Thomas (1998) claimed that teachers do not care about evaluating what students understand. Whereas, Schwartz, Bransford and Sears (2005) revealed that every single class are different from another and different practices are needed for metacognitive interventions in every class. As a matter of fact, in this study, results revealed a significant difference between students' learning styles and metacognitive awareness. Students, who prefer visual and auditory learning styles, have significantly different scores in metacognitive awareness scale. Learning styles may affect individuals' way of thinking in every moment of the life. Thus, this result has a significant part in education. In fact, parents, teachers and administrators should know metacognitive awareness and learning styles. Thus, knowing these terms can be helpful to understand how the problematic and unsuccessful students show undesirable behaviors since those students' learning styles and metacognitive awareness levels are not considered.

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