European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.344919 Volume 3 | Issue 4 | 2017

THE RELATIONSHIPS BETWEEN CRITICAL THINKING SKILLS AND LEARNING STYLES OF GIFTED STUDENTS

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Abstract:
The current study investigates the relationship between critical thinking skills and learning styles of mentally gifted students. The participants were 225 gifted students in Turkey attending Science and Art Centres which are after-school activity centers for mentally gifted students. Participants were 9 -15 years old and were attending secondary schools and high schools. The data were gathered using the Kolb Learning Style Inventory and the Critical Thinking Scale and analyzed using Chi-Square, t test, ANOVA and regression analyses. The findings revealed that gender was not a significant variable for learning styles but it was a significant variable for critical thinking skills. Gifted students had high scores on the Critical Thinking scale. Relationships were also found between gifted students' learning styles and their critical thinking skills except in the analysis dimension of the Critical Thinking scale. Gifted students who achieved the highest scores on the scale had assimilating and converging learning styles.

Keywords: gifted students, critical thinking, critical thinking disposition, learning styles, modes of learning

1. Introduction

The current educational era has witnessed curriculum revolutions in many countries influenced by the constructivist movement. This revolution has also affected all components of education including educational policy, teachers, and schools. The revolution has launched new terms such as "learning to learn," "teaching thinking

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skills", and "creative thinking". "Critical thinking" is also one of these terms. This is because, in today's world, an individual is exposed to many new and contradictory ideas and challenging conditions during an ordinary day. From the time one wakes up, one is exposed to many advertisements on TV, the internet, and other media, and in the workplace one is again exposed to many new ideas and offers. Thus, an individual has to decide on many things such as what to buy, where to go on holiday, and which news reports to believe. To choose the best option, one should know how to compare the options and to think deeply; in other words, one should know how to use critical thinking (McKnight, 2000; Kenney, 2013). Despite many curricular reforms, teaching critical thinking has not reached the desired level set out in curriculum goals. Many researchers have tried to discover the reasons for this problem. As noted by Sternberg (1987), many curriculums are doomed to fail to teach critical thinking because they are prepared in advance of classes. Sternberg emphasizes teachers' and learners' individual differences. These differences include variations in students' learning styles and IQ levels (Demir, 2006; Güven & Kürüm, 2008; Kettler, 2014; Thomson, 2010). In the literature, there are many studies analyzing the relation between critical thinking skills and other variables such as age, gender, teaching and learning styles in general school education. However, there are limited number of studies dealing with the relationship between the learning styles and critical thinking skills of mentally gifted students. This study attempts to answer the question of whether there is a relationship between the critical thinking skills of gifted learners and their learning styles in Turkey.

2. Literature Review

2.1 Critical Thinking (CT)

In the literature, there are numerous definitions of critical thinking (e.g. Brookfield, 1987; Kurnaz, 2014, Lipman, 1988; Meyers, 1986). Robert Ennis (1985, p. 45) defined critical thinking as "*reasonable and reflective thinking focused on deciding what to believe or to do*". Sternberg (1986, p. 3) defines the term as "*the mental processes, strategies, and representations people use to solve problems, make decisions, and learn new concepts*". Although there are many different definitions of the term, critical thinking and its components were not identified until 1990 by a group of scientists who joined the Dephi Panel managed by Facione in the USA (Facione, 1990). In the Dephi Report critical thinking is defined as "*self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based*" (Facione, 2013, p. 4). For Facione, critical thinking has six components.

The first is interpretation, which means, "*to comprehend experiences, data, events, judgments, rules and so on*" (Ennis, 2011, p. 6).

The second component of critical thinking is analysis, which means "*to identify the relationships among events, concepts and the other forms of judgments*" (Demir, 2006).

The third component is inference, in the sense of drawing conclusions based on the evidence available (Demir, 2006; Rudd & Baker, 2000).

The fourth component is explanation, defined as to justifying an explanation in a coherent, methodical, reasonable way (Lowy, 2014).

The fifth component is evaluation which is defined by Facione as the ability "*to assess the logical strength of the actual or intended inferential relationships among statements, descriptions, questions, situations and so on''*.

The sixth component of critical thinking is self-regulation, which is defined as "*self-consciously to monitor one's cognitive activities*" (Facione, 2013, pp. 4-5).

Although teaching critical thinking does not guarantee better life conditions for learners in the future, knowing critical thinking enables them to make more accurate decisions affecting the future. Making accurate decision about their lives may make them happier. Teaching critical thinking needs time and effort, and knowing students' learning styles makes teaching critical thinking easier (Rayneri, Gerber & Wiley, 2006). Furthermore, knowing a student's learning style and teaching according to the student's learning style help the teacher engage students with the subject (Boydak, 2008; Rudd & Baker, 2000).

2.2 Learning Styles

In the last thirty years, many different learning style models have been set; however, Rita Dunn was one of the first to use the concept of a learning style (Dunn & Dunn, 1979). According to Dunn, Beaudry and Klavas (2002) learning styles are learners' dominant behaviours during their learning process. Learning styles indicate "*an individual's preferred way of learning or how the individual acquires information*" (Felder & Brent, 2005, p. 59).

Kolb's learning style model is based on his experiential learning theory. Kolb (1981) regards learning styles as the ways in which learners approach learning, and argues that individuals tend to have a preferred learning style. According to Kolb (1984, p. 74), the learning process consists of a four-stage learning cycle. The first stage is "Concrete Experience" (CE-feeling). At this stage, the learner encounters a new situation or reinterprets an existing experience. This provides the basis for the second stage called "Reflective Observation" (RO-watching). The learner understands ideas and situations from different points of view; in other words, an individual learner looks

at ideas and situations from several points of view as part of the learning process. In the learning process, the learner relies on patience, objectivity, and careful judgment (Suliman, 2006). Reflective observation is required for "Abstract Conceptualization" (AC - thinking). In this stage, learning involves using theories, logic and ideas, rather than feelings, to understand problems or situations. Typically, a learner relies on systematic planning and develops theories to solve problems. In the final stage the learner applies this new knowledge to a new situation; this is called "Active Experimentation" (AE- doing) (Smith & Kolb, 1986). When a learner enters the learning process, these four stages are experienced and each stage of the learning cycle is associated with a learning mode - diverging, assimilating, converging, and accommodating (Svinicki & Dixon, 1987).

A. Diverging Style: Divergers are sensitive and good observers. They like exploring new ideas. They behave naturally and use imagination to solve problems. They are the best of all the learning mode groups at viewing concrete situations from several different viewpoints. Kolb called this style "Diverging" because people who use this style perform better in situations that require the generation of ideas (Baymeyer, 2004; Kolb & Kolb, 2005). Divergers have Concrete Experience/Reflective Observer (CE/RO) characteristics (Kolb, 1984).

B. Assimilating Style: Assimilators prefer to be concise and to have a logical approach. Ideas and concepts are more important than people. They prefer good, clear explanations rather than practice or application. Assimilators excel at understanding wide-ranging information and organizing it in a clear, logical format (Svinicki & Dixon, 1987). They are primarily interested in ideas, abstract concepts and numbers. Assimilators have Abstract Conceptualization/Reflective Observation (AC/RO) as dominant learning abilities (Kolb, 1984).

C. Converging Style: Convergers can solve problems and use their knowledge to find solutions to problems. They like technical tasks and are prone to analytical thinking; however, they generally have difficulties in looking at problems from different perspectives. Convergers like experimenting with new ideas (Kolb, 1984). Their learning style is classified as Abstract Conceptualization/Active Experimenter (AC/AE).

D. Accommodating Style: The Accommodating learning style is 'hands-on', and accommodators rely on intuition rather than logic. These learners use other people's analysis, and prefer to take a practical, experiential approach (Koob & Funk, 2002). They prefer to work in teams to complete tasks. They do not like to work systematically and tend not to think analytically. Accommodators have Concrete Experience/Active Experimentation (CE/AE) as dominant learning abilities (Kolb, 1984). A student's mode of learning is one of the important factors that define the instruction given. As gifted

students' preferred modes of learning differ from their peers, the teaching methods should be different from the methods used in general education (Eriş, 2010; Myers & Dyer, 2006). Indeed, applying teaching methods appropriate to students' learning style improves students' achievements (Alnesyan, 2012; Ghazivakili, et al., 2014; Mahmoud, 2012).

2.3 Gifted Education

Giftedness and gifted education are not old concepts in education and educators have tried to define the term gifted. The term "gifted" is generally defined as extraordinary mental performance in children or as higher learning ability in children when compared with their peers (NAGC, 2010). Gifted students generally process information faster than average-ability peers in complex tasks (Roberts, et. al., 1988). When these definitions are considered, it is supposed that gifted children should have an aptitude to think critically. However, the level of critical thinking skill varies between gifted students because of individual differences (Kettler, 2014).

The 1970s and 1980s were a period when special curriculums, aiming at developing creativity and critical thinking, were designed for gifted education (Tuttle, Becker & Sousa, 1988). During the same period, some new instructional designs were also prepared in the light of research on the characteristics of the gifted (Reis & Mc Coach, 2000). One of the individual characteristics examined in the research was learning style and another was the critical thinking skills of the gifted. Later, many studies (Dixon et al., 2004; Mahmood, 2012; Schenck & Cruickshank, 2014; Siriopoulos & Pomonis, 2007; Suliman, 2006) looked for relationships between learning style and critical thinking in different fields, such as nursing, engineering, agriculture, primary education (İşlekeller, 2008; Kettler, 2014). However, only a very limited number of studies dealt with the relationship between teaching critical thinking and the learning styles of gifted children.

Although similarities in teaching approaches in gifted education can be described, there are no general 'hands on' activities suitable for every gifted student (Ford, Grantham & Whiting, 2008; Ross, & Wright, 1987) because of their having different cognitive levels and coming from different cultural, socio-economic backgrounds. In these circumstances, it became a priority for educators across the world to define gifted students' learning preferences in their own cultures. Roberts, et al. (1988) indicated that as gifted students have different learning preferences than their peers, an enriched curriculum should be applied in regular classes and this enriched curriculum should contain differentiated activities in learning experiences, to help gifted students manage independent study, develop strategies for cooperative learning

and to participate in interdisciplinary activities (Dixon, et al., 2004; Ketler, 2014; Van Tassel-Baska, 1992).

2.4 Gifted Education in Turkey

In Turkey, gifted education has flourished during the last two decades. The new model for gifted education has been given a place in the Turkish education system. In this model, students who show signs of being talented during their compulsory education are identified by their teachers. These students are then given two tests. The first is a multiple-choice exam and students who pass then have a right to take a performance test. In the performance test, students' IQ levels are determined by Wisc-R, WNW or similar IQ tests whose reliability and validity analyses are made based on a Turkish sample. Students who are gifted attend a Science and Art Center (SAC) at least two days in a week (MNE, 2015). At an SAC, they attend courses according to their defined abilities and study with a mentor up to end of their compulsory education period at the age of 18.

The SACs' standards for gifted education advise that to work effectively with identified gifted students, educators need to understand the characteristics of the gifted. As differentiated and enriched curriculums are applied at SACs, knowing students' learning styles helps teachers when teaching critical thinking. There is an emphasis on developing critical thinking in both the gifted education program and in the general education program. This study examines whether critical thinking skill levels should be considered when designing differentiated learning activities, and whether this enables educators and curriculum designers to compare the effects of cultural differences in gifted education. Defining gifted students' critical thinking skills and learning styles helps to decide upon the nature of gifted education programs. Although the results cannot be generalized to all cultures, it can provide results that are comparable with those of many other cultures. The results may also be helpful in preparing instructional designs for gifted students in other cultures.

3. Method

3.1 Participants

The sample of the study consisted of 225 gifted and talented students voluntarily attending two different SACs. In Turkey, there are 83 SACs. 129 (57.3%) of the participants were male and 96 (42,7%) were female. 53 students (23,6%) were 5th grade, 45 (20%) 6th grade, 35 (15.6%) 7th grade and 92 (40.9 %) 8th graders. Their attendance duration at an SAC varied. 50 (22.2%) of them had been attending an SAC for 1 year, 58

(25.8%) students had been attending an SAC for 2 years and 117 had been attending an SAC for 3 or more years. Students' ages varied from 11 to 16 years.

3.2 Data Collection Tools

The present study used the Critical Thinking Skills Scale (CTSS) developed by Demir (2006). The CTSS measures six dimensions of critical thinking. Of these, three dimensions, the analysis, evaluation and inference dimensions, are related to giving answers as 'true' or 'false' in certain situations. For the evaluation dimension, answers were coded as '1' for correct answers and '0' for incorrect answers. The analysis dimension consisted of eight items, the evaluation dimension had nine items and the inference dimension had eight items.

Scores for the interpretation and explanation dimensions were based on both four multiple-choice tests. Questions were based on a single text that was used for both tests. In the interpretation dimension, there were 10 items and in the explanation dimension, there were nine items. The last dimension, self-regulation, consisted of 12 items. These dimensions were coded with a Likert-type scale, as 1=never, 2= sometimes and 3= always.

The scale used in this study was developed by Demir (2006). In Demir's (2006) research, the Pearson correlation values were: .71 for the analysis dimension; .86 for the evaluation dimension; and .70 for the inferences dimension. The K-20 values were: .76 for the interpretation dimension; .77 for the explanation dimension; and .99 for the self-regulation dimension (Demir, 2006). In the present study, the Pearson correlation values were found to be: .74 for the analysis dimension; .83 for the evaluation dimension; and .74 for the inferences dimension. Reliability values were found to be: .81 for the interpretation dimension; .88 for the explanation dimension; and .89 for the self-regulation dimension.

The 'Kolb Learning Style Inventory III' was used to define gifted students' learning styles. The inventory, consisting of 12 items, was developed by Kolb (1985) and adapted by Gencel (2007) to Turkish culture. In the Gencel inventory, individuals are tested on how they would respond in 12 different formal learning situations. For each situation, participants are asked to choose from 4 possible learning approaches. In the present study, participants were asked to grade the situations according to their personal preferences on a scale of 1 to 4, where 4 was for the most suitable situation, and 1 was for the least suitable situation. Analyzing their responses, students' learning styles were distributed into four categories as 'concrete experience' (CE), 'reflective observation' (RO), 'abstract conceptualization' (AC) and 'active experimentation' (AE). The AE score was subtracted from the AC score and the RO score was subtracted from

the AE score, and the results were analyzed according to the scale. At the end of the process, students were labeled as 'accommodating', 'diverging', 'assimilating', or 'converging'. In addition, the distribution of the students was determined according to the Nine-Region Learning Style Type Grid (Hunt, 1987).

The same scale has been used in many studies in Turkey, including: Demirbaş & Demirkan, 2007; Ekici, 2013; and Tezci & Ataseven, 2016. In the present study, the following Cronbach Alpha reliability coefficients were found: .76 for the CE dimension; .71 for the RO dimension; .78 for the AC dimension; .84 for the AE dimension; .85 for AC-AE; and .79 for and AE-RO. These values are similar to the values found by Kolb (1985). They are higher than the values found in a previous adaptation study by Aşkar and Akkoyunlu (1993), but are similar to that of Gencel (2007).

3.4 Data Analysis

Descriptive statistics were used to identify the participants' levels of critical thinking and learning styles. The Chi-Square and t test were conducted to examine gender differences. An ANOVA test was conducted to examine whether participants' responses differed by their learning styles. A Pearson correlation analysis was carried out to examine the inter-relations between the variables of interest. Finally, a regression equation block method was conducted to examine the relative contribution of the factors predicting critical thinking.

4. Findings

4.1 Descriptive Analysis of Learning Styles

Students' learning style scores' Mean (M), Standard Deviation (SD) and Range (R) values were analyzed for each item (CE, RO, AC, AE, AC-CE and AE-RO). In addition, students' favorite learning styles were defined. The results were shown in Table 1.

Table 1: The average raw scale scores and preferred learning styles

	R	M	SD	Skewness	Kurtosis
CE	44-14	23.47	5.95	.885	1.004
RO	43-16	29.11	4.98	.138	.471
AC	48-20	33.82	6.48	.512	-.184
AE	45-18	33.60	5.72	-.182	-.191
AC_CE	34 to -14	10.35	10.65	.210	.044
AE_RO	26 to -19	4.49	8.59	-.393	.128
Preferred Styles	Accommodating (n=36. 16%)	Diverging (n=56. 24.9%)	Assimilating (n=77. 34.2%)	Converging (n=56. 24.9%)	

According to the analysis, the lowest mean (M = 23.47, SD = 5.95) was seen in the CE dimension and the highest mean (M = 33.82, SD = 6.48) was seen in the AC dimension. According to the scores obtained on the learning style scale, the assimilating learning style was the most preferred style (34.2%). Other preferred styles were the converging learning style (24.9%), the diverging learning style (24.9%) and the accommodating learning style (16%).

4.2 Analyses of learning styles according to demographic variables

A Chi-square analysis was conducted to define whether students' learning styles change according to gender and duration of attendance at an SAC.

Table 2: The distribution of gender and duration of attendance at a Science and Art Center by Learning Style

	Gender		Duration of Attendances to SAC		
	Male	**Female**	**1 Year**	**2 Year**	**3 and more years**
Accommodator	16	20	9	8	19
Converger	30	26	5	8	43
Diverger	32	24	8	13	35
Assimilator	51	26	11	13	53
Total	129	96	33	42	150

There was no significant difference in learning styles by gender and duration of attendance at an SAC (gender, X^2= 5.263, df=3, p=.154; attendance duration at an SAC, X^2= 7.564, df=6, p=.272).

4.3 Descriptive Statistics of Critical Thinking

The highest possible scores on three sub-dimensions of the critical thinking scale were 8 for 'evaluation', eight for 'inferences', 10 for 'interpretation' and 9 for 'explanation', and the lowest possible score was 0 on all three sub-dimensions. For the self-regulation dimension, the highest possible score was 36 and the lowest possible score was 12.

Descriptive statistics of the scores taken from critical thinking scale and sub dimensions are given in Table 3.

Table 3: Descriptive statistics for the critical thinking scale and its sub-dimensions

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Analysis	225	5.00	8.00	7.27	.97	-1.020	-.252
Evaluation	225	5.00	9.00	8.18	1.07	-1.069	-.003
Inferences	225	4.00	8.00	7.08	1.05	-.887	-.382
Interpretation	225	3.00	10.00	7.75	1.72	-.364	-.564
Explanation	225	4.00	9.00	7.51	1.35	-.531	-.835
Self-regulation	225	20.00	36.00	30.18	4.14	-.703	-.083
Entire Scale	225	7.67	13.33	11.33	.08	-.524	-.030

According to the analysis, the lowest mean (M = 7,08, SD =1.05) was seen in the interpretation dimension and the highest mean (M = 8,18, SD = 1.07) was seen in the evaluation dimension. The mean scores on the sub-dimensions and on the overall critical thinking scale were high. That is to say, gifted students had a high ability to think critically.

4.4 Analysis of Variance Critical Thinking Skills by Learning Styles

ANOVA was conducted to define the relationship between preferred learning styles (LS) and critical thinking skills. The results are given in Table 4.

Table 4: ANOVA Results for Critical Thinking Skills According to Learning Styles

CTT	LS	N	M	SD	Mean Square	$F_{(3.221)}$	p	$f2$	Tukey
Analysis	a-Accommodators	36	7.06	1.01	1.714	1.814	.146		-
	b-Convergers	56	7.48	.83					
	c-Divergers	56	7.14	1.08					
	d-Assimilators	77	7.30	.96					
Evaluation	a-Accommodators	36	7.69	1.19	4.302	3.834	.011*	.21	a<b.d
	b-Convergers	56	8.43	1.00					
	c-Divergers	56	8.11	.98					
	d-Assimilators	77	8.27	1.08					
Inferences	a-Accommodators	36	6.67	1.04	4.242	3.956	.009*	.20	a<b.d
	b-Convergers	56	7.30	.97					
	c-Divergers	56	6.89	1.17					
	d-Assimilators	77	7.23	.97					
Interpretation	a-Accommodators	36	6.44	1.50	51.989	22.770	.000*	.54	a.c<b.d
	b-Convergers	56	8.55	1.42					
	c-Divergers	56	6.98	1.55					

	d-Assimilators	77	8.32	1.54					
Explanation	a-Accommodators	36	7.11	1.32	14.065	8.492	.000*	.32	a.c<b.d
	b-Convergers	56	7.73	1.33					
	c-Divergers	56	6.93	1.36					
	d-Assimilators	77	7.95	1.19					
Self-regulation	a-Accommodators	36	27.58	4.71	125.264	7.975	.000*	.27	a<b.d
	b-Convergers	56	31.14	4.00					
	c-Divergers	56	29.63	3.73					
	d-Assimilators	77	31.09	3.71					
Entire	a-Accommodators	36	10.42	1.24	19.734	15.698	.000*	.42	a.c<b.d
	b-Convergers	56	11.79	1.09					
	c-Divergers	56	10.95	1.14					
	d-Assimilators	77	11.68	1.06					

*p<.05

According to the results, there were no significant differences on the Analysis dimension (F= 1.814, p<.05) in terms of learning style. On the evaluation dimension, accommodators had lower scores (M= 7.69, SD=1.19) than convergers (M= 8.43, SD=1.00) and assimilators (M=8.27, SD=1.08) (F=3.834, p<.05). On the inferences dimension, accommodators (M= 6.67, SD=1.04) had lower scores than convergers (M= 7.30, SD=.97) and assimilators (M=7.23, SD=.97) (F=3.956, p<.05). On the interpretation dimension, students preferring accommodating (M= 6.44, SD=1.50) and diverging learning styles (M=6.98, SD= 1.55) had lower scores than students who preferred converging (M= 8.55, SD=1.42) and assimilating (M=8.32, SD=1.54) learning styles. On the Explanation dimension, accommodators (M= 7.11, SD=1.32) and divergers (M=6.93, SD= 1.36) had lower scores than convergers (M= 7.73, SD=1.33) and assimilators (M=7.95, SD=1.19) (F=8.492, p<.05). On the self-regulation dimension, students preferring accommodating learning styles (M=27.58, SD=4.71) had lower scores than students preferring converging (M=31.14; SD= 4.00) and assimilating (M=31.09; SD=3.71) learning styles. According to the overall scores on the critical thinking skills scale, convergers (M=11.79, SD=1.09) and assimilators (M=11.68, SD=1.06) had higher scores than accommodators (M=10.42, SD=1.24) and divergers (M=10. 95, SD=1.14) (F=15.698, p<.05). Analysis of the means on the interpretation dimension and overall scores on the critical thinking scale revealed a large effect size, for the rest of the dimensions the effect size was found to be at a medium level (Cohen, 1988). This result shows that learning styles had an important effect on critical thinking skills.

4.5 Correlation and Regression Analysis

Correlation analysis was carried out to determine whether the gifted students' critical thinking skills (both the overall score and the sub-dimension scores on the critical thinking scale) were associated with CE, AC, AE, and RO modes of learning. The results of the analysis are provided in Table 5.

Table 5: Correlational Analysis

	1	2	3	4	5	6	7	8	9	10	11	12
1-Analyses	1											
2-Evaluation	.43**											
3-Inferences	.42**	.59**										
4-Interpretation	.32**	.35**	.30**									
5-Explanation	.39**	.34**	.31**	.54**								
6-Self-regulation	.43**	.47**	.47**	.22**	.37**							
7-Critical Thinking Entire	.63**	.67**	.64**	.58**	.65**	.87**						
8-CE	.52**	.35**	.31**	.41**	.47**	.46**	.59**					
9-RO	.31**	.36**	.34**	.40**	.31**	.38**	.49**	.52**				
10-AC	.38**	.66**	.56**	.33**	.38**	.58**	.68**	.49**	.46**			
11-AE	.27**	.30**	.38**	.19**	.31**	.43**	.46**	.55**	.44**	.48**		
12-AE-RO	.05	.06	-.01	.06	.01	-.02	.14*	.03	.19**	-.03	-.38**	
13-CE-AC	.05	-.05	-.08	-.02	.04	-.14*	-.04	.25**	-.04	-.24**	.05	-.04
Gender	-.08	-.11	-.12	-.10	-.21**	-.11	-.19*	.06	.11	-.12	-.16*	-.03

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed)

Analysis of the results showed that there was a positive medium level of correlation between the scores taken from the sub-dimensions of the critical thinking scale and the learning styles inventory scores. The lowest correlation was found between the interpretation dimension of the critical thinking scale and the AE mode of learning (r=.19, p<.01). The highest correlation was found between the evaluation dimension of the critical thinking skills scale and AC (r=.66<.01). There was also a positive medium level of correlation with a significant meaningful difference among all variables (p<.01). There was no significant relationship between AE-AC, CE-AC and the sub dimensions of the critical thinking scale. There was a medium level correlation between overall critical thinking scores (r=.59, p<.05) and RO (r=.49, p<.05), AC (r=.68, p<.05), AE (r=.46, p<.05). As there was no autocorrelation between learning style row scores, a forced hierarchical regression analysis and stepwise method was applied to determine which variables served as predictors for the sub-dimensions of the critical thinking scale. In the analysis, the sub-dimensions of critical thinking were dependent variables. The

predictor variables included in the equation were as follows: the first block consisted of the demographic variable (gender as a dummy variable) and the second block consisted of the mode of learning followed by CE, AC, RO and AE. The results are presented in Table 6.

Table 6: Regression Analysis

Dependent Variable		Independent Variables	β	Std. Error	t	p	R	R^2	df	F
Analysis	Model 1	CE	.517	.006	9.025	.000	.517	.268	1, 223	81.454
	Model 2	CE	.439	.006	6.752	.000	.536	.280	2, 222	44.645
		AC	.159	.009	2.451	.015				
Evaluation	Model 1	AC	.656	.007	12.990	.000	.656	.431	1, 223	168.742
Inferences	Model 1	AC	.556	.007	10.001	.000	.556	.310	1, 223	100.024
	Model 2	AC	.487	.008	7.768	.000	.571	.326	2, 222	17.748
		AE	.145	.007	2.319	.021				
Interpretation	Model 1	CE	.406	.011	6.639	.000	.406	.165	1, 223	44.079
	Model 2	CE	.274	.013	3.929	.000	.462	.213	2, 222	29.970
		RO	.205	.018	3.662	.000				
Explanation	Model 1	Gender	-.213	.137	-3.249	.001	.213	.045	1, 223	11.115
	Model 2	Gender	-.241	.119	-4.230	.000	.532	.283	2, 222	43.772
		CE	.488	.007	8.577	.000				
	Model 3	Gender	-.218	.120	-.218	.000				
		CE	.412	.008	6.326	.000	.548	.300	3, 321	31.543
		AC	.152	.013	2.316	.021				
Self-regulation	Model 1	AC	.581	.036	10.653	.000	.581	.334	1, 223	113.481
	Model 2	AC	.470	.040	7.727	.000	.613	.370	2, 222	66.881
		CE	.226	.027	3.712	.000				
Critical Thinking Entire	Model 1	Gender	-.190	.134	-2.891	.004	.190	.036	1, 223	8.355
	Model 2	Gender	-.108	.100	-2.199	.029	.688	.473	2, 222	99.807
		AC	.666	.009	13.579	.000				
	Model 3	Gender	.091	-.152	-3.393	.001	.757	.573	3, 221	98.741
		AC	.582	.009	9.408	.000				
		CE	.365	.006	7.165	.000				
	Model 4	Gender	-.172	.091	-3.859	.000	.767	.589	4, 220	78.735
		AC	.436	.010	8.244	.000				
		CE	.308	.007	5.730	.000				
		RO	.156	.009	2.927	.004				

In the stepwise regression analysis, CE, AC, RO and AE served as the predictor variables. The dependent variables were Analysis, Evaluation, Inferences, Interpretation, Explanation, Self-regulation and the Overall Critical Thinking Scale. It was found that each mode made an independent contribution to the equation. The values were as follows: Analysis dimension, CE (β =0.44) and AC (β =0.16), Evaluation dimension, AC (β =0.66); Inferences dimension, AC (β =0.49) and AE (β =0.15); Interpretation dimension, CE (β =0.27) and RO (β =0.21); Explanation dimension, CE (β =0.38) and AC (β =0.20); Self-regulation dimension, AC (β =0.47) and CE (β =0.23).

It was found that AC (β =0.49), CE (β =0.29) and RO (β =0.13) predicted the Critical Thinking Scale entire score and it emerged that AC alone accounted for 46.2% of the variation in General Critical Thinking Skills. The other variables (CE and RO), collectively, accounted for an additional 9.3% of the variation in the Critical thinking. AC and CE were the best predictive of critical thinking. Gender, accepted as Dummy variable, was a predictive in Explanation dimension (β= -0.22) and overall of the critical thinking scale (β= -0.17). For other sub dimensions, gender had no contribution to the equation.

5. Conclusion and Discussion

The purpose of this study is to identify whether mentally gifted students' critical thinking skills differentiate according to their gender, duration of attendance to SAC and preferred learning styles, and which modes of learning (CE, AC, RO and AE) predict critical thinking skills. The results showed that the predominant style was assimilating, followed by converging, diverging and accommodating.

Research conducted on different populations revealed varying results. Yenice (2012), Ghazivakili, et al. (2014) and Tulbure (2012) found that the predominant learning style were convergent followed by assimilating. In some studies, the predominant learning style was found to be diverging (Andreou, Papastavrou & Merkouris, 2014; Gyeong & Myung, 2008; Siriopoulos & Pomonis, 2006). Other studies found that the assimilating style was predominant (Yamazaki, Murphy & Puerta, 2002; Patterson, 1994, Tezci & Ataveseven, 2016), while yet others found the accommodating style to be predominant (Colucciello, 1999; Nastanski & Slick, 2011). Kolb (2005) defined the converging learning style as the predominant learning style in his study. Ross & Wright (1987) argued that since gifted students are different from non-gifted students, the teaching of gifted students should be different from the teaching of students attending general education, and that gifted students' learning styles and cognitive characteristics are not the same as those of non-gifted students.

In this study, the preferred learning style was found to be the assimilating style, followed by the converging and diverging styles in joint second place. In Turkey a number of studies (Ay, Padem & Eriş, 2010; Güven & Kürüm, 2007; Tezci & Ataseven, 2006) found that the preferred learning style was the assimilating style. These findings are contrary to Demirbaş and Demirkan's (2007) study in which they state that the dominant learning style is converging. On the other hand, in other studies related to students' learning style preferences there were different results (e.g. Colucciello, 1999; Cook, n.d.; Kolb, 1993; Kvan & Yuan, 2005; Mahmoud, 2012). Mahmoud, in a study

(2012, p. 409) based on research group characteristics (e.g. gifted or non-gifted, young or adult, teacher or student, student enrolled in department, and cultures indicated that, "students' preferred learning styles might be influenced by culture because of different socialization". Results from previous research (e.g. Becher & Trowler, 2001; Kolb, 1981, 1993) indicated that students' learning styles changed according to the subject being studied.

The results in the present study indicate that gender and duration of attendance at an SAC were not significant variables in preferred learning styles. Gender was not a significant variable in gifted student's preferred learning styles. Learning styles have stable characteristics and develop regardless of the subject being studied or the skill being mastered (Kolb, 1981; Nastanski & Slick, 2011; Ross & Wright, 1987). The finding about gender agrees with many studies (Demirbaş & Demirkan, 2007; Myers & Dyer, 2006; Walsh & Hardy 1999; Yenice, 2012), but contradicts other studies (Ghazivakili, et al, 2014; Peng, Ma & Li, 2006; Philbin, Meier, Huffman & Boverie, 1995; Wehrwein, Lujan & DiCarlo, 2007).

In the current study, gender was not a significant variable in the terms of learning styles, but it was found to be related to thinking skills. Gender served as a predictor of overall thinking skill disposition scores and for the "explanation" dimension. Gender was not a significant predictor for other sub dimensions of the critical thinking scale. Some studies (Rudd, Baker & Hoover, 2000; Torres & Cano, 1995b; Walsh & Hardy, 1999) indicate that gender was a significant variable in critical thinking skills, however. Nevertheless, other studies (Kettler, 2014; Myers & Dyer, 2006) of gifted students' critical thinking skills found that there was no relationship between gender and critical thinking skills.

In this study, gifted students' critical thinking scores for both the overall score on the critical thinking scale and the scores on its sub dimensions were high. The highest mean in the sub dimensions was seen in the evaluation dimension. This implies that the gifted education program (SAC program) in Turkey is sufficient for developing gifted students' critical thinking skills. The SAC program contains learner-centered learning methods such as problem based learning, discussion, brain storming, individual and small group projects. These methods include innovative applications based on students' learning. Students have control over their own learning process and actively construct their own knowledge. Teaching and learning applications based on such approaches contribute to developing critical thinking skills (Ross & Wright, 1987; Salehi, 2007; Willingham, 2007). A study comparing gifted and non-gifted students by Kettler (2014) showed that gifted students had a higher capacity than non-gifted peers for critical thinking.

The results of the present study indicate that there is a relationship between critical thinking and preferred learning styles except in the "analysis" dimension. There were significant differences between the four learning styles compared with the overall score of critical thinking disposition and the sub dimensions (evaluation, inferences, interpretation, explanation and self-regulation). The mean scores of the assimilating and converging groups were higher than those of the diverging and accommodating groups. In other words, the overall score of critical thinking and sub dimensions, except for "analysis," were correlated with the assimilating and converging styles preferred by gifted students.

Gifted students preferring assimilating and converging learning styles were better critical thinkers than divergers and accommodators. This finding is consistent with other studies conducted in different countries (Colucciello, 1999; Myers & Dyer, 2006; Suliman, 2006).The results of the present study, however, indicate that students' learning styles may play an important role in critical thinking.

Learning style is relatively stable and develops according to the student's field of education (Wong & Nunan, 2011). When the sample group is considered to be cognitively highly able, it can be said that students with high cognitive capacity prefer mostly 'assimilating and diverging' learning styles. Kolb (2015) asserted that there was a relationship between assimilating learning style and thinking skills. He also indicated that there were relationships between the organization of knowledge, building conceptual structures, testing ideas and theories and analyzing the data.

Ghazivakili, et al (2014) found a significant difference between the 'evaluation', 'inductive reasoning' and 'critical thinking' skills according to students' thinking styles. In the present study, convergers had higher scores on the critical thinking scale than other learning styles. Wessel and Williams (2004) found similar results in their study of Master's entry-level students. Although, there are many studies (Durukan & Maden, 2010; Güven & Kürüm, 2007; Myers & Dyer, 2006; Torres & Cano, 1995; Yenice, 2012) indicating the relationships between learning style and critical thinking, there are some other studies (Ay, et. al., 2010; Rudd et al., 2000) that indicate the reverse. This discrepancy may be caused by how the sample group was selected and by the use of different tools to define learning styles. Kettler (2014) found a significant difference between gifted and non-gifted students. Another reason for the discrepancy in the results of these studies is that only Kettler's studied gifted students. Gifted students apply a wide variety of different strategies in problem solving, decision making, assessing their performances compared with their non-gifted peers (Kettler, 2014). Thus, gifted students' preferred learning styles may be different from those of non-gifted peers.

In this study, a positive correlation was found between the overall scores of critical thinking disposition, its sub-dimensions and modes of learning. The highest correlation was found between the entire critical thinking skills scale score and the AC mode of learning. The lowest correlation was seen between the analysis dimension of the critical thinking scale and the AE mode of learning. There was a medium level of positive correlation between all variables. Toress and Cano (1995), Pai and Eng (2013) found similar results.

According to the regression results, gender was only a predictor variable in the explanation and the self-regulation dimensions and the overall score of critical thinking disposition. In the analysis dimension, the CE mode of learning was the most positive predictor of critical thinking disposition, followed by the AC mode of learning. The AC mode of learning was the only significant predictor in the assessment dimension of critical thinking disposition. In the inferences dimension, the AC mode of learning made a high contribution to variance. In the interpretation dimension, the CE and the RO modes of learning were predictive. In the explanation dimension, except for gender, the CE mode of learning was the best predictor, followed by the AC mode of learning. In the self-regulation dimension, the AC mode of learning was the best predictor variable, this was followed by the CE mode of learning. The AC mode of learning made the highest contribution to the variance for the critical thinking disposition except for gender, respectively the CE and RO modes of learning. The current study shows that although the most predictive mode of learning was AC, other modes of learning were predictive of the critical thinking disposition. According to Kolb (1984), learning styles are not fixed personal traits. Thus, teaching should be based on learning preferences rather than on learning styles and all modes of learning should be taken into consideration in the teaching and learning process.

It is clear that gifted students have different cognitive characteristics. Although learning styles are affected by personal characteristics, environmental factors are also considered to be important factors in the development of learning styles (Kolb, 1981; 1984), and the design of teaching is an important influence on gifted students' learning styles. A study by Mills supports Kolb's (1984) theory, in that analytical thinking, evaluation, critical thinking, clarity and flexibility are associated with the AC mode of learning (Mills, 2003). Kolb's learning theory was based on a four-stage learning cycle. In this respect, Kolb's experimental learning theory works on two levels: a four-stage cycle of learning and four separate learning styles (Kolb, 1984).

Yamazaki, et. al. (2002) indicated that the AC and CE mode of learning preferences were related to higher order thinking. Similarly, Suliman (2006) found a positive correlation between critical thinking skills and AC, CE modes of learning, and

a negative correlation between critical thinking skills and the CE and RO modes. In some studies (Lowy, 2013; Mahmoud, 2012; Nasrabady, et al. 2012) that used different learning styles scales, a relationship was found between critical thinking and learning styles.

As learning styles offer a framework related to strong and weak aspects of students' learning processes (Kolb,1993), the AC, CE, RO and AE modes of learning should be taken into consideration in the teaching and learning process for developing gifted students' critical thinking skills. The AC mode of learning was predictive for all critical thinking skills on the scale except for the interpretation dimension. In the current study, the AC mode of learning was the strongest and most prevalent predictor. Therefore, in an educational setting, gifted students should perhaps be frequently engaged in creating theories to explain observations. This mode is related to abstraction and analytical skills, which are important skills in devising a theory (Kolb, 1981).

Gifted students like learning on their own and "*they will do just fine on their own*" (Ross & Wright, 1987, p. 50). This is evidence for their being independent learners and teachers should consider this characteristic when teaching them. Furthermore, developing students' perceived efficacy and their regulation of self-aims should be taken into consideration during teaching and learning. The results of this study also indicate that the curriculum applied in gifted education centers should be based on activities. Purvis (2009) indicated that curriculum and instructional design had a great effect on teaching critical thinking. Thus, it may be helpful to consider students' learning modes when designing curriculums and teaching and learning experiences.

When the nature of the gifted students' preferred learning styles are considered (Kolb, 1984), it seems clear that their learning environment should support their being independent learners and help them to control their own individual learning process. The curriculum should also be enriched in accordance with these findings. Teachers' consideration of learning styles during gifted students' education will contribute to the development of gifted students' critical thinking skills.

6. Limitations of the Study

The current study was conducted with only 225 participants. Furthermore, the participating students could not be divided into age categories because although students' age was the same, their attendance duration at SACs varied. Comparing the results of general education students' critical thinking skills with those of gifted students will help us to understand their learning styles and to create better learning opportunities for gifted students.

7. Future Direction

Conducting similar studies with larger samples and comparing the results with studies of non-gifted students will give better results that will help to generalize the findings. Searching for other variables, such as socio-cultural background and their past learning experiences during the compulsory education period, and their effects on gifted students' critical thinking skills will shed light both on how to understand and on how to develop their critical thinking processes.

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