



ISSN:1306-3111  
e-Journal of New World Sciences Academy  
2008, Volume: 3, Number: 2  
Article Number: C0061

**SOCIAL SCIENCES**  
**EDUCATION SCIENCES**

Received: October 2007  
Accepted: March 2008  
© 2008 www.newwsa.com

**Kürşat Yenilmez**  
**Nuray Girginer**  
**Özlem Uzun**

University of Eskişehir Osmangazi  
kyenilmez@ogu.edu.tr  
Eskişehir-Türkiye

**MATHEMATICS LEARNING STYLES OF STUDENTS OF THE FACULTY OF ECONOMICS  
AND BUSINESS ADMINISTRATION IN TURKEY**

**ABSTRACT**

In this study, the relationship among mathematics learning styles and mathematics success of the Faculty of Economics and Business Administration students is examined. The sample of the study includes 1440 students from the Business Administration, Economics and Finance Departments of nine universities in Turkey. Forster's (1999) "How do I Actually Learn?" scale is used by translating into Turkish. Demographic information form which was prepared by the authors is also used. The factor analysis, ANOVA, MANOVA and Tukey test techniques are used for statistical analyses. According to the results of the analyses, six factors in learning mathematics are determined. Among the six determined factors, it is determined that the most common mathematics learning style among students of Faculties of Economics and Administrative Sciences is diligent learning and the least common style is technology user style. Besides, it was also determined that there are some differences among departments and class levels in terms of the using these learning styles.

**Keywords:** Learning Mathematics, Learning Styles,  
Faculty of Economics and Business Administration

**TÜRKİYE'DEKİ İKTİSADİ VE İDARİ BİLİMLER FAKÜLTESİ ÖĞRENCİLERİNİN  
MATEMATİK ÖĞRENME STİLLERİ**

**ÖZET**

Bu çalışmada, İktisadi ve İdari Bilimler Fakültesi öğrencilerinin matematik öğrenme stilleri ile matematik başarıları arasındaki ilişki araştırılmıştır. Araştırmanın örneklemini Türkiye'deki dokuz üniversitenin İşletme, İktisat ve Maliye bölümlerinde öğrenim görmekte olan öğrenciler arasından rastlantısal olarak seçilen 1440 öğrenci oluşturmaktadır. Veri toplama aracı olarak Forster'ın (1999) "Nasıl Öğrenirim?" ölçeğinin Türkçe çevirisi ile demografik bilgi formu kullanılmıştır. Verilerin analizi aşamasında faktör analizi, tek yönlü varyans analizi (ANOVA), çok yönlü varyans analizi (MANOVA) ve Tukey çoklu karşılaştırma testinden yararlanılmıştır. Analiz sonuçlarına göre, matematik öğreniminde altı faktör belirlenmiştir. Elde edilen altı faktör arasında İktisadi ve İdari Bilimler Fakültesi öğrencilerinin matematik öğrenirken en çok kullandıkları stil Çabalayıcı öğrenme stili olurken en az kullanılan da Teknoloji Kullanıcı stili olarak tespit edilmiştir. Bunun yanında, bölümler arasında ve sınıflar arasında öğrenme stillerinin kullanımı açısından farklılıklar olduğu da belirlenmiştir.

**Anahtar Kelimeler:** Matematik Öğrenimi, Öğrenme Stilleri,  
İktisadi ve İdari Bilimler Fakültesi



## **1. INTRODUCTION (GİRİŞ)**

People have been curious about how to learn. Learning can be defined simply as change of behaviors toward the wanted aspects. Positive changes in behaviors are possible on conditions that know how learning styles are used. For positive changes in behaviors, at first we need to determine the students' learning styles. In addition, we must choose suitable learning experiences, and then apply to these experiences with suitable learning materials.

Metacognition is one of the important factors in increasing effectiveness in learning process. Metacognition consists of the skills about people who ask the following kind of questions themselves.

- What do I know about this matter?
- How much time do I need to learn this?
- How do I estimate the solution of this? [1].

To be aware of these informational processes in learning process and to obtain direct learning are determined by the concept of metacognition. People who develop these characteristics can predict their learning, what, how, at which speed, and can choose the suitable learning strategies for them [2].

Style is a combination of many biologically and experientially imposed characteristics that contribute to learning, each in its own way and together as a unit. Thus, learning style is more than merely whether a child remembers new and difficult information most easily by hearing, seeing, reading, writing, illustrating, verbalizing, or actively experiencing; perceptual or modality strength is only one part of learning style. It also is more than whether a person process information sequentially, analytically, or in a 'left-brain' mode rather than in a holistic, simultaneous, global 'right-brain' fashion; that, too, is only one important component of learning style [3]. The concept of learning style has both promise and problems associated with it. While some researchers believe that "style is the most important concept to demand attention in education in many years and is at the core of what it means to be a person" other commentators believe that researchers "have not yet unequivocally established the reality or utility of the concept" [4 and 5].

As known learning style can serve as a guide in designing learning experiences that match or mismatch students' styles, depending on the teacher's purpose. Some studies show that identifying a student's style and then providing instruction consistent with that style contribute to more effective learning. Although some bring a very instrumental orientation to learning, it may say more about their developmental stage than about learning style.

One way to organize the several strands of research on learning styles and teaching is the metaphor of an onion, in which the layers of the onion are analogous to the different levels of a person's characteristics, which could be called 'style' [5]. At the core of the onion is style in the sense of basic characteristics of personality. Information processing models, describing how persons tend to take in and process information, form the second layer; social interaction models, dealing with how students tend to interact and behave in the classroom, make up the third; and learning environments and instructional preferences constitute the fourth [6].

There are important studies about the levels of a person's characteristics mentioned above. A special learning style model is preferred by the researchers in every one of these studies. There are some important studies in the area of Personality Models [7, 8, 9, 10, 11, and 12]; in the area of Information-Processing Models [13, 14, 15,



16, and 17]; in the area of Social-Interaction Models [18, 19 and 20] and in the area of Instructional-Preference Models [21].

Kolb's 'Experiential Learning' Model is a famous one of the above models. Kolb describes learning as a four-step process. Learners have immediate *concrete experience*, involving themselves fully in it and then reflecting on the experience from different perspectives. From these *reflective observations*, they engage in *abstract conceptualization*, creating generalizations or principles that integrate their observations into sound theories. Finally, learners use these generalizations or theories as guides to further action, *active experimentation*, testing what they have learned in new, more complex situations.

A perspective similar to Kolb's model has been developed by Gregorc, who believes that learning styles emerge from innate predispositions or proclivities and that people learn both through concrete experience and abstraction. In each of these modes, an individual may learn randomly or sequentially. Gregorc considers each of these dualities as qualities that indicate how individuals relate to the world. Crossing the two main modes with each of the subdivisions produces a typology of patterns for learner preference: Concrete Sequential, Concrete Random, Abstract Sequential, and Abstract Random. While everyone exhibits all four patterns to some extent, most people have a predilection for one style or, at most, two [6].

One of the most popular models is the Dunn and Dunn Learning Styles Model in the last years. This model included twenty one elements that, when classified, revealed that learners are affected by their

- *immediate environment* (sound, light, temperature, and furniture/seating designs),
- *own emotionality* (motivation, persistence, responsibility, and need for either externally imposed structure or the opportunity to do things in their own way),
- *sociological preferences* (learning alone, in a pair, in a small group, as part of a team, or with either an authoritative or collegial adult; and wanting variety as opposed to patterns and routines),
- *physiological characteristics* (perceptual strengths, time-of-day energy levels, and need for intake and/or mobility while learning),
- *processing inclinations* (global/analytic, right/left, and impulsive/reflective).

Dunn and Dunn define the learning style as the way in which each learner begins to concentrate on, process, and retain new and difficult information. That interaction occurs differently for everyone.

People seem different in terms of their ability, learning level and learning strategies. If the learning experiences are suitable for every student's learning style and speed, it will be taken the high-level output.

Students have different *learning styles*, characteristic strengths and preferences concerning how they take in and process information. Some students tend to focus on facts, data, and algorithms; others are more comfortable with theories and mathematical models. Some respond strongly to visual forms of information, like pictures, diagrams, and schematics; others get more from verbal forms written and spoken explanations. Some prefer to learn actively and interactively; others function more introspectively and individually [22].

Consequently, we can say learning is an individual activity. These differences constitute the learning styles of students.

The problem of this research is to determine the factors of mathematics learning styles and the relationship among these factors and demographic aspects of the students in Faculty of Economics and Business Administration in Turkey.

## **2. RESEARCH SIGNIFICANCE (ÇALIŞMANIN ÖNEMİ)**

The major purpose of this study was to determine changes in mathematics learning styles of students from several universities in Turkey. A secondary purpose was to determine whether these changes were dependent on mathematics success of the students. The following questions have been asked for these purposes;

- What are the mathematics learning styles of the students in Business Administration, Economics, and Public Finance departments of the faculties of Economics and Business Administration?
- Do the factors of mathematics learning styles of students in Business Administration, Economics, and Finance departments vary according to mathematics success of the students?

Students have different mathematics learning styles. Developing personal mathematics learning styles varies depending on various factors. Determining these factors is very important from the point of view of being present of contents and increasing mathematics success. However, the real factor in the classroom is the teacher. S/he possesses an important position as his/her education method is characteristic in emphasizing the success and transforming failure into a positive state in terms of determining the attitude and anxiety level of the students towards math classes. Therefore, it is important that the teacher uses appropriate education methods on his/her students so as not to cause them experience mathematics anxiety problems. This research bears importance in terms of determining mathematics learning styles of students of administrative sciences who will also make use of mathematics in their future business lives when they graduate. In this context, this research may initiate some other studies for the rearrangement of education approaches in teaching mathematics in a way to determine according to mathematics learning styles and to develop mathematics attitudes of students.

It is accepted that students who participated in the research reflected their real feelings and opinions while giving answers to questions included in the measurement tools.

This research is limited to students of Business Administration, Economics, and Finance departments of 9 state universities located in different geographical regions of Turkey in 2003-2004 Academic Year Fall Term.

## **3. METHOD (YÖNTEM)**

The relational scanning model was used in the research.

### **3.1. Sample of the Study (Çalışma Örnekleme)**

The research field is comprised of students enrolled in 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> years of Business Administration, Economics, and Finance departments of Faculties of Economics and Administrative Sciences of state universities in Turkey in the 2003-2004 Academic Year Fall Term. Considering that mathematics learning styles of students from 9 state universities located in seven different geographic regions, which were selected by simple random sampling method, may vary according to their departments, a gradual sampling method depending on strata was

performed by attaching a sub stratum to each department. The volume of sampling was determined so as to include 1620 persons comprising of 15 students from 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> years of each department. However, 1440 students out of 1620 have been reached.

### 3.2. Instruments of the Study (Ölçme Aracı)

Business Administration, Economics and Finance undergraduate students were applied a two-section questionnaire form at the stage of data collection. Forster's "How do I Actually Learn?" scale was used by translating into Turkish for collecting data [23]. This scale will be considered as Learning Style Scale (LSS) throughout the study. Upon the reliability test, the Cronbach Alpha coefficient was found .80 for the questionnaire. According to these results the questionnaire was supposed to be reliable. This instrument has 23 items.

Beside the mathematics learning styles scale, a demographic information form prepared by the researchers was also used for determining the demographic characteristics of students. The demographic information form includes questions relating to gender, department, class level, educational background of parents, general success, and mathematics success.

Mathematics learning styles of students attending faculties of Economics and Administrative Sciences of state universities in Turkey were examined according to their genders, departments, class levels, mathematics success and general academic success. Factor analysis was performed by means of principal components method for LSS (Learning Style Scale) including 23 items in the classification of mathematics learning styles of students, and 6 factors were determined for mathematics learning styles of students. The mentioned factors were named and the effect of mathematics success levels, general academic success levels as of the last term and the effect of gender on these factors were examined by Multiple Analysis of Variance (MANOVA). One-way variance analysis was utilized for testing the difference between average scores of all factors of mathematics learning styles and class levels, mathematics success and departments. Tukey Test was also applied for determining the groups among which there was difference on condition that the obtained F value was considered significant.

Data analysis was performed on computer with SPSS 11.0 software package and the significance level was taken as .05 for all statistical tests.

### 4. FINDINGS AND INTERPRETATIONS (BULGULAR VE YORUMLAR)

Data obtained by applying LSS and the questionnaire form consisting of personal information were summarized in the following tables in the forms of frequencies and percentages (Table 1 and 2).

Of the 1440 students who have been applied the questionnaire form 696 were female (48,3%) and 744 were male (51,7%). Considering the distribution as per the departments, 490 students from the Department of Business Administration (34%), 430 students from the Department of Economics (30%) and the Department of Finance (29,9%) have been reached. It was determined that 35,6% of the students were graduates of public high schools upon the examination performed with regard to graduated high schools. Only 2,9% of graduates of vocational high schools attended universities for majoring in social sciences which is followed by graduates of Anatolia-science high schools with 8,1%. Students were asked about their mathematics success scores and general academic success (transcript) scores concerning the last term by means of the questionnaire and the following ranges were used; 0-49, 50-59, 60-69, 70-74, 75-79, 80-84, 85-89, 90-100. Both mathematics success levels and general academic success levels were classified so

that scores between 0-49 indicate failure, 50-59 indicate low level of success, 70-84 indicate medium level of success and 85-100 indicate high level of success. First-year students were classified into a separate group as they did not yet have any record concerning either math classes or general academic success. 471 students (32,7%) were either unsuccessful or with medium success with regard to mathematics success levels. However, most students were among the medium success group in terms of the general academic success level (45,49%).

Table 1. The distribution of students according to personal information  
(Tablo 1. Kişisel bilgilere göre öğrencilerin dağılımı)

Variable	f	%	Variable	f	%
Gender			Department		
Female	696	48,3	Business Administration	490	34,0
Male	744	51,7	Economics	520	30,0
Mathematics Success			Finance	430	29,9
First Year	500	34,7	Class level		
Unsuccessful	94	6,5	First year	500	34,7
Low	377	26,2	Second year	286	19,9
Medium	306	21,3	Third year	314	21,8
High	163	11,3	Fourth year	340	23,6
General Success			Graduated High School		
First Year	500	34,7	Public High School	513	35,6
Unsuccessful	28	1,9	Vocational High School	39	2,7
Low	173	12,0	Anatolia-Science High School	427	29,7
Medium	654	45,4	Private High School	117	8,1
High	85	5,9	Super High School	344	23,9

When mathematics success and general academic success of students whom the questionnaire was applied according to their departments were examined, it was determined that students who were successful in math classes were also successful in terms of the general academic success. In this respect, the Department of Business Administration (BA) has the highest percentage value. 25 students from the Department of Business Administration (1,7%) are highly successful both in terms of mathematics and general success level. The same figure is 15 (1%) for the department of Economics (E) and 11 (0,8%) for the department of Finance (F) (Table 2).

Factor analysis was applied to the LSS consisting of 23 items in an effort to classify mathematics learning styles of students attending higher education in the field of social sciences. 9894,348 value,  $p=0000<0,05$  and Kaiser-Meyer-Olkin sampling value were obtained as 0,814 as a result of the Barlett test, and this value is considered acceptable. After the 23 items constituting LSS were inserted in the SPSS software package, Varimax option was selected in the Principal Component Analysis, and those having Eigenvalues above 1 according to the obtained Scree Plot distribution were included in the evaluation. It was determined upon the analysis of the Scree Plot graph that there was no change in data following the sixth component.

Upon the factor analysis 6 factors were determined out of LSS consisting of a total of 23 items (variables/questions). The first factor explains 15,57% of the variance, the second one explains 10,64% of the variance, the third one explains 9,887% of the variance and the remaining factors explain 8,260%, 7,412% and 6,872% of the variance respectively. These six factors were given names after examining their contents. The extent to which each of these variables (items/questions) may be associated with the related structural concept (factors) and together what they refer to were paid attention. Then, the classified factors were exposed to the reliability test

(Alpha Test). Reliability tests of all factors were found statistically significant by the alpha test. The distribution of items in LSS to the 6 factors in terms of their factor loads, Eigenvalues of factors, variance explanation percentages and alpha test results were presented in Table 3.

Table 2. The distribution of mathematics success and general academic success of students according to departments  
(Tablo 2. Bölümlere göre öğrencilerin matematik ve genel başarı dağılımı)

DEP.	MATHEMATICS SUCCESS	GENERAL ACADEMIC SUCCESS									
		First		Unsuccessfull		Low		Medium		High	
		f	%	f	%	f	%	f	%	f	%
BA	First year	181	12,								
	Unsuccessfu			6	,4	9	,6	3	,2		
	Low			2	,1	28	1,9	75	5,2	4	,3
	Medium			1	,1	11	,8	92	6,4	12	,8
	High					2	,1	39	2,7	25	1,7
	Total	181	12,	9	,6	50	3,5	209	14,5	41	2,8
E	First year	234	16,								
	Unsuccessfu			3	,2	13	,9	11	,8		
	Low			3	,2	24	1,7	77	5,3	3	,2
	Medium			3	,2	6	,4	90	6,3	8	,6
	High			3	,2	3	,2	24	1,7	15	1,0
	Total	234	16,	12	,8	46	3,2	202	14,0	26	1,8
F	First year	85	5,9								
	Unsuccessfu			5	,3	20	1,4	24	1,7		
	Low			2	,1	43	3,0	112	7,8	4	,3
	Medium					10	,7	70	4,9	3	,2
	High					4	,3	37	2,6	11	,8
	Total	85	5,9	7	,5	77	5,3	243	16,9	18	1,3

A six-factor mathematics learning scale was obtained by factor analysis performed for determining characteristics of mathematics learning styles of students schooling in the field of social sciences. The aim was to examine whether these undergraduate students showed a significant difference according to mathematics success levels in terms of these 6 factors related to mathematics learning. MANOVA analysis was used for the test of the research hypothesis which is "Do LSS factor scores of students show a significant difference in terms of mathematics success levels?" Scores of the six factors according to the related items determined for LSS were calculated before the analysis (Table 4).

Table 3. Adjusted component matrix and variance explanation percentages of mathematics learning styles obtained by factor analysis  
(Tablo 3. Matematik öğrenme stillerinin faktör analizi ile elde edilen düzeltilmiş bileşen matrisi ve varyans açıklama yüzdeleri)

FACTORS	VARIABLES	Factor Load	Eigen value	Var. Exp. %	Cum.Var. Exp. %	Alpha	p
Factor 1 REFLECTIVE	3: I learn by answering the questions of the teacher.	,798	5,069	15,576	15,576	0,826	0,000
	2: I learn some stuff in the classroom by explanations.	,767					
	4: I learn by explaining my studies to the teacher.	,749					
	1: I learn by answering questions in all classroom studies.	,715					
	5: I learn by answering questions of my friends.	,598					
	6: I learn by explaining the subject to my friends.	,527					
	7: I learn by asking the teacher whether s/he agrees with my opinions in all classroom studies.	,525					
Factor 2 ENVIRONMENT ORIENTED INQUISITIVE	11: I learn by asking the opinions of my friends and by stating whether I agree or not.	,795	2,260	10,640	26,216	0,769	0,000
	9: I learn by asking my friends whether they agree with me or not.	,777					
	12: I learn by requesting my friends to explain the subjects.	,691					
Factor 3 DILIGENT	23: I learn by reading and studying my own notes.	,765	2,073	9,887	36,103	0,655	0,000
	22: I learn by listening to the teacher during all classroom studies.	,689					
	15: I learn by doing my homework and studying alone.	,668					
	21: I learn by checking whether my answers are correct or not.	,586					
	18: I learn by writing the solutions to problems in detail.	,396					
	13: I learn by solving the problems (test questions) in the classroom.	,325					
Factor 4 TECHNOLOGY USER	20: I learn by testing the operations using a calculator/computer.	,871	1,616	8,260	4,363	0,849	0,001
	19: I learn by using a calculator (computer, etc.).	,871					
Factor 5 COLLABORATIVE	16: I learn by doing my homework and studying with another person.	,704	1,363	7,412	51,775	0,455	0,000
	14: I learn by solving the problems (tests) in the class with other students.	,622					
	17: I learn by studying subjects on figures (diagrams).	,545					
Factor 6 INSTRUCTOR ORIENTED INQUISITIVE	8: I learn by requesting explanations to all classroom studies.	,634	1,108	6,872	58,646	0,298	0,000
	10: I learn by requesting from the teacher to explain the subjects to me.	,619					



Table 4. MANOVA results of lss factor scores according to mathematics success levels

(Tablo 4. ÖSÖ faktör puanlarının matematik başarı düzeylerine göre manova sonuçları)

Descriptive Statistics					Box's Test of Equality of Covariance Matrices	
	MATH SUCCESS	Mean	Std. Deviation	N	Box's M	133,314
FACTOR 1	First year	2,705	,739	500	F	1,567
	Unsuccessful	2,571	,888	94	df1	84
	Low	2,774	,762	377	df2	672756
	Medium	2,951	,747	306	Sig.	,001
	High	3,060	,693	163		
	Total	2,807	,764	1440		
FACTOR 2	First year	2,816	,910	500		
	Unsuccessful	2,620	1,036	94		
	Low	2,803	,920	377		
	Medium	2,845	,868	306		
	High	2,789	,936	163		
	Total	2,803	,916	1440		
FACTOR 3	First year	3,816	,593	500		
	Unsuccessful	3,547	,561	94		
	Low	3,664	,675	377		
	Medium	3,880	,643	306		
	High	3,885	,604	163		
	Total	3,780	,633	1440		
FACTOR 4	First year	2,001	,960	500		
	Unsuccessful	2,441	1,184	94		
	Low	2,672	1,033	377		
	Medium	2,660	1,042	306		
	High	2,871	1,143	163		
	Total	2,444	1,085	1440		
FACTOR 5	First year	2,992	,752	500		
	Unsuccessful	2,936	,818	94		
	Low	3,085	,715	377		
	Medium	3,199	,816	306		
	High	3,141	,727	163		
	Total	3,074	,762	1440		
FACTOR 6	First year	3,084	1,035	500		
	Unsuccessful	2,734	1,116	94		
	Low	3,031	1,003	377		
	Medium	3,062	,970	306		
	High	2,950	,962	163		
	Total	3,074	,762	1440		
Total		Total	1,013	1440		
Multivariate Tests						
Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	,971	8093,754	6,000	1430,000	,000
	Wilks' Lambda	,029	8093,754	6,000	1430,000	,000
	Hotelling's Trace	33,96	8093,754	6,000	1430,000	,000
	Roy's Largest	33,96	8093,754	6,000	1430,000	,000
MATH SUCCESS	Pillai's Trace	,167	10,387	24,000	5732,000	,000
	Wilks' Lambda	,839	10,726	24,000	4989,884	,000
	Hotelling's Trace	,185	11,011	24,000	5714,000	,000

Results of MANOVA, applied to LSS Factor scores for mathematics success levels, indicate that students with different mathematics success levels show significant differences in terms of LSS factors (Wilks Lambda= 0.029,  $F(6, 1430) = 8093$ ,  $p < 0.05$ ). This finding shows that scores to be obtained from the linear component consisting of the determined Factor scores change depending on mathematics success levels.

Results of one-way ANOVA performed on the basis of six factors of LSS according to mathematics success levels were presented in Table 5.

Table 5. MANOVA results of six factor scores of lss according to mathematics success levels

(Tablo 5. ÖSÖ'ne ait altı faktör puanlarının matematik başarı düzeylerine göre anova sonuçları)

		Sum of Squares	df	Mean Square	F	Sig.
FACTOR 1	Between	27,671	4	6,918	12,206	,000
	Within Groups	813,289	1435	,567		
	Total	840,959	1439			
FACTOR 2	Between	3,791	4	,948	1,130	,341
	Within Groups	1203,571	1435	,839		
	Total	1207,363	1439			
FACTOR 3	Between	15,604	4	3,901	9,954	,000
	Within Groups	562,385	1435	,392		
	Total	577,989	1439			
FACTOR 4	Between	161,831	4	40,458	37,824	,000
	Within Groups	1534,919	1435	1,070		
	Total	1696,750	1439			
FACTOR 5	Between	10,687	4	2,672	4,640	,001
	Within Groups	826,300	1435	,576		
	Total	836,988	1439			
FACTOR 6	Between	11,020	4	2,755	2,694	,030
	Within Groups	1467,369	1435	1,023		
	Total	1478,389	1439			

As may be seen in Table 5, all factor scores of learning styles, except for Factor 2 scores for mathematics success levels ( $F(4,1435) = 1,130$ ,  $p = 0,341 > 0.05$ ), are significant at 0,05 significance level. On condition that the significance level is 0,01, factor 6 scores also gain significance ( $F(4,1435) = 2,694$ ,  $p = 0,03 > 0.01$ ). As is known, the basic logic of factor 2 and factor 6 was similar while naming mathematics LSS factors; factor 2 represented environment oriented inquisitive learning style and factor 6 represented instructor oriented inquisitive learning style. It is possible to come to a conclusion that inquisitive learning style is not related with mathematics success level. Results of Tukey multiple comparison test performed to determine mathematics success levels leading to differences determined for other LSS factor scores were presented in Table 6.

Table 6. Tukey multiple comparison test results of lss factors according to mathematics success levels  
(Tablo 6. ÖSÖ faktörlerinin matematik başarı düzeylerine göre çoklu karşılaştırma Tukey testi sonuçları)

Dependent Variable	(I) MATH SUCCESS	(J) MATH SUCCESS	Mean Difference (I-J)	Std. Error	Sig.
FACTOR 1	First year	Unsuccessful	,134	,084	,508
		Low	-,069	,051	,662
		Medium	-,246	,054	,000
		High	-,355	,067	,000
	Unsuccessful	First year	-,134	,084	,508
		Low	-,203	,086	,133
		Medium	-,380	,088	,000
		High	-,489	,097	,000
	Low	First year	,069	,051	,662
		Unsuccessful	,203	,086	,133
		Medium	-,177	,057	,019
		High	-,285	,070	,001
	Medium	First year	,246	,054	,000
		Unsuccessful	,380	,088	,000
		Low	,177	,057	,019
		High	-,108	,073	,571
	High	First year	,355	,067	,000
		Unsuccessful	,489	,097	,000
		Low	,285	,070	,001
FACTOR 3	First year	Unsuccessful	,268	,070	,001
		Low	,151	,042	,004
		Medium	-,063	,045	,625
		High	-,069	,056	,737
	Unsuccessful	First year	-,268	,070	,001
		Low	-,117	,072	,484
		Medium	-,332	,073	,000
		High	-,337	,081	,000
	Low	First year	-,151	,042	,004
		Unsuccessful	,117	,072	,484
		Medium	-,215	,048	,000
		High	-,220	,058	,002
	Medium	First year	,063	,045	,625
		Unsuccessful	,332	,073	,000
		Low	,215	,048	,000
		High	-,005	,060	1,000
	High	First year	,069	,056	,737
		Unsuccessful	,337	,081	,000
		Low	,220	,058	,002
		Medium	,005	,060	1,00
FACTOR 4	First year	Unsuccessful	-,440	,116	,001
		Low	-,671	,070	,000
		Medium	-,659	,075	,000
		High	-,870	,093	,000
	Unsuccessful	First year	,440	,116	,001
		Low	-,230	,119	,298
		Medium	-,218	,121	,378
		High	-,429	,133	,012
	Low	First year	,671	,070	,000
		Unsuccessful	,230	,119	,298
		Medium	,012	,079	1,000

		High	- ,198	,096	,243
	Medium	First year	,659	,075	,000
		Unsuccessful	,218	,121	,378
		Low	- ,012	,079	1,000
		High	- ,211	,100	,219
	High	First year	,870	,093	,000
		Unsuccessful	,429	,133	,012
		Low	,198	,096	,243
		Medium	,211	,100	,219
FACTOR 5	First year	Unsuccessful	,056	,085	,964
		Low	- ,093	,051	,375
		Medium	- ,206	,055	,002
		High	- ,148	,068	,192
	Unsuccessful	First year	- ,056	,085	,964
		Low	- ,149	,087	,428
		Medium	- ,263	,089	,027
		High	- ,204	,098	,227
	Low	First year	,093	,051	,375
		Unsuccessful	,149	,087	,428
		Medium	- ,113	,058	,294
		High	- ,055	,071	,937
	Medium	First year	,206	,055	,002
		Unsuccessful	,263	,089	,027
		Low	,113	,058	,294
		High	,058	,073	,933
	High	First year	,148	,068	,192
		Unsuccessful	,204	,098	,227
		Low	,055	,071	,937
		Medium	- ,058	,073	,933

As may be seen in Table 6, mathematics success levels of students in reflective learning style group are high. In this respect, it may be stated that students who are good at mathematics consolidate what they learn by sharing with others. However, mathematics success levels of students who have factor 3 (Diligent) learning styles are generally low. The difference between highly successful and unsuccessful groups in terms of the use of technology user learning is remarkable.

MANOVA analysis was used for the test of the research hypothesis which is "Do LSS factor scores of students show a significant difference in terms of gender?" Results of MANOVA performed on LSS factor scores according to gender were presented in Table 7.

Table 7. MANOVA results of lss factor scores according to gender  
(Tablo 7. ÖSÖ faktör puanlarının cinsiyete göre MANOVA sonuçları)

Descriptive Statistics					Box's Test of Equality of Covariance Matrices	
	GENDER	Mean	Std. Deviation	N	Box's M	42,366
FACTOR 1	FEMALE	2,868	,718	696	F	2,008
	MALE	2,750	,801	744	df1	21
	TOTAL	2,807	,764	1440	df2	7535271
FACTOR 2	FEMALE	2,823	,871	696	Sig.	,004
	MALE	2,784	,956	744		
	TOTAL	2,803	,916	1440		
FACTOR 3	FEMALE	3,899	,602	696		
	MALE	3,669	,642	744		
	TOTAL	3,780	,633	1440		
FACTOR 4	FEMALE	2,529	1,058	696		
	MALE	2,364	1,105	744		
	TOTAL	2,444	1,085	1440		
FACTOR 5	FEMALE	3,128	,736	696		
	MALE	3,022	,783	744		
	TOTAL	3,074	,762	1440		
FACTOR 6	FEMALE	3,112	,967	696		
	MALE	2,948	1,049	744		
	TOTAL	3,027	1,013	1440		
Multivariate Tests						
Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	,980	11602,425	6,000	1433,000	,000
	Wilks' Lambda	,020	11602,425	6,000	1433,000	,000
	Hotelling's Trace	48,580	11602,425	6,000	1433,000	,000
	Roy's Largest Root	48,580	11602,425	6,000	1433,000	,000
GENDER	Pillai's Trace	,039	9,629	6,000	1433,000	,000
	Wilks' Lambda	,961	9,629	6,000	1433,000	,000
	Hotelling's Trace	,040	9,629	6,000	1433,000	,000
	Roy's Largest Root	,040	9,629	6,000	1433,000	,000

MANOVA results of LSS factor scores for gender indicate that students show significant differences according to gender in terms of LSS factors (Wilks Lambda= 0.020,  $F(6, 1433) = 11602,425$ ,  $p < 0.05$ ). This finding shows that learning styles of students vary depending on the gender.

Results of one-way ANOVA performed on the basis of six factors of LSS according to departments were presented in Table 8. As may be seen in Table 8, Factor 1, Factor 2 and Factor 3 scores are significant at 0,05 significance level according to departments. Results of Tukey test performed to determine the departments among which differences occur were presented in Table 8. According to the table, students of Business Administration and Finance departments use the Reflective learning style represented by Factor 1 more compared to students of Economics department. Students of Business Administration use the Environment Oriented Inquisitive learning style represented by Factor 2 more when compared to students of Economics and Finance departments. Students of Business Administration and Finance departments use the Technology User learning style represented by Factor 4 more compared to students of Economics department.

According to one-way ANOVA performed on the basis of six factors of LSS in terms of classes (Table 9), Factor 1, Factor 3 and Factor 4 scores showed statistically significant differences among classes. Results of Tukey multiple comparison test performed to determine the class levels at which differences occur were presented in Table 9.

Table 8. ANOVA and Tukey multiple comparison test results of six factor scores of lss according to departments  
(Tablo 8. ÖSÖ'ne ait altı faktör puanlarının bölümlere göre anova ve Tukey testi sonuçları)

		Sum of Squares	df	Mean Square	F	Sig.
FACTOR 1	Between Groups	6,844	2	3,422	5,895	,003
	Within Groups	834,115	1437	,580		
	Total	840,959	1439			
FACTOR 2	Between Groups	17,736	2	8,868	10,712	,000
	Within Groups	1189,627	1437	,828		
	Total	1207,363	1439			
FACTOR 3	Between Groups	1,259	2	,629	1,568	,209
	Within Groups	576,730	1437	,401		
	Total	577,989	1439			
FACTOR 4	Between Groups	20,841	2	10,421	8,935	,000
	Within Groups	1675,908	1437	1,166		
	Total	1696,750	1439			
FACTOR 5	Between Groups	,297	2	,149	,255	,775
	Within Groups	836,690	1437	,582		
	Total	836,988	1439			
FACTOR 6	Between Groups	1,243	2	,621	,605	,546
	Within Groups	1477,146	1437	1,028		
	Total	1478,389	1439			
Tukey Test						
			Mean Difference (I-J)	Std. Error	Sig.	
Dependent Variable	(I) DEPARTMENT	(J) DEPARTMENT				
FACTOR 1	Business Administration	Economics	,145	0,048	,007	
	Finance	Economics	,141	0,050	,012	
FACTOR 2	Business Administration	Economics	,253	0,057	,000	
		Finance	,202	0,06	,002	
FACTOR 4	Business Administration	Economics	,174	0,068	,028	
	Finance	Economics	,293	0,070	,000	

Table 9. ANOVA and Tukey multiple comparison test results of six factor scores of lss according to classes  
(Tablo 9. ÖSÖ'ne ait altı faktör puanlarının sınıflara göre ANOVA ve Tukey testi sonuçları)

		Sum of Squares	df	Mean Square	F	Sig.
FACTOR 1	Between	8,530	3	2,843	4,905	
	Within Groups	832,429	1436	,580		,002
	Total	840,959	1439			
FACTOR 2	Between	,637	3	,212	,253	,859
	Within Groups	1206,726	1436	,840		
	Total	1207,363	1439			
FACTOR 3	Between	5,253	3	1,751	4,390	,004
	Within Groups	572,736	1436	,399		
	Total	577,989	1439			
FACTOR 4	Between	158,457	3	52,819	49,307	,000
	Within Groups	1538,293	1436	1,071		
	Total	1696,750	1439			
FACTOR 5	Between	5,103	3	1,701	2,936	,032
	Within Groups	831,885	1436	,579		
	Total	836,988	1439			
FACTOR 6	Between	5,654	3	1,885	1,838	,138
	Within Groups	1472,735	1436	1,026		
	Total	1478,389	1439			
Tukey Test						
				Mean Difference (I-J)	Std. Error	Sig.
Dependent Variable	(I) CLASS	(J) CLASS				
FACTOR 1	First year	Third year		-,173	0,055	,009
		Fourth year		-,171	0,054	,007
FACTOR 3	Second year	Fourth year		-,135	0,51	,037
	Third year	Fourth year		-,144	0,049	,019
FACTOR 4	First year	Second year		-,568	0,077	,000
		Third year		-,655	0,075	,000
		Fourth year		-,793	0,073	,000
	Second year	Fourth year		-,224	0,083	,035

Table 9 indicates that third and fourth year students use the Reflective learning style represented by Factor 1 more than first year students. According to the same table, fourth year students use the Diligent learning style represented by Factor 3 more than second and third year students. The use of the Technology User learning style represented by Factor 4 increases as the class level increases.

#### 4. DISCUSSION (TARTIŞMA)

Upon analysis related to differences in use of learning styles determined as a result of factor analysis performed in terms of mathematics success, it was determined that mathematics success levels of students who prefer the reflective learning style are generally high. This may be interpreted as students who are good at mathematics learn while they teach others. However, the Diligent learning style is mostly preferred by students with low level of mathematics success. This result may be interpreted as students with low level of mathematics success struggle to get high scores. Especially, students highly successful in mathematics prefer technology user learning style more compared to those with low level of mathematics success, and this fact may be considered as an indicator expressing that math knowledge



is very important and effective in terms of acquiring the competence to use technology.

On the other hand, it was determined that among the 6 factors the most common style used by students of Faculties of Economics and Administrative Sciences is the Diligent learning style and the least common style is Technology User style. Thus, we may state that these students are reluctant or shy in terms of sharing their knowledge with friends or getting the support of their friends about topics they have not understood well, and that they mostly try to learn mathematics in the class and by studying their own classroom notes. This attitude of students of Faculties of Economics and Administrative Sciences may be due to the Bell-shaped Curve system which is still being applied at universities. Because class assessments are performed according to the average score within this system, and the higher the class average is, the harder it gets to pass the course.

According to results of Tukey Multiple Comparison Test performed to determine the departments which cause interdepartmental differences, determined by ANOVA in terms of factors of learning styles, it was determined that students of Business Administration department are more inquisitive about the environment when compared to students from other departments. It is not surprising that students of Business Administration department prefer an inquisitive learning style being the future entrepreneurs and decision makers in a risky environment.

It was statistically determined that students of Business Administration and Finance departments prefer a more reflective and technology-oriented learning style than students of Economics department. Thus, we may conclude that students of Business Administration and Finance departments are more active than students of Economics department in terms of putting what they learn into practice.

As a result of the analyses performed in accordance with differences among classes, it was concluded that third and fourth year students use the Reflective learning style more than first year students. This situation may be due to the fact that third and fourth year students prefer to consolidate their mathematics knowledge by means of lecturing juniors considering that they already have all the required mathematics knowledge. On the other hand, it is observed that fourth year students use the Diligent learning style more than second and third year students. The underlying factor that yields to this result may be the desire of fourth year students to have as much advanced mathematics knowledge as possible because of future worries related to employment when they graduate. It was determined that the use of Technology User learning style increased proportionally with the class level. This may be due to the desire of students in these departments to apply knowledge they acquire in courses related to computers and other technologies in second and third classes to the math course.

In conclusion, students of Faculties of Economics and Administrative Sciences represent a student profile who believes in the necessity of good mathematics knowledge in compliance with the changing and developing world order, shares his/her knowledge of mathematics with friends, but on the other hand, fails to be qualified in terms of the use of technology which constitutes another requirement of today.

Considering the obtained results, it is recommended that instructors lecturing mathematics at Faculties of Economics and Administrative Sciences provide interactive in-class activities and make use of various learning styles that students have by organizing





different activities. Math class activities that will activate the social intelligence of students and that will support and ensure synergy should be organized. Math classes should be made free from the board, chalk and teacher talk triangle and be transformed into interaction-based places where various classroom tools are used and where the student gets pleasure from learning. Education process should also be supported with technological tools such as computers and students should definitely be provided with the use of these technologies.

#### REFERENCES (KAYNAKLAR)

1. Slavin R.E., (1986). Educational Psychology Theory into Practice. NY: Prentice Hall.
2. Woolfolk, E.A., (1993). Educational Psychology. Boston.
3. Dunn, R. & Dunn, K. (1992). Teaching Elementary Students Trough Their Individual Learning Styles. Boston: Allyn and Bacon.
4. Guild, P.B. and Garger, S., (1985). Marching to Different Drummers. Alexandria, Va.: Association for Supervision and Curriculum Development.
5. Curry, L., (1983). An Organization of Learning Styles Theory and Constructs. Paper presented at the annual meeting of the American Educational Research Association, Montreal, Quebec, 11-15 April.
6. Claxton, C.S. and Murrell, P.H., (1987). Learning Styles Implications for Improving Educational Practices. Washington: ASHE-ERIC.
7. Witkin, H.A., (1976). Cognitive Style in Academic Performance and in Teacher-Student Relations, In Individually in Learning. edited by Samual Messick and associates, San Francisco: Jossey-Bass.
8. Macneil, R., (1980). The Relationship of Cognitive Style and Instructional Style to the Learning Performance of Undergraduate Students. Journal of Educational Research, 73, pp:354-359.
9. Adams, V.M. and Mcleod, D.B., (1979). The Interaction of Field Dependence/Independence and the Level of Guidance of Mathematics Instruction. Journal for Research in Mathematics Education, 10, pp:347-355.
10. Ramirez, M. and Castaneda, A., (1974). Cultural Democracy, Bicognitive Development, and Education. New York: Academic Press.
11. Myers, I.B., (1976). Introduction to Type. Gainesville, Fla.: Center for the Application of Psychological Type.
12. Lawrance, G., (1984). A Synthesis of Learning Style Research Involving the MBTI. Journal of Psychological Type, 8, pp:2-15.
13. Pask, G., (1975). Conversational Techniques in the Study and Practice of Education. *British Journal of Educational Psychology*, 46, pp:12-25.
14. Siegel, L. and Siegel, L.C., (1965). Educational Set:A Determinant of Acquisition. Journal of Educational Psychology, 56, pp:1-12.
15. Schmeck, R., (1981). Improving Learning by Improving Thinking. Educational Leadership, 38, pp:384-385.
16. Kolb, D.A., (1984). Experiential Learning: Experience as the Source of Learning and Development. New York: Prentice-Hall.
17. Gregorc, A.R., (1979). Learning/Teaching Styles, In Student Learning Styles: Diagnosing and Prescribing Programs. edited by J.W. Kefee, Reston, Va.: National Association of Secondary School Principals.



18. Reichmann, S. and Grasha, A., (1974). A Rational Approach to Developing and Assessing the Construct Validity of a Student Learning Style Scales Instrument. *Journal of Psychology*, 87, pp:213-223.
19. Fuhrmann, B. and Grasha, A., (1983). *Designing Classroom Experiences Based on Student Styles and Teaching Styles. A Practical Handbook for College Teaching*, Boston: Little, Brown & Co.
20. Eison, J., (1979). *The Development and Validation of a Scale to Assess Differing Learning Orientations toward Grades and Learning*. Doctoral dissertation, University of Tennessee.
21. Canfield, A., (1980). *Learning Styles Inventory Manual*. Ann Arbor, Mich.: Humanics Media.
22. Felder, R., (1996). Matters of Style. *ASEE Prism*, 6(4), pp:18-23.
23. Forster, P.A., (1999). How do I Actually Learn? A Questionnaire for (co) Participatory Learning in the Presence of Technology. *Proceedings Western Australian Institute for Educational Research Forum 1999*.