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AN INVESTIGATION OF MATHEMATICS ACHIEVEMENT OF EIGHTH GRADE STUDENTS WITH RESPECT TO THEIR LEARNING STYLES

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AN INVESTIGATION OF MATHEMATICS ACHIEVEMENT OF EIGHTH GRADE STUDENTS WITH RESPECT TO THEIR LEARNING STYLES

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I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

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This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

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ABSTRACT

AN INVESTIGATION OF MATHEMATICS ACHIEVEMENT OF EIGHTH GRADE STUDENTS WITH RESPECT TO THEIR LEARNING STYLES

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This study aimed to investigate the differences in mathematics achievement scores of the eighth grade students with respect to their learning styles. Mathematics achievements of the eighth grade students were determined by the number of correct answers given in the mathematics subtest of Level Determination Examination (abbreviated in Turkish as SBS) which was administered in June 2009. Mathematics achievements of the eighth grade students were also determined by teacher-assigned mathematics grades which were given at the end of the school year of 2008-2009. Learning styles of different students were determined by Learning Style Questionnaire developed by Kolb.

This study was conducted with 283 eighth grade students who attended schools located in different specified regions (city centre, suburban and villages) of Mustafakemalpaşa town of Bursa during spring semester of 2008-2009.

The data were analyzed by using Kruskal-Wallis Test and Mann-Whitney U Test. The results indicated that the most common learning style was found to be assimilators. The results of the statistical analyzes showed that there was a significant difference in mathematics achievement scores of students with respect to learning styles. The mean of the SBS mathematics scores of convergers were found to be higher than that of assimilators, divergers and accommodators. The mean of both SBS mathematics achievement scores and teacher assigned mathematics scores of female students were found to be higher than that of male students. The mean SBS mathematics achievement scores of students who attended different schools located in the city centre were found to be higher than that of students who attended schools located in the suburbia and villages.

Keywords: Learning Styles, Mathematics Achievement

ÖZ

SEKİZİNCİ SINIF ÖĞRENCİLERİNİN MATEMATİK BAŞARILARININ ÖĞRENME BİÇİMLERİNE GÖRE İNCELENMESİ

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Bu çalışmanın amacı; sekizinci sınıf öğrencilerinin matematik başarılarındaki farklılıkların öğrenme biçimlerine göre incelenmesidir. Sekizinci sınıf öğrencilerinin matematik başarı puanları; Haziran 2009'da gerçekleştirilen Seviye Belirleme Sınavı (SBS) matematik testindeki doğru yanıt sayısı ve matematik öğretmenlerince 2008–2009 dönem sonunda verilen karne notlarına göre belirlenmiştir. Öğrencilerin öğrenme biçimleri, Kolb tarafından geliştirilen Öğrenme Biçimleri Ölçeği ile belirlenmiştir.

Bu çalışma; 2008 – 2009 eğitim öğretim yılının 2. döneminde, Bursa ili Mustafakemalpaşa ilçesinin farklı bölgelerindeki (şehir merkezi, belde ve köyler) okullara devam eden 283 öğrenci ile gerçekleştirilmiştir.

Ölçme araçlarından elde edilen bulgular karşılaştırmalı olarak Kruskal – Wallis Testi ve Mann – Whitney U Testi ile analiz edilmiştir. Çalışmaya katılan öğrenciler arasında özümseyen öğrenme stilinin en yaygın olduğu tespit edilmiştir.

İstatiksel sonuçlar, öğrencilerin öğrenme biçimleri ile matematik başarıları arasında anlamlı bir farklılığın olduğunu göstermiştir. Ayrıştıran öğrenme biçimine sahip öğrencilerin SBS matematik testi doğru ortalamalarının özümseyen, değiştiren ve yerleştiren öğrenme biçimlerine sahip öğrencilerden daha yüksek olduğu bulunmuştur. Kız öğrencilerin matematik başarı puanlarının erkek öğrencilerin matematik başarı puanlarından daha yüksek olduğu bulunmuştur. Ayrıca şehir merkezindeki okullara devam eden öğrencilerin SBS matematik doğru ortalamasının, belde ve köy okullarına devam eden öğrencilerin matematik doğru ortalamalarından yüksek olduğu görülmüştür.

Anahtar Kelimeler: Öğrenme Stilleri, Matematik Başarısı

To

My Parents and Sister
Sevim, Selçuk and Seçil KURBAL
Who always stand by me...

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LSI	: Learning Style Inventory
SBS	: Seviye Belirleme Sınavı (Level Determination Exam)
SBSMATHS	: Mathematics Achievement Scores in the Subtest of SBS
TAMS	: Teacher Assigned Mathematics Scores

CHAPTER I

INTRODUCTION

Most educators recognize that understanding the ways in which individuals learn is a key element for the improvement of education (Collinson, 2000). Turkish students' mathematics performances in examinations which assessed overall criteria have been reported to be very low in internationally (Programme for International Student Assessment, PISA, 2003 and 2006) and national assessment studies (Level Determination Exam, Turkish abbreviation SBS, 2009 and 2010). There are discussions for major overhauls in improvement (Ministry of National Education, 2003, 2006, 2009, 2010). It has been argued that many students do not know how to use mathematical fundamentals and for this reason students have not developed higher order thinking skills in mathematics (PISA Report, Ministry of National Education, 2007). Besides, understanding the use of mathematics and its reasoning is crucial to be a qualified individual in professions like engineering, software technology and even more in the health sciences.

Mathematics is a compulsory qualification for understanding today's world. It is reasonable to argue that deficiencies in utilizing mathematics arose from inadequate application in mathematics instruction which did not take into account different learning styles.

Finding the answers to the questions: "How do students learn?", "Do all students learn in the same way?" and 'Why do students choose specific ways to

learn?' would be the first step in increasing mathematical achievement in examinations. Finding the answers to those questions would also lead to innovations in the instructional strategies of handling mathematics lessons.

Understanding the differences in learning requires understanding the process of learning mechanisms in a student's mind. Theory of cognitive learning is taken into account the concept of learning in terms of process, not output of a behavior. The basic question of this understanding is 'How does a learner learn?' rather than 'What did a learner learn?'

The idea of learning styles is one of the derivations of cognitive learning. The concept of learning style arose from the studies related with individual differences (Kaya, 2007). Learning styles originate from characteristics which are inborn and stable, but changes from person to person (Kaplan & Kies, 1997). Learning styles delve into the ways in which each learner begins to concentrate on, process, and retain new and difficult information (Dunn, 1991). Learning styles can also be described as the combination of cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment. It is demonstrated in a pattern of behavior and performance by which an individual approaches educational experiences (Keefe & Ferrell, 1990). Individual thoughts on learning styles show that there should be certain differences in every individuals learning.

The concept of learning styles was also suggested by David Kolb, a learning style specialist, under the name of Experiential Learning Theory (ELT) which is the core of current study to take into account the learning process (Kolb, 1984).

According to ELT, "Learning is defined as the process whereby knowledge is created thorough the transformation of experience. Knowledge results from the grasping and transforming experience" (Kolb, 1984. p.41). The applications of learning style model which ELT is offered were analyzed in various studies (Kolb; Boyatsiz & Mainemalis, 2001). Hichox (1991) examined an important amount of quantitative and qualitative research related to the applications of learning styles of the ELT model in the education field and found that 61.7 % of studies supported the ELT model and, 16.1 % indicated mixed support (with the effect of other variables) of ELT. Thus, the role of learning styles in the ELT model of mathematics achievement is the topic that needs further research (Hichox, 1991).

According to researchers' observation in the literature of learning styles, number of studies about the role and effect of learning styles on mathematics achievement of students was relatively low as compared to studies where the investigated relation between learning styles and the other course achievements like science, social sciences, web based instructions and language (Schroeder, 1993; Raiszadeh, 1997; Bailey et al, 1999; Aruilommi & Ark, 2002; Chun – Shing & Gamon, 2002; Kopsovich, 2003; Özkan, 2003). There are also studies that concentrate more on learning styles and demographic variables such as gender, age and origins of people (Severiens et al, 1994, Soylu & Akkoyunlu, 2002, Dunn et al., 1989). In summation, topics of studies on learning styles showed diversity.

The mathematics achievement of students is assessed in a variety of measuring instruments. In some of cases, students' achievements in mathematics were measured by teacher assigned mathematics examinations. Teacher assigned

mathematics examinations were used as a measuring tool in studies which were about the learning styles and mathematics achievement (Owens, 1999, Kaya et al, 2009).

The more reliable assessments tools that are used, the more valid the scores are obtained. For this reason, nationally and internationally accepted tests can be a reasonable source of valid and reliable data. In literature, researcher of the study could not identify any research study that investigated the relation between students' mathematics achievements in a national examinations and learning styles. In Turkey 8^{th} grade students take the SBS which is the Turkish abbreviation for the Level Determination Examination for the selection of different vocational high schools. It contains one-hundred questions; twenty of which are mathematics questions. The mathematics questions were covered by the studies of the 8^{th} grade mathematics curriculum which is determined by the National Ministry of Education.

It is important for this study to investigate the mathematics achievement of students in the national examination in relation with their learning styles. Besides this, relationship between the teacher assigned grades of students and learning styles of students are also taken into account together in this study.

1.1 Purpose of Study

The main purpose of this study was to investigate mathematics achievements of eighth grade students with respect to their learning styles. The other purpose was to investigate the mathematical achievement scores of the students with respect to

their gender and schools' location in the specified regions of town which are city center, suburban and village.

1.2 Research Questions

There are four research questions of this study stated as follows:

1. Is there a statistically significant difference in the SBS mathematics scores of 8th grade students with different learning styles?
2. Is there a statistically significant difference in teacher assigned mathematics scores of 8th grade students with different learning styles?
3. Is there a statistically significant difference between female and male 8th grade students regarding their SBS mathematics scores?
4. Is there a statistically significant difference in SBS mathematics scores of 8th grade students according to their schools' location in the specified regions of town which are the city centre, suburban and village?

1.3 Hypotheses

The problems of this study stated above were tested with the following hypotheses which are stated as null hypotheses.

Null Hypothesis 1: There is no statistically significant difference in the SBS mathematics scores of 8th grade students with different learning styles.

Null Hypothesis 2: There is no statistically significant difference in teacher assigned mathematics grades of 8th grade students with different learning styles.

Null Hypothesis 3: There is no statistically significant difference between female and male 8th grade students regarding their SBS mathematics scores.

Null Hypothesis 4: There is no statistically significant difference in SBS mathematics scores of 8th grade students according to their schools' location in the specified regions of town which are the city centre, suburban and village.

1.4 Definition of Important Terms

Learning Styles: Perception or assimilation of individuals to new information and operates or accommodate new perceived information differently with experiences. Compounds of assimilation and accommodation techniques define learning styles of the individual. In this research, the learning style is a measure of an individual's relative emphasis on the four learning modes or orientations as identified by Kolb in his Learning Style Inventory (Concrete Experience-CE, Reflective Observation-RO, Abstract Conceptualization-AC, and Active Experimentation-AE) and on two combinations scores that indicate the extent to which the individual emphasizes abstractness over concreteness (AC-CE) and action over reflection (AE-RO). (Kolb, 1985, p.61)

Level Determination Examination (SBS): It is an examination which consists of one- hundred questions that are covered with subjects of the 8^{th} grade course curriculum which include mathematics, Turkish, science, the social sciences and English.

SBS Mathematics Achievement Scores: The number of correct answers on an 8th grade student' test from mathematics section of the SBS.

Teacher Assigned Mathematics Grade: It is the cumulative grade score which of an 8th grade student obtained from the mathematics lesson in the school.

1.5 Significance of Study

Research studies related to learning styles in Turkish context are mostly descriptive in nature that aims to identify students' learning styles. (Aktaş & Mirzeoğlu, 2008; Mutlu & Aydoğdu, 2003; Peker & Aydın, 2003; Şirin & Güzel, 2006;). Beside this, in the Turkish context, most of the studies about learning styles were conducted in relation to the achievements in the subjects like science, biology, physical education, language, or architecture (Demirbaş, 2006; Mutlu & Aydoğdu, 2003; Özkan, 2003; Tabanlıoğlu, 2003). Knowledge about the relationship between students' learning styles and in national examinations, such as Level Determination Examination applied in Turkey, is limited. This study will be contributed to information about the learning styles of students and mathematics achievement of students in the nationally administered examination.

The successful achievement in Math has always been important for students, instructors, schools, researchers and also national commissions of education. In the literature, the reasons that lie beneath the failure and success in mathematics were investigated from different aspects. Studies that investigated the relationship between differences in students' learning styles and the students' scores in teacher-

made mathematics examinations applied at schools were conveyed in different countries. Clearly, results of investigations on relation of mathematics achievements of students showed differences as regarding to their learning styles (Raiszadeh, 1997; Kopsovich, 2003; Aruilommi et al., 2002). This study's outcomes will hopefully add new information in terms of learning styles differences of students and their mathematics achievements.

Students' achievement in mathematics partly depends on the effectiveness of the instruction provided in the mathematics courses. Studies about the effect of learning style based instruction to the achievements of students indicated positive results (Shaughnessy, 1998; Burke & Dunn, 2000). Findings of this study will inform educators about the learning styles of the study group. This may provide insight into the efforts of improving instructional approaches used in the mathematics courses.

Further, researchers still need to identify the importance of learning styles in the achievement of students in different domains. This study which, is addressed to identify the relationship between students' learning styles and mathematics achievements in nationally administered examination, will be contributed to fill the gap in the literature.

1.6 My Motivation to the Study

There were important reform movements in Turkish educational system in 2003 and the curricula of almost all elementary school courses changed. Since then,

new curricula in any course favored student-based learning instead of teacher centered instruction. Following that, activity-based instruction was taken into account as a method teaching mathematics. When this reform winds below in Turkish education system, I was a student of Elementary Mathematics Education program in Middle East Technical University (METU). I had a doubt whether activity-based learning is the only method or the best strategy for mathematics instruction or not. Teachers should take into account that some students may not like doing activity. If mathematics is the least favorite course at most of the times among students in almost every school, then mathematics instruction could be personalized for every single student. With these considerations, while I was an undergraduate student, I took the course called "independent studies in mathematics education" where I could pursue a project in mathematics education. I administered a survey about learning styles to the students of a private school in Ankara in 2005. My purpose was to determine upper elementary school students' learning styles and to investigate relationship between mathematics achievement, their career intentions and their learning styles. Since that project, I started to believe that learning styles of students are interesting dimension to explore. Beside this, in my master's studies I began to explore the theory of learning styles especially with personalized teaching. During my master's studies I conducted a study titled *Generating Mathematics Manipulative with Gifted Children who Have Different Learning Styles* in 2008 at the Center of Science and Art in Mustafakemalapaşa Town of Bursa. In this study, I investigated the approach toward mathematics manipulative of gifted students who have been classified in the same intelligence group, musical, logical – mathematical

and linguistic but have different learning styles. According to result of that study, gifted students who had the same type of intelligence but had a different type of learning style were taught mathematics in different ways. In light of these studies, I decided to investigate the relationship of learning styles with mathematic achievement in a larger sample, which was selected from different locations of the same town. Moreover, I believe that result of this study will contribute to my teaching profession in terms of personalized mathematics teaching.

CHAPTER II

REVIEW OF LITERATURE

The main purpose of this study was to investigate the relation between SBS mathematics achievements scores of 8th grade students and learning styles of them. Investigating the relation between teacher assigned mathematics scores and learning styles of 8th grade students, difference in both mathematics achievements scores in SBS and teacher assigned mathematics scores in respect of genders and difference in mathematics achievements in SBS according to students attended schools located in the different regions in the town where study was accomplished were the other purposes of this study. In accordance with those purposes, this chapter is devoted to the review of literature about learning styles. First, an overview of learning styles is presented in regard to the birth, development and current shape of the theory. Then, research studies related to learning styles were reviewed.

2.1 Definition of Learning from the Perspective of Experiential Learning Theory

Learning is one of the most important individual processes that occur in every part of human life, as in organizations, education and training programs (Martin, 1999). So, perception of learning shows diversity from which concept of learning was overviewed. The theoretical core of this study is based on Experiential Learning Theory (ELT). One of the significant followers and implementers of this theory is

David Kolb who was the creator of Learning Styles of ELT. To understand learning styles in a meaningful manner, perception of learning from the view of ELT should be identified. Kolb and Kolb (2005) revised the definition of learning in ELT in the manner that follows:

"Learning is best conceived as a process, not in terms of outcomes. The primary focus should be on engaging students in a process that best enhances their learning – a process that includes feedback on the effectiveness of their learning efforts." (Kolb & Kolb, 2005, p. 3)

Kolb and Kolb (2005) also emphasized the importance of repetition with different examples in the learning process with following words: "All learning is relearning. Learning is best facilitated by a process that draws out the students' beliefs and ideas about a topic so that they can be examined, tested and integrated with new, more refined ideas" (Kolb & Kolb, 2005, p. 4).

Kolb and Kolb grounded the learning process as conflict resolution from the perspective of Piaget's approach with followings: "Learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world. Conflict, differences, and disagreement are what drive the learning process. In the process of learning one is called upon to move back and forth between opposing modes of reflection and action and feeling and thinking. Learning is a holistic process of adaptation to the world. It is not just the result of cognition but involves the integrated functioning of the total person—thinking, feeling, perceiving and behaving. Learning results from synergetic transactions between the person and the environment. In Piaget's terms, learning occurs through equilibration of the dialectic

processes of assimilating new experiences into existing concepts and accommodating existing concepts to new experience" (Kolb & Kolb, 2005, p. 5).

Learning is also meant that putting new things and generating ideas. "Learning is the process of creating knowledge. ELT proposes a constructivist theory of learning whereby social knowledge is created and recreated in the personal knowledge of the learner. This stands in contrast to the "transmission" model on which much current educational practice is based where pre-existing fixed ideas are transmitted to the learner" (Kolb & Kolb, 2005, p. 6).

From the perspective of ELT, the concept of learning was defined with the Kolb's words. In a theoretical structure of study, definition of learning styles was necessarily to be explained.

2.2 Learning Styles

Since style is a relative word, educators who specialized in learning styles developed different ideas while investigating learning styles. Introducing different definitions for learning styles will help to look at the concept from a broader perspective.

The concept of learning style arose from the studies related with the individual differences (Kaya, 2007). Learning styles were originally from characteristics which are inborn and stable but they change thorough the life of person (Kaplan & Kies, 1997). It is generally assumed that learning styles refer to beliefs and behaviors preferred by individuals to aid their learning in a given situation (Brown, 2000; Dunn & Griggs, 1998; Hohn, 1995 as cited in Kaya 2007). The concept of learning

styles was also described as psychological, cognitive and affective behaviors which how is an individual perceives, interacts and reacts with learning environments (Keefe 1982). Learning styles were explained as a concept of emphasizing perceived talents of an individual which is observable and with distinctive behaviors (Gregorc, 1984). Last but not least, for a more simple approach, learning styles defined as educational conditions under which a student is most likely to learn (Stewart & Felicetti, 1992).

The way an individual learns is his/her learning style. The cognitive, sensory and physiological structure of individual, which affects his/her perceptions, behaviors in a learning environment, and interactions with people, defines learning styles (Mutlu & Aydoğdu, 2004). According to Silver, Strong and Perini (1997), learning style is a regular or steady way of reacting to new information and using stimuli in the environment of learning. They argue that roots of learning styles were based on psychoanalytic questioning of marketplace enterprises to emphasize how people feel as they solve problems, create products and interact with other people (Silver, Strong & Perini, 1997).

As seen, there are various definitions of learning styles. Beside the given ones, there are also descriptions of learning styles from the view of ELT. McCarthy is one of the crucial learning style specialists. To McCarthy, every individual differently perceives or assimilates new information and operates or accommodates new perceived information with experiences. Compounds of assimilation and accommodation techniques define the learning styles of the individual which are

innovative, analytic, dynamic and common sense learners (Morris & McCarthy; 1990; McCarthy, 2000).

Kolb who is an educational researcher had been working on learning styles, whose theory is the core of the present study. Kolb defined learning styles as a continuum that one moves through over time, usually people come to prefer, and rely on, one style over others (Henke, 2001). Observation of events that happened in the environment of an individual, synthesizes these observations with concepts, generating ideas (hypotheses) to test and choosing new experiences to apply the idea which come from the observed concepts cause to come into existence of different learning styles (Kolb, 1984). Therefore, learning styles are not really concerned with "what" individuals learn, but rather "how" they prefer to learn. When taking into account definitions of learning styles, model of learning styles which is the core of this study is going to be determined.

2.3 Bases of Kolb's Learning Styles Model

Actually, difference thoughts on learning can be associated with the question of "Does everyone learn in a same way?" The idea of learning in different ways, which is referred as learning styles, was born in the 1960s. Rita Dunn was the first discoverers of learning styles put it in a literary agenda. Dunn (1996) stated the definition of learning style as a different and authentic learning ways of learners as one is getting ready for assimilating or remembering new or difficult information (Dunn, 1996). After the 1960s, there was attention on educational researchers about learning styles since there exist over twenty different learning style theories in

literature and these theories explain the learning styles concept from different points of views.

There are many learning styles models in the education literature. These models are based on different point of views, which are physiological, psychological, cognitive, and affective. As far as the purpose of this study is considered, psychological and cognitive types of learning style models are taken into account to express the theoretical bases of ELT.

Carl Jung, a Swiss psychologist, was a contemporary of Sigmund Freud and a leading exponent of Gestalt personality theory. Clark (2008) states that during the early 1900s, Carl Jung established field identifying distinct personality patterns. Many theorists have broken these patterns into categories attempting to make them easier to understand. Jung developed a personality theory that introduced two attitudes extroversion and introversion (Clark, 2008). To be clear, extroversion means "the act, state, or habit of being predominantly concerned with and obtaining gratification from what is outside the self.'' Introversion is "the state of or tendency toward being wholly or predominantly concerned with and interested in one's own mental life". (Merriam Webster Dictionary, 1993)

Jung explained natural types of learning of students by Psychological Types Theory (1971). According to Jung, human's behaviors' are realized by choosing one of functions which are judging and perceiving. To Jung, information is perceived either concretely through sensing or abstractly through intuition. Then, information is judged either through the logic of thinking or the subjectivity of feeling. These are the four Jungian functions – sensing, intuition, thinking, and feeling- that exist in

every individual. One of these functions is dominant, one is auxiliary and ranks as the second most used function, and the third is the tertiary function that is not used too often and demands more energy to use. The fourth function is a person's inferior or shadow function and is too weak to use (Silver et al, 2000, cited in Güneş, 2004).

As it can be understood from previous paragraph, cognitive learning styles began with understanding what lies underneath behavior, which means "What was in mind when that behavior was done?" To explain behavior from a different perspective, Kurt Lewin, a social scientist, proposed a mathematical equation as a function like B = f (P, E) which means that one's behavior (B) is related to both one's personal characteristics (P) and to the social situation in which one finds oneself in environment (E) (Clark, 2008). Clearly, human behavior is the function of personality and environment. Clark (2008) also stated that Lewin is best known for his work in the field of organizational behavior and the study of group dynamics. His research discovered that learning is best facilitated when there is a conflict between immediate concrete experience and detached analysis within the individual. His cycle of action, reflection, generalization, and testing is a characteristic of experiential learning (Clark, 2008).

One of the more important concerns of this study is in the cognitive dimension of the learning process. Dunn, Sklar, Beaudry and Bruno (2001) stated that bases of cognitive dimension are extended along the functionality of brain. The hemispherical shape of the brain is detected by the researchers' attention and functionality of this situation was questioned for dozens of centuries. Interest in the functioning of left and right hemispheres and its implication for human cognition

can be traced back to ancient times when Hippocrates suggested that brain was the organ of mind. Then, much clinical and experimental evidence (Zenhaursen, 1978; Repetti, Gebhart, Nickel & Levi, 1979) demonstrated differential processing in the left and right cerebral hemispheres of humans' intact brain. Different processing of hemispheres of brain naturally brings a result of different though ways, or styles, like analytical / global, successive simultaneous or inductive / deductive etc. (Dunn et al., 2001).

James Zull, a biologist, sees a link between ELT and neuroscience research, suggesting that this process of experiential learning is related to the process of brain functioning in his study of In the Art of Changing the Brain: Enriching Teaching by Exploring the Biology of Learning (Kolb & Kolb, 2005). Put into words, the figure 1 illustrates that concrete experiences that come through the sensory cortex, reflective observation involves the integrative cortex at the back, creating new abstract concepts which occurs in the frontal integrative cortex, and active testing involves the motor brain. In other words, the learning cycle arises from the structure of the brain. (Zull, 2002, p. 18–19) In the Figure 2.1, the relation of the cerebral cortex of the brain and learning preferences is indicated.

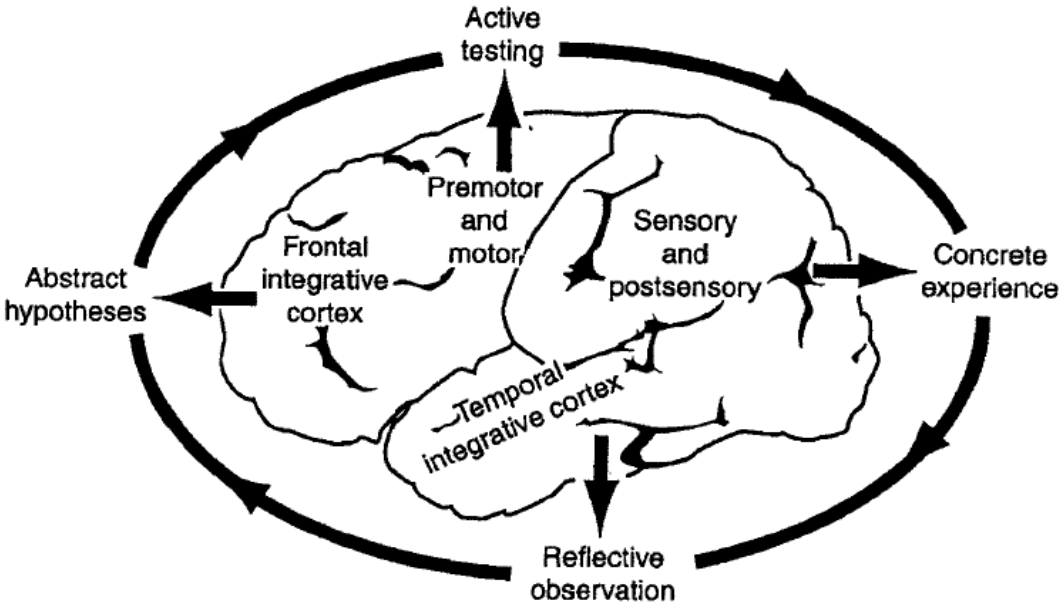

Figure 2.1: The Experiential Learning Cycle and Regions of the Cerebral Cortex
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In sum, functionality of brain brings the learning process into consideration and outputs of learning process come with the behaviors. Behaviors are the cooperation of personality which is the reflection of psychology and environment. And idea of learning styles according to Experiential Learning Theory is grounded on those compounds.

2.4 Kolb's Model for Learning Styles in the Experiential Learning Theory

2.4.1 Development of Learning Style in the Experiential Learning Theory

Kolb's experiential learning theory is based on a model of the learning circle which is introduced by Jung in 1923. By utilizing Jung's model, Kolb introduced experiential learning theory based on learning styles in the 1970s. According to Kolb, individuals learn from their experiences and can evaluate results of this knowledge in a safe way (Peker, 2003).

The approach of experiential learning theory toward learning process is different from behaviorist approach. The reason is called as experiential learning has two reasons: these are scientific bases of theory came from the studies of John Dewey, Kurt Lewin, and Jean Piaget, and another reason is rooted from the reality that experience placed crucial place in the learning process. Kolb (1984) stated in his book that essence of his theory based on the studies of three scientists who were Lewin, Piaget and Dewey (Kolb, 1984). Ergür (1998) explained the impression of Kolb in evolution of Experiential Learning Theory. Kolb was impressed by three views while composing experiential learning theory which is John Dewey's views of pragmatist philosophy, Kurt Lewin's phenomenological views comes from Gestalt psychology and rationalist views of Jean Piaget who is a developmental psychologist. These specifications which experiential learning theory has distinguished from behaviorist learning theory denies role of experience and conscious, and is distinguished from cognitive approaches which place importance on remember in abstract symbols, gaining and guiding of knowledge. Experiential learning theory introduced the idea of combining the concepts of cognition, experience, perception and behavior in the learning process (Ergür, 1998).

In this study, Kolb's Experiential Learning Theory (ELT) is taken into account as a core for understanding the learning preferences of individuals. Therefore, Kolb's definition of learning has become important. Kolb, in fact in ELT, defined the learning concept as "The process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and from which new implications for action can be drawn. These

implications can be transforming experience." (Kolb, 1984, p. 41) So far, learning has transformed from behavioral outcomes to cognitive progression. When the learning concept is thought, then learning cannot be squeezed into just two concepts like behavioral outcomes or cognitive progression. Like in the definition of ELT, a combination of these two concepts, behaviors and cognition, would give the mind insight to understand the nature of learning. As it can be understood by the Kolb's definition of learning, learning is cyclical process and is needed to be based on observing or observing concrete experience and its transformation to information and taking action with individual implication or contribution.

2.4.2 Learning Modes

The ELT model portrays two dialectically related modes of grasping experience - Concrete Experience (CE) and Abstract Conceptualization (AC) - and two dialectically related modes of transforming experience - Reflective Observation (RO) and Active Experimentation (AE) (Kolb, 1984). Experiential learning is a process of constructing knowledge that involves a creative tension among the four learning modes that is responsive to contextual demands. This process is portrayed as an idealized learning cycle or spiral where the learner "touches all the bases"- experiencing, reflecting, thinking, and acting - in a recursive process that is responsive to the learning situation and what is being learned. Immediate or concrete experiences (CE) are the basis for reflective observations (RE). These reflections are assimilated and distilled into abstract concepts (AC), converted

active experimentation (AE) and serve as guides in creating new experiences (Kolb, 1984).

The concept of learning style describes individual differences in learning based on the learner's preferences for employing different phases of the learning cycle. Kolb explained this with following words: "Because of our hereditary equipment, our particular life experiences, and the demands of our present environment, we develop a preferred way of choosing among the four learning modes. We resolve the conflict between being concrete or abstract and between being active or reflective in a patterned, characteristic way (Kolb, 1984, p. 42). In the Figure 2.2, learning modes of an individual is indicated.

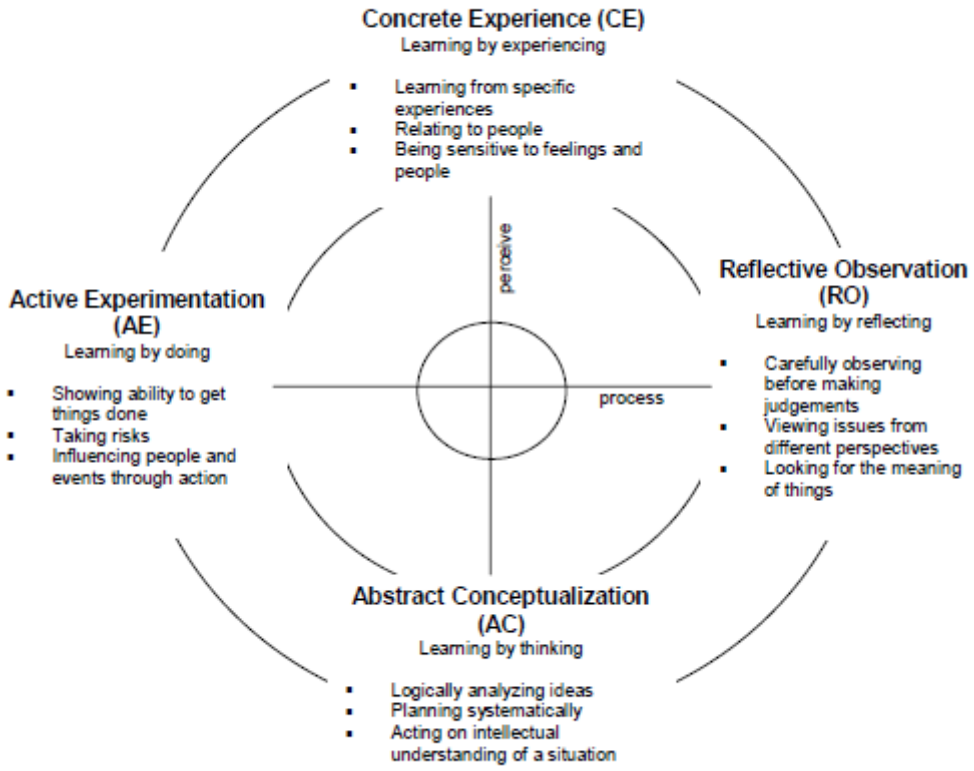


Figure 2.2: Four Learning Modes of Experiential Learning Theory

Atherton summarized this figure that "There are four stages of learning which follow from each other: Concrete Experience is followed by Reflection on that experience on a personal basis. This may then be followed by the derivation of general rules describing the experience, or the application of known theories to it (Abstract Conceptualization), and hence to the construction of ways of modifying the next occurrence of the experience (Active Experimentation), leading in turn to the next Concrete Experience. However, Kolb is not stated any time interval to complete process." (Atherton, 2011, p. 20)

To obtain a clear understanding, it is necessary to develop a terminology that explains the name of the stages because not all forms of skill and knowledge equally accented. Atherton (2011) explained these terms with these words:

"Concrete Experience corresponds to knowledge by acquaintance, direct practical experience as opposed to knowledge about something, which is theoretical, but perhaps more comprehensive, and represented by Abstract Conceptualization. In other words, stage of Concrete Experience of the learning cycle highlights that process of learning requires personal involvement like everyday situations that people experience. Individual at this stage relies more on feelings than a systematic approaches to an encountered problem or situation. An evaluation would be that an individual more dependent to his ability to be an open-minded and adaptable to change." (Atherton, 2011)

"In the Abstract Conceptualization stage, process of learning is drastically concentrated on mathematical reasoning, ideas and logic to perceive the problem

instead of relying on feelings. In contrast to CE, individual at this stage uses his mind in a way of systematic planning, developing theories and ideas and problem solving." (Atherton, 2011)

"Reflective Observation concentrates on what the experience means to the experience, or its connotations, while Active Experimentation transforms the theory of Abstract Conceptualization by testing it in practice and relates to its denotations. In other words, individuals at the stage of Reflective Observation able to understand the ideas and see encounter situations from different points of view. This stage can be viewed as a calm approach to experienced event so that individuals at this stage depend on more objectivity, patience to learn and careful judgment rather than take an action. People would rely on their own thoughts and feelings." (Atherton, 2011)

"Active experimentation can be seen as vivacious stage of learning cycle. Learning has an active form which is in the variable situations and experimenting with influencing. Individuals possess the active approaches and concentrated on what really works. People want to see results and getting involved the process of learning." (Atherton, 2011)

2.4.3 Types of Learning Styles

Many of the research on ELT have focused on the concept of learning style using the Learning Style Inventory (LSI) to assess individual learning styles (Kolb 1971, 1985, 1999). While individuals tested on the LSI show many different patterns of scores, previous researches with the instrument have identified four learning styles that are associated with different approaches to learning —

Diverging, Assimilating, Converging, and Accommodating. The following summary of the four basic learning styles is based on both research and clinical observation of these patterns of LSI scores (Kolb, 1984, 1999a).

According to Kolb (1984) an individual with diverging style has CE and RO as dominant learning abilities. He argued that people with this learning style are best at viewing concrete situations from many different points of views. Kolb labeled it as "diverging" because a person with it performs better in situations that call for generation of ideas, such as a "brainstorming" session. People with a Diverging learning style have broad cultural interests and like to gather information. They are interested in people, tend to be imaginative and emotional, have broad cultural interests, and tend to specialize in the arts. In formal learning situations, people with the Diverging style prefer to work in groups, listening with an open mind and receiving personalized feedback (Kolb, 1984).

An individual with an assimilating learning style has AC and RO as dominant learning abilities (Kolb, 1984). People with this learning style are best at understanding a wide range of information and putting into concise, logical form. Individuals with an assimilating style are less focused on people and more interested in ideas and abstract concepts. Generally, people with this style find it more important that a theory have logical soundness than practical value. The Assimilating learning style is important for effectiveness in information and science careers. In formal learning situations, people with this style prefer readings, lectures, exploring analytical models, and having time to think things through (Kolb, 1984).

Kolb (1984) stated that an individual with a converging learning style has AC and AE as dominant learning abilities. People with this learning style are best at finding practical uses for ideas and theories. They have the ability to solve problems and make decisions based on finding solutions to questions or problems. Individuals with a Converging learning style prefer to deal with technical tasks and problems rather than with social issues and interpersonal issues. These learning skills are important for effectiveness in specialist and technology careers. In formal learning situations, people with this style prefer to experiment with new ideas, simulations, laboratory assignments, and practical applications (Kolb, 1984).

An individual with an accommodating learning style has CE and AE as dominant learning abilities (Kolb 1984). People with this learning style have the ability to learn from primarily "hands-on" experience. They enjoy carrying out plans and involving themselves in new and challenging experiences. Their tendency may be to act on "gut" feelings rather than on logical analysis. In solving problems, individuals with an Accommodating learning style rely more heavily on people for information than on their own technical analysis. This learning style is important for effectiveness in action-oriented careers such as marketing or sales. In formal learning situations, people with the Accommodating learning style prefer to work with others to get assignments done, to set goals, to do field work, and to test out different approaches to completing a project (Kolb, 1984). In the Figure 2.3, learning styles are indicated.

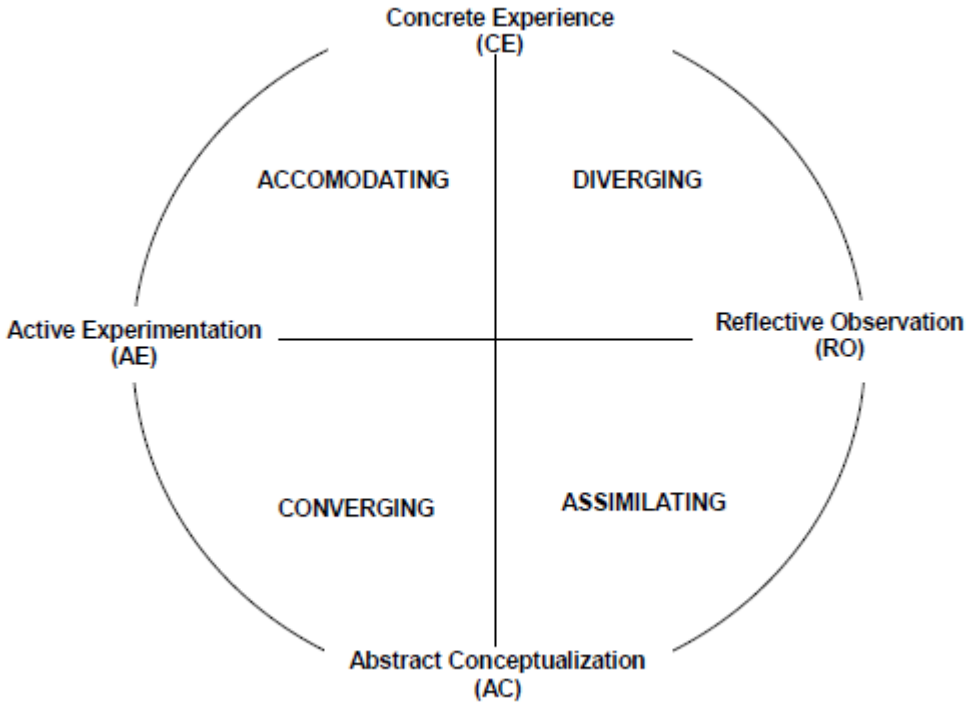


Figure 2.3: Learning Styles in the Learning Circle

To summarize the specifications all learning styles, Peker and Mirasyesdioğlu (2008) suggested a figure which states specifications of all four learning styles. In Figure 2.4, strengths of learning styles are indicated.

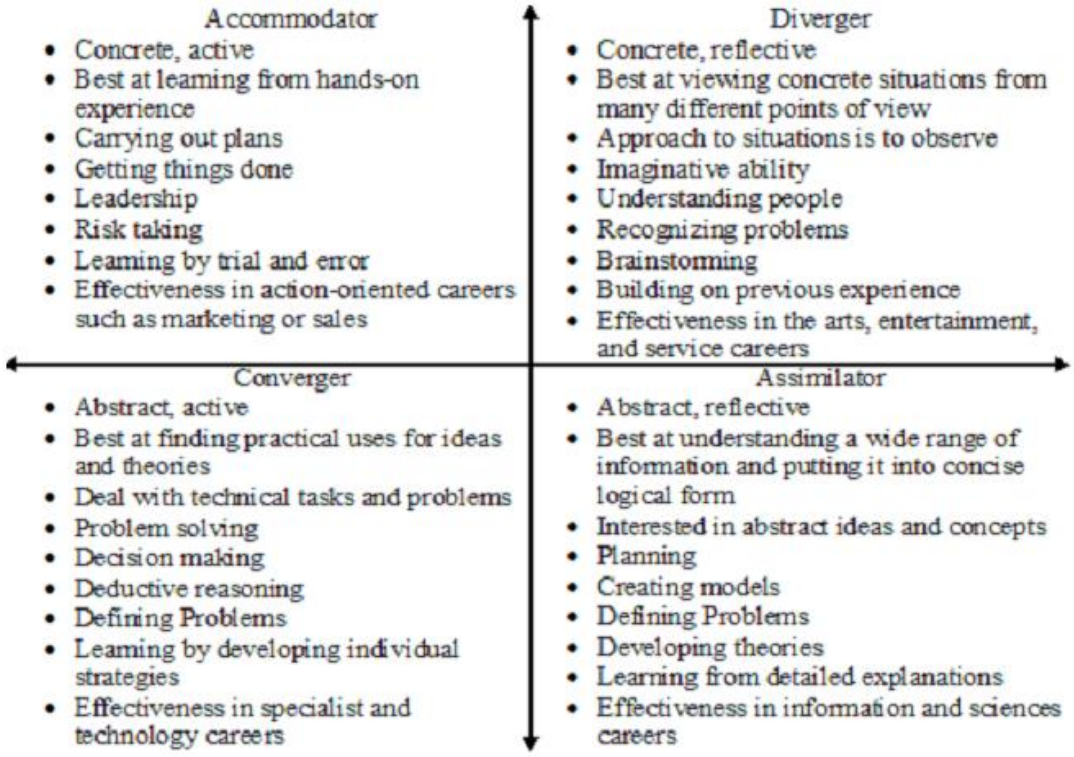


Figure 2.4: Strengths of Learning Styles

(Adapted from, Peker & Mirasyedioğlu, 2008)

2.5 Studies on Learning Styles

There are still questions concerning the relation between learning styles and variables such as gender, ethnicity, and choice of major and academic achievement. Therefore, investigation of learning outcomes (what one learns) and the learning process (how one learns) are continuous to be a central topic of educational research (McKee, 1995). Some students perform better than others at acquiring knowledge about a new topic, even when everyone was given the same instruction. Why do learners have such differences? One possible reason is that successful learners start with a good learning strategy and know how to find out ways for acquiring new material (Vollmeyer & Rheinberg, 2000, cited in Özkan, 2003).

There are important studies in literature concerning the academic achievement or performance of students having different learning styles. (Claxton & Murrell, 1987; Gregorc, 1979; Guild & Garger, 1984; Schroeder, 1993; Witkin, 1973) Many others investigated the relationship between achievements in courses and learning styles. Since the mathematical achievement and learning styles of students are main concern of this study, research studies that focus on learning styles in relation with mathematics achievement of students were taken into consideration at the beginning of this review.

Studies presented here were done with the primary school students. Research was carried out by Aruilommi, Nurmi and Aunola (2002) on the mathematical achievement and reading abilities with 105 first grade students showed that learning styles of students affect the mathematics achievement and reading abilities in a positive direction. Burke and Dunn (2000) conducted a study on mathematics achievement of 2^{nd}, 3^{rd} and 4^{th} grade primary school students under classical instructional methods and learning style-based instruction. The mathematics achievement of students under classic instructional method and learning style-based instruction were considerably different. They found that achievement of students from learning style-based instruction was higher than those in the classical instructional method (Burke & Dunn, 2003).

Kopsovich (2003) conducted a large scale study on learning styles, mathematics achievement, and gender differences with five hundred 5^{th} grade primary school students. Dunn & Dunn's learning style inventory was implemented. Analysis of inventory showed that students who possessed different learning styles

scored differently in mathematics achievement test. Last but not least, providing learning atmosphere and activities according to different learning styles of students resulted in an increase in mathematics achievement (Kopsovich, 2003).

In a few of studies, the mathematical achievement of students and learning styles show no correlation. Yazıcı and Sulak (2008) conducted a study about the relationship between learning styles and mathematics achievements of 5^{th} grade students, as well as the changes in the learning styles of these students in two months of time interval. Results of the study showed that, in a two months period, learning styles of considerable amount of students' changed because of inconsistency in the results of Kolb's Learning Styles Inventory that participants of study scored. The mathematics achievement of students showed no difference in a favor of one specific learning style. In addition, students' arithmetic scores also did not show any significant difference in a favor of one specific learning style. Another important result of this study is that Kolb's learning style inventory showed inconsistency in this grade (Yazıcı & Sulak, 2008). Although, there are many studies about learning styles of primary students and their achievements in mathematics, it was not witnessed any study in literature about relation of elementary students' learning styles of students and mathematics achievement.

There are very few studies done with mathematics achievement of high school and university students' learning styles as compared to achievement in different courses (Aşkar & Akkoyunlu, 2002; Fer, 2003; Kaya, Özbacacı & Tezel, 2009; Treacy, 1996) Nonetheless, the numbers of studies are limited, many of which show a positive correlation in a majority of the cases.

For example, in her investigation, Treacy studied with 377 college students in the subjects of learning styles, beliefs about technology and mathematical achievement. The result of this study showed that learning styles, beliefs and mathematics achievement were correlated (Treacy, 1996). In another study, Fer studied relationship between 106 mathematics and science prospective teachers' learning styles and their easy-to-learn learning activities. Easy-to-learn learning activities and learning styles of students have significant relation. However, results showed that gender of students and learning styles have no correlation (Fer, 2003). Studies about learning styles in relation with the achievements in the courses of science, social studies and other ones were taken into account also.

Kaya, Özabacı and Tezel (2009) conducted a study investigating the relationship between demographic variables and learning strudels of 687 second grade primary school students. According to their results, there is a significant relationship between learning styles and achievements in science. Students who had diverging learning styles received higher scores from school courses as compared to students with other types of learning styles (Kaya et al., 2009). In a different study, Akkoyunlu and Soylu (2002) conducted an experimental study with 39 students about the effect of learning styles on students' achievement in different learning environments. Research was conducted in the framework of a single group with a repeated measurement tools in experimental design model. Three different learning environments: text-based, narration-based, and computer-mediated (narration + music + text + static picture) were planned and participants studied in these environments at different times. According to the results, it has been clarified that

the type of the learning style was not significantly effective on students' achievement in different learning environments (Akkoyunlu & Soylu, 2002). In another study, Demirbaş's (2002) research on the experiential theory consisted of application in a studio design courses with interior architecture students showed that instruction which was done according to the learning styles of student addressing the four modes learning cycle has successful results on students' achievement. In a different manner, Güven's (2008) study on the relationship between primary students' learning styles, attitudes, and academic achievement showed that their learning styles and attitude towards the course of social sciences were positively correlated. In addition, academic achievement and learning style of students have a weak correlation. Lastly, gender difference of students and learning styles had no meaningful relation (Güven, 2008).

Blanch-Payne (1999) conducted a research about relation between students' achievements and learning styles of them. In this study, Kolb's 3rd version of LSI was used and for success marks, the final scores of students were taken into account. Result of the research showed that learning styles and overall success are not significantly related (Blanch-Payne, 1999). In parallel with previous study, Farkas (2003) examined traditional versus learning style-based instructional methods with 105 seventh grade students in terms of their achievement, attitudes, emphatic tendencies, and transfer skills in response to lessons. Analysis of data showed that students indicated more positive attitudes when they were instructed in the manner of multi-sensory approach, which includes instructional methodology developed by Dunn and Dunn (1992), and performed higher as compared to traditional learning

method (Farkas, 2003). In a different example, Özkan's (2003) study on achievement in biology and learning styles with 980 tenth grade high school students showed that biology achievement test's mean scores of assimilators are higher than other learning style types. This means that students' learning styles had a significant effect on biology achievement test scores (Özkan, 2003). The achievements of students in almost every course and learning styles of students in different school segments were investigated. Studies which have been reviewed so far are related with the situation analyses, and those are as important as the studies which investigated the effect of the learning style based instruction to the achievement in school of students. Reason of this, results about relation between learning styles and academic achievement give a light for the question: "Is instruction planned according to learning styles of students has a positive effect to the achievement of students?"

Mutlu (2000) investigated the relationship between learning styles and biology achievement with 226 ninth grade students from different Anatolian High Schools and Anatolian Teacher High Schools. According to this research, assimilators were the highest achievers which were connected to the reason of traditional instructional methods since assimilators were perceived information by abstract conceptualization and processed information by reflective observation. Another research topic of this study was the relationship between attitudes toward biology and learning styles which shows that students have converger type of learning style have a more positive attitude towards as compared to students who had other learning styles. This results support the evidence of learning styles since converger

learning style is the composite of perceiving information as abstract conceptualization and processing information with active experimentation. This situation is suited with the traditional biology instruction (Mutlu, 2000).

Owens examined the learning preferences of students in terms of mathematics achievement and attitude under different instructional methods. The study is organized so as to compare the mathematics achievement of students under problem-based instruction and non-problem-based instruction. The results of the study showed that, at the beginning of the semester, there was no significant difference among the students' learning styles and mathematics achievement. However, students in the experimental group which have problem based instruction, showed difference in terms of increase in mathematics achievement at the end of the semester. Owens concluded that if mathematics instruction is planned to learners' ways of learning, then developing mathematics attitude and mathematics achievement in positive manner is possible (Owens, 1999).

In another study, Matthews (1999) investigated the relationship between learning preferences and achievement of students and found that learning style and academic achievements of high school students had strong relationships. In research, it was found that students with converger learning style were the highest achievers as compared to other learning styles (Matthews, 1999). In parallel to Matthews's research, research about the relation of learning styles and academic achievement show that students who have converger learning style are dominant in achievement scores as compared to other learning styles (Witkin, Moore, Goodenough & Cox, 1987).

In a different aspect, Garcia and Hughes (2000) investigated the predictability of academic achievement according to preferred learning ways. They collected data from 220 college students. Results of study showed that learning styles and predictably of achievement in certain cases are dependent. Students, who study in applied sciences and have concrete experience learning way, are higher achievers as compared to other learning ways which are Abstract Conceptualization and Reflective Observation (Garcia & Hughes, 2000). Parallel with this, Steele, Palensky, Lynch, Lacy and Duff (1998) conducted a research study about scores in the multiple choice assessment test of computer – assisted instructional program and learning preferences of students. Study performed with 227 medical students. Results indicated that convergers and assimilators performed better than accommodators and divergers on multiple choice test measurement (Steele et al, 1998).

In different aspect of learning style, research about relationship between learning styles and problem solving skills among college students, done by Şirin and Güzel (2006) with 330 senior prospective teachers showed that there was no significant relation between the problem solving skills and learning style types. Another result of this study indicated that students graduated from science and mathematics teacher education programs had converging type of learning styles in dominance as compared to students graduated from social sciences. Accommodator learning style has a majority at students from social sciences as compared to students from science and mathematics programs. This result is crucial because it

shows that learning styles are shaped by subject matter courses (Şirin & Güzel, 2006)

Hancock (2000) investigated the effectiveness of the 4MAT applications in lessons. 4MAT system is an instructional design according to learning styles of learners. Hancock's study investigated the effects of 4MAT instruction on the fifth, sixth, and seventh grade students' achievement. Results of the experiment denoted that implications existed for the use of organized, structured lesson plans focused on student engagement as a means to reduce teacher off – task behavior and positively influence student achievement (Hancock, 2000).

There were also studies concerning the relationship between student learning styles and course achievement showing different outcomes. Some of these studies found no correlation between learning style type course achievement (Davis, 1998; Harland-White 1993; Hinterthuer, 1984; Shelton 1994; Taylor 1986). However, some of these investigations revealed that abstract conceptual learners outperformed concrete experience learners. (Buchanan, 1992; Carthey 1998; Caskey, 1981; Purkiss 1994;). Carthey (1998) was even more specific and described the highest achieving learners as the converger learner. Caskey (1981) found that students' socioeconomic backgrounds correlated with learning style characteristics. He found lower socioeconomic groups performed with a more concrete experience style.

In another study, Demirel (2006) investigated whether correct matching of learning styles between teachers and students provided increase in the achievement of learning the English Language. Results of the study showed that if correct match of teachers and learners in terms of learning styles was provided with a suitable

instructional plan according to students' learning style, there was statistically significant increase in learning the English Language of learners (Demirel, 2006).

One another concern of this study is investigating mathematics achievements of students in terms of gender and areas in town where students live in. There are studies in the literature which investigates relation achievements of students regarding to their socioeconomic levels and geographical situations.

Işıksal and Çakıroğlu (2008) conducted a study to investigate the gender differences of the eighth grade students regarding to mathematics achievements in nation wide applied high school entrance examination. In this study, students were selected from five different regions of Turkey according to their socio economic backgrounds. The results of this study showed that there was no significant mean difference in mathematics achievement scores regarding to gender. However, there was a significant difference in mathematics achievements among five different regions. The mean mathematics scores of socio economically developed regions (İstanbul, Ankara and İzmir) were the highest, smaller cities had the lowest mean scores. Despite that, results showed that regional differences of mean mathematics achievement scores had no practical significant.

Bengiç (2009) conducted a study to investigate relation the achievement in social studies course and learning styles of students who were in Denizli (the west of Turkey) and Ağrı (the east of Turkey) provinces. Achievement scores in social studies course were the teacher assigned scores and Dunn & Dunn learning style inventory was used to determine the learning styles of the students. According to the

results, there was no significant difference reported between the achievement scores in students in Denizli and students in Ağrı.

Cox (2000) implemented a study to investigate and to compare regional and gender differences in mathematics achievements. A secondary education qualification examination was used to assess the students' mathematics achievements and students were randomly selected from rural and urban areas (country versus metropolitan). Findings of this study show that students, both males and females, in urban areas outnumbered their urban counterparts in administered examination in terms of mathematics achievements and females significantly performed better than males in this examination.

2.6 Summary

So far, purposes, problems, hypothesize of study and related literature review about topics of study was done. As it can be inference from this chapter, there were limited number of studies which are related with relation of the mathematics achievement scores of students and learning styles of them. Besides, there was no study which investigates the mathematics achievement scores of elementary students in multiple choice examinations which are administered nationally.

In sum, there is a gap in the studies related with the elementary school students and mathematics achievement scores. Results of this study which, will be hoped to assist to fill this gap and will also add new information about the topic of learning styles of students and its relation with mathematics achievement. Lastly,

results of study may then be helpful for the teachers of mathematics in terms of planning their instructional strategies.

CHAPTER III

METHODOLOGY

The main purpose of this study was to investigate the possible differences among students' SBS mathematics scores according to their learning styles. Additional purposes were to investigate the mathematics achievement scores of students according to gender differences and difference in location. In this chapter, information about the design and population of study, sampling, data collection instruments, the variables of the study will be explained. In addition, procedures and methods used to analyze data will be stated, as well as a brief explanation of the assumptions and limitations of the study.

3.1 Research Design

Casual comparative is the overall design of this study. Gay (1987) described causal-comparative research method as follows: "Causal-comparative research attempts to identify a cause-effect relationship between two or more groups. Causal comparative research attempts to determine reasons, or causes, for the existing condition. Causal-comparative studies typically involve two (or more) groups and one independent variable. Causal-comparative studies involve comparison." Gay (1987) also stated about the sampling of the casual comparative studies that: "Individuals are not randomly assigned to treatment groups because they already were selected into groups before the research began."

In this research, the researcher administered the Learning Styles Inventory (LSI), developed by David Kolb to 283 eighth grade elementary students. Purpose of this study was to investigate the difference in mathematics achievements of eighth grade students with respect to their learning styles. In this study, learning styles of students and gender are the independent variables. One of the other independent variables is regions of the town were already determined by geographically before. Students were selected from schools clustered in the regions, city center, suburban (belde) and villages, of Mustafakemalpaşa town in Bursa. Mathematics achievement scores in the SBS subtest and teacher assigned mathematics scores were obtained from the official web site of Ministry of National Education with the permission and assistance of authorized personnel. The main advantage of administering such a questionnaire to such a group was the high rate of return and the questionnaire's low expense (Fraenkel & Wallen, 2003). SPSS for Windows was used for data analysis in this study

3.2 Population and Sample

All the 8th grade students in Mustafakemalpaşa town of Bursa in Turkey were identified as the target population for this study. The accessible population of this study was determined as the 8th grade students who took the SBS in schools located in regions which are in the city centre, suburban (belde) and villages of Mustafakemalpaşa town. This is the population which the results of the study will be generalized.

A purposive sampling strategy reflecting size of institution, public versus non-public, region of the country, and institutional mission served as the basis for selecting participants. In this case it was desirable to purposively choose the region and the respondents because this provided information-rich cases for in-depth analysis related the central issues being studied. Purposive sampling was an effective tool when used with mixed method studies, and in this case it allowed common sense decisions to be made to choose the right habitations and meeting the right number of people from the conference pre-registration listings for the purpose of the study (CEMCA 2004).

In total, there were 1311 eighth grade students in the schools of Mustafakemalpaşa town. In order to obtain a representative data from this population, purposive sampling was used since comparison of students' mathematics achievements should be made regionally according to purpose of this study. Sometimes, it is desirable to purposively choose the region and the respondents for a specific purpose (CEMCA, 2004). One of the versions of purposive sampling which is area sampling or geographical cluster sampling was used because schools in which the investigation was administered in were located in different regions of the Mustafakemalpaşa town of Bursa in Turkey. From another perspective of purposive sampling, convenience of access was taken into account not all of the schools in the defined geographical areas were suitable to administer the inventory (LSI) of study or obtain students' SBS mathematics achievement scores were available or the schools were located in regions not easy to reach.

In this respect, the schools from different regions in the town, city centre, suburban and villages of Mustafakemalpaşa were the groups. To be specific in terms of geographical manner, in this study, the term suburban was used to represent the land located in the outskirts of the town which has an independent governmental administration from the town, Mustafakenalapaşa, and has a minimum population of five hundred people.

Table 3.1 shows the number of schools in the district of Mustafakemalpaşa according to their geographical locations, also denotes the number of schools selected for this study according to their geographical locations, and indicates the number of 8th grade students from the selected schools in each location.

Table 3.1 Number of Schools, Selected Schools and the 8th Grade Students of Selected Schools

Location	Number of Schools	Number of Selected Schools	Number of 8th grade Students from Selected Schools
City Center	14	3	115
Suburban	5	1	102
Village	13	2	66
Total	32	6	283

Gender and ages of students who participated in this study were also important to understand the basic characteristics of the sample. Table 3.2 represents the general distribution of students' gender according to their ages.

Table 3.2: Distribution of Ages According to Gender

Ages	Female	Male	Total
13	2	1	3
14	149	120	269
15	5	6	11
Total	155	127	283

3.3 Variables

There are five variables in this study which were categorized as dependent variables and independent variables. Dependent variables of this study were SBS mathematics scores of students and teacher assigned mathematics grades of students. Independent variables of this study were learning styles of students, regions where selected schools were located, and gender of students.

Table 3.3 Categorization of Research Variables

Type of Variables	Name of Variable
Mathematics Scores in SBS	Dependent Variable
Teacher Assigned Mathematics Grades	Dependent Variable
Learning Styles	Independent Variable
Regions of Town Schools Selected	Independent Variable
Gender	Independent Variable

3.3.1 Dependent Variables

One of the dependent variables of this study was teacher assigned mathematics achievement scores of 8th grade students in school. This variable was scaled from 1 to 5 as listed in the school report papers at the end of the 2008 – 2009 school year. Data of teacher assigned mathematics grades of students were obtained from the official internet web site of National Ministry of Education which consists of students' general information (National Ministry of Education, 2008).

The other dependent variable of study was SBS mathematics scores. Specifically, the number of correct answers on the SBS mathematics test was accepted as the mathematics achievement scores of students. In the mathematics test of SBS, there were twenty questions which cover the 8th grade mathematics curriculum. It is a continuous variable and measured on an interval scale. Possible minimum and maximum scores of students range from 0 to 20.

In SBS examination there are one hundred questions from five different subject areas: Turkish, mathematics, science, social studies, and English Language. SBS is a national examination administered every year and is used to selecting students for vocational high schools in Turkey.

3.3.2 Independent Variables

The independent variables of this study were gender, location of schools, and learning styles of students. In statistical analysis, females were coded as 0 and males were coded as 1. Schools clustered for this study were located in regions of

Mustafakemalpaşa which are the city centre, suburban and villages. In statistical analysis, villages were coded as 1, the city center was coded as 2 and suburban was coded as 3.

Another independent variable of the study was learning styles of students. According to Kolb's Experiential Learning Theory, there are four type of learning styles which are Accommodator, Converger, Diverger and Assimilator which are coded as 1, 2, 3 and 4 in statistical analysis of research respectively.

3.4 Data Collection Instruments

This study contains two data collection instruments used to obtain data from students. The two instruments used were the Learning Style Inventory (LSI) and the mathematic achievement test in SBS (Level Determination Examination).

3.4.1 Learning Style Inventory

All participants were administered the Turkish version of the revised Learning Style Inventory (Kolb, 1985) translated into Turkish by Aşkar and Akkoyunlu in 1993 (Appendix A). The Learning Style Inventory (Kolb, 1985) includes twelve conditional statements. Each statement has four options to be selected addressing specific learning modes in the learning process. The participant of the inventory was expected to rank these sentences from four to one according to his/her learning modes in the learning process. Four means that the most favorable learning mode in the learning process. Three means that the second most favorable learning mode in the learning process. Two means the third favorable learning mode, and lastly, one means the least favorable learning mode in the learning process.

In the Learning Style Inventory, Kolb (1985) defined the first sentence of every conditional statement as the learning mode of Concrete Experience (CE). The second sentence of every conditional statement represented the learning mode of Reflective Observation (RO). The third sentence of every conditional statement represented the Abstract Conceptualization (AC), and the fourth sentence of every conditional statement represented the Active Experimentation (AE). These learning modes had different characteristic meanings for the learning process.

Characteristic specification of Concrete Experiences is the learning by feeling, Reflective Observation is the learning by watching, Abstract Conceptualization is the learning by thinking and Active Experimentation is the learning by doing.

Evaluation of inventory began with the summation of all scores for each learning modes. The results of summation were the raw scores ranging from a minimum of 12 to maximum of 48. These raw scores were plotted on the learning modes grid (Figure 3.1) indicating the strength, weakness or balance of participant to particular learning modes in the learning process. Raw scores also show that two learning dimensions were learned by experiencing or thinking and learned by doing or reflecting. In other words, learning process is perceived as practical or theoretical and is accomplished in actively or passively. Last but not least, plotted raw scores of participant composed a kite like shape on the grid, which can be counted as a picture of learning modes of an individual in the learning process. Evaluation form of raw scores given for the definition of the learning modes was given in the Figure 3.1.

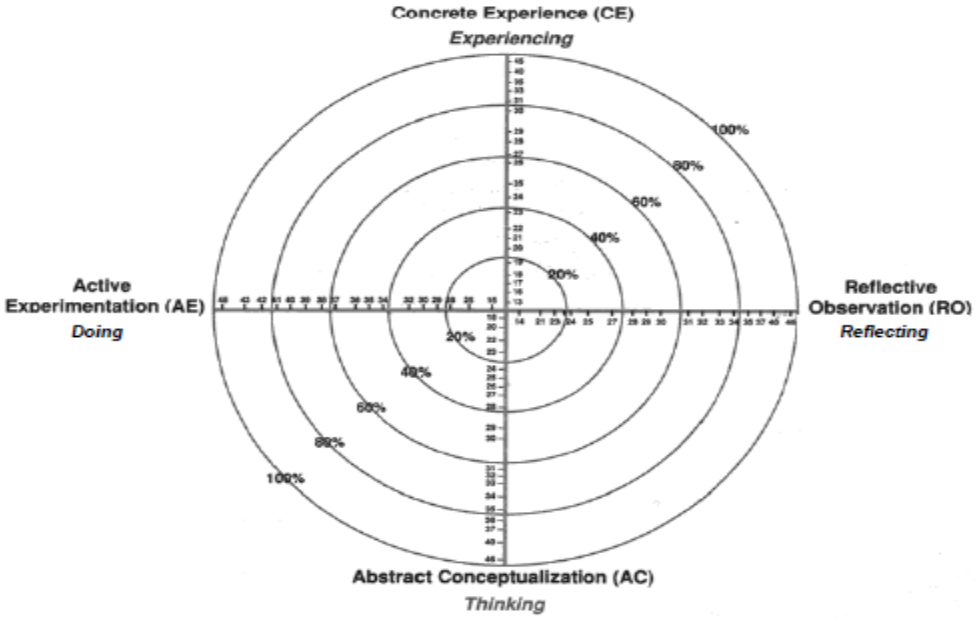


Figure 3.1: Learning Modes Grid

Emphasize on CE versus AC and AE versus RO scores define the learning styles of participants. In determination of learning styles, scores of subtractions (AC – CE) and (AE – RO) form two dimensions which are bisected to form Learning Style Grid (Figure 3.2). The bisected two dimensions have four quadrants that indicate the four learning styles, accommodating, diverging, converging or assimilating. (AC – CE) and (AE – RO) scores ranged from + 36 to – 36 and from + 36 to – 36 respectively. Combining the two scores of (AC – CE) and (AE – RO) on the Learning Style Grid indicates the learning style of the participant. (AC – CE) score also reflects abstractness (positive value) over concreteness (negative value) in the learning process. The score of (AE – RO) reflects action (positive value) over reflection (negative value) in the learning process. Evaluation of learning styles is given in the Figure 3.2.

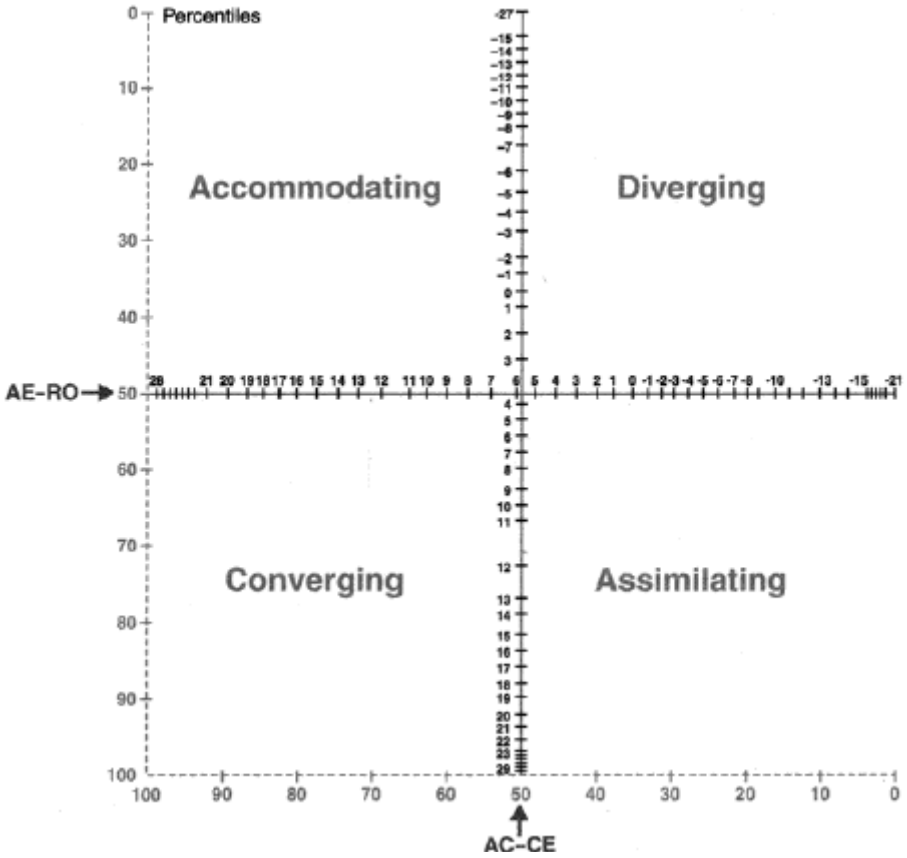


Figure 3.2: Learning Styles Grid (Kolb 1999, p.6)

Cronbach's Standardized Scale Alpha (abbreviated as Cronbach's Alfa (α) was used to test the reliability of Learning Style Inventory. Reliability of current study was demonstrated in Table 3.4. As seen in the table, reliability scores of current study were acceptable. However, reliability scores of current study were low as compared to other studies which were done by Kolb and Aşkar & Akkoyunlu.

Reliability Learning Style Inventory (LSI) was also tested by Kolb. Kolb administered LSI to 1446 university students in 1996. In the test, alpha scores of learning modes and two combined scores of learning modes were calculated. In

Table 3.4, alpha scores of the Kolb's study were indicated. Values of alpha scores were ranged from 0.88 to 0.73 which found as adequate for reliability.

Aşkar and Akkoyunlu (1993) translated and adapted Kolb's LSI into Turkish. Reliability and validity study of adapted and translated LSI was established with 103 participants who were students of Teacher Certificate Program of Hacettepe University. Alpha scores of adapted and translated LSI were indicated in Table 3.y. results of Alpha scores were ranged from 0.58 to 0.77 which were acceptable for reliability.

Table 3.4 Reliability Scores of Current Study, Kolb's Study and Aşkar & Akkoyunlu's Study

	Cronbach's Alfa (α) of Current Study	Cronbach's Alfa (α) of Kolb's Study	Cronbach's Alfa (α) of Aşkar & Akkoyunlu Study
Concrete Experience	0.55	0.82	0.58
Reflective Observation	0.59	0.73	0.70
Abstract Conceptualization	0.63	0.83	0.71
Active Experimentation	0.54	0.78	0.65
AC – CE	0.65	0.88	0.77
AE – RO	0.64	0.81	0.76

3.4.2 Mathematics Subtest of SBS

Mathematics subtest of SBS (Appendix B) was used for assessing the mathematics achievement of 8th grade students. The test was prepared by Ministry of National Education and consisted of twenty questions covering contents of the official mathematics curriculum for 8th grade. Table 3.4 shows the topics of mathematics questions in the SBS in the year 2009.

Table 3.5 Topics of Questions in Mathematics Sub-Test of 8th grade SBS in 2009

Subjects in the 8th Grade Mathematics Curriculum	Number of Questions
Probability	1
Irrational Numbers and Reel Numbers	1
Exponential Numbers and Squared Root	3
Standard Deviation	1
Algebraic Equivalences	1
Equations with Two Unknowns	1
Triangle Inequality and Inequalities	2
Fractals	1
Transformations in Geometry	2
Histograms	1
Similarities and Congruence in Triangles	1
Surface Area of 3 Dimensional Geometric Figures	1
Volume of 3 Dimensional Geometric Figures	1
Perspective Drawing	1

Slope of Lines and Trigonometric Ratios	2
Total	20

Mathematics subtest score was the number of correct answers given by the students. Each correct answer was valued as one point. It ranged from a minimum of 0 points to a maximum of 20 points. Higher scores on the test meant higher performances in the mathematics course. Beside this, SBS scores have important consequences for students, because the results were used as data in evaluating the qualification for vocational high schools. It is important for many students to obtain higher scores in the SBS.

3.5 Procedure

Defining and setting the research problem was the first step of this study. The next step was to determine the significance of the research problem for theory and for the schools in Turkey. After being sure that data for the research requested was obtainable, available and measurable, related literature review was done.

The second step of the study was the administration of the Learning Style Inventory. Six schools were selected and the application process in the schools from different regions was started with permission requested from administrative principals of the selected schools. After the official permission was obtained from the directorate of district national education and the schools administration, the process of data collection was started.

The learning Style Inventory was administered in six different schools. Two of the selected schools were located in the villages of Mustafakemalpaşa town. One of the selected schools was located in the suburban region of Mustafakemalpaşa town, and the remaining three selected schools were located in the city center of Mustafakemalpaşa town. Selection criteria for the schools depended on the representativeness of the general sample. In general, one of the selected schools was private college and the other five were state schools. One of three selected schools in the city center was private college which consisted of some scholar students because of great success in the SBS. In general, students of this school were the children of economically high – class or middle class families. The second school located in the city center consisted of students who were children of middle – class families. The third school selected in the city center consisted of students who were children of economically middle – class or low – middle class families. Population of selected state schools was relatively high as compared to other state schools. Mustafakemalpaşa town has five suburban regions and selected school was the school located in one of suburban regions of Mustafakemalpaşa which has the largest population as compared to the other regions. Students of selected school in the suburban region are the children of economically low – middle class and low class families. Besides this, the selected school in suburban region has the largest population of students as compared to school in the suburban region. In the village region, schools were selected from villages with a relatively higher population than other villages in the region. Students of selected schools in village regions were the children of economically low class and the poorest class families.

One lesson hour was given for administering LSI to students. Each application of LSI was done under the control and observation of the researcher. The scoring of each LSI was done by the researcher.

The third step was obtaining the data of teacher assigned mathematics grades and mathematics achievement scores of students in SBS. At the end of the 2008 – 2009 academic years, teacher assigned mathematics grades were obtained from the official internet website of Ministry of National Education via the assistant principals of each selected school. The mathematics achievement scores of students in SBS were obtained from the official internet website of Ministry of National Education under the control of information technology specialist and the authorized administrator of directorate of the district national education of Mustafakemalpaşa.

The fourth and the final step of the study was gathering all necessary data together to analyze in statistical software program on the computer.

3.6 Data Analysis

The data obtained for this study were analyzed by using descriptive and inferential statistics. To analyze the data in the manner of descriptive statistics, standard deviation, median, mode and mean were used. Histograms of the analyzed variables were also presented. In order to test the null hypotheses, statistical techniques of Pearson Correlation and Chi-square Test, t test, Mann – Whitney U Test and Kruskal – Wallis Test were used.

3.7 Assumptions and Limitations of Study

To understand the results of study in a more meaningful way, stating assumptions and limitations would be useful.

3.7.1 Assumptions of the Study

Assumptions made by the researcher of the study are presented as follows.

1. Administration of the LSI was done under standard conditions meaning that there was no warning or request from the researcher to the student to do something in a desired way.
2. Students sincerely and correctly responded to the items of the LSI.
3. The mathematics teachers of participated students scored the students for their mathematics achievement in the school fairly and independently.
4. The students obtained mathematics grades in the school and the SBS mathematics achievement scores fairly with only their personal efforts.
5. It was not reported by the participants of the study that there was no distraction happened in the administration of SBS.
6. The assistant principals and the principals of the selected schools served necessary data sincerely and honestly.
7. Assessment of the SBS's results examination was done correctly.

3.7.2 Limitations

The following limitations of the study should be taken into account while evaluating the results.

1. The study was conducted in the selected schools of Mustafakemalpaşa town of Bursa province in Turkey. The results of the study were generalized from these selected schools.

2. Learner characteristics were not taken into account beyond the determination of learning styles.

3. Achievement of students was assessed by their own mathematics teachers.

3.8 Internal Validity of the Study

Variables of this study are mathematics achievement scores in SBS; teacher assigned mathematics scores, learning styles, gender and selected schools from different regions of town. These are possible threats for internal validity.

Instrumentation could not be a threat to study since the learning style inventory was administered to all groups in a classroom environment by researcher. SBS was a strictly administered nationwide examination. Mathematics achievement scores in SBS and teacher assigned mathematics scores were obtained from the official web site of Ministry of National Education with official permission. Besides, location could not be threat for this study because learning style inventory, mathematics achievements scores in SBS and teacher assigned mathematics scores were obtained in similar conditions where classrooms are.

Data collector characteristics and data collector bias were assumed to be controlled by implementing inventories with another teacher to ensure that standard procedure where data were collected.

Since the schools which were participated in this study were accepted as groups, random assignment of the subjects was not possible. Important concern for this study was the assigned groups not the individuals.

Confidentiality was not a threat for this study since the names of students were not used in data analyses. Instead of names, a single number assigned for every single participant and names of the students were not used.

3.9 External Validity of the Study

Participants of this study were selected in groups (schools) from the accessible population and 283 eighth grade students participated to this study. Results of this study can easily be generalized to accessible population since generalization of this study's results does not have any limitations.

All the inventory administrations carried out in standardized classrooms during regular one class hour. In administrations, it was not reported any noteworthy differences in classroom environments. Hence, it was thought that external threats were sufficiently controlled.

CHAPTER IV

RESULTS

In the previous chapters, the purpose, literature review of the study and methods were explained. This chapter is devoted to explaining the results of the study. Initially, the results of the study were presented as descriptive statistics.

4.1 Descriptive Statistics

4.1.1 Descriptive Statistics of SBS Mathematics Subtest

Descriptive statistics related to the students' mathematics achievement scores in subtest of SBS (SBSMATHS) were categorized according to the gender of students and presented in the Table 4.1. Scores could range from 0 to 20, where higher scores mean greater mathematics achievement. As Table 4.1 shows, female students had a mean of 6.7 from achievement scores while male students had a mean of 5.5 which means that female students had slightly higher achievement scores than male students. Table 4.1 also indicates the other basic descriptive statistics of sample such as standard deviation and standard error of mean.

Table 4.1 Descriptive Statistics Related to the Mathematics Achievement Scores in SBS Mathematics Subtest According to Gender

SBSMATHS	Female	Male	Total
N	156	127	283
Mean	6.7	5.5	6.2
S. Deviation	4.5	4.0	4.2
S. Error of Mean	0.36	0.36	-
Minimum	0	0	0
Maximum	20	18	20

Table 4.2 presents the descriptive statistics related to the mathematics achievement scores in the SBS mathematics subtest of students according to the location of their school in the three specified regions of Mustafakemalpaşa. As Table 4.2 indicates, students attending schools located in the city center had a mean of 8.82, which were the highest mean scores of the three regions. Table 4.2 also indicated that students attending schools located in suburban and village regions had approximately close mean value scores; however, scores were slightly higher for students in the village regions more than students in the suburban. Students in villages had a mean of 4.71 and students in the suburban had a mean of 4.17 which means that that students attended schools in villages had a slightly higher mean value than students attended to the school in suburban. The median, standard deviation, standard error mean of the sample were also presented in Table 4.2.

Table 4.2 Students' SBS Mathematics Achievement Scores According to Their Schools' Location in the Specified Regions of Mustafakemalpaşa

SBSMATHS	Village	City Center	Suburban	Total
N	66	115	102	283
Mean	4.71	8.82	4.17	6.1
Median	4	8	3	5
S. Deviation	2.94	4.40	3.27	4.20
S. Error of Mean	0.36	0.41	0.32	0.25
Minimum	0	1	0	0
Maximum	16	20	17	20

4.1.2 Descriptive Statistics of Teacher Assigned Mathematics Scores

The official grading system of National Ministry of Education was used for teacher assigned mathematics scores. The current grading system, for the categorization of the achievement scores (out of 5), was used to identify the achievement level of each student. According to the grading system, the highest grade is 5, which identify the achievement level of *very well* while the lowest grade is 1, which identifies the achievement level of *poor*. Passing grades are ranged from 2 to 5 with 1 as a failing grade. In Table 4.3, teacher assigned scores which are officially determined by National Ministry of Education, are presented.

Table 4.3 Quality – Point Equivalents of the Grades of Teacher Assigned Mathematics Scores administered by National Ministry of Education

Range of Teacher Assigned Mathematics Scores	Grades	Level
100 – 85	5	Very Well
84 – 70	4	Well
69 – 55	3	Average
54 – 45	2	Sufficient
44 – 0	1	Poor

Table 4.4 presents descriptive statistics of students' teacher assigned mathematics scores (abbreviated as TAMS) according to their schools' locations in the specified regions of the Mustafakemalpaşa where research was conducted. As seen in Table 4.4, students attending schools located in the city center region had a mean of 3.24, which was the highest mean value of the three regions. The achievement level of students attending schools in the city center region were slightly above general average. Students attending schools in the village region had a mean of 2.55 which was higher than the mean of students attending school located in suburban region which was 1.96. In addition, the achievement level of students attending schools in the village region was below average and the students attending school in the suburban region was almost sufficient. Table 4.4 also presents the other basic descriptive statistics about teacher assigned mathematics scores.

Table 4.4 Students' Teacher Assigned Mathematics Scores According to Their Schools' Locations in the Specified Regions of Mustafakemalpaşa

TAMS	Village	City Center	Suburban	Total
N	66	115	102	283
Mean	2.55	3.24	1.96	2.61
Median	3	3	1	3
S. Deviation	1.30	1.24	1.31	1.40
S. Error of Mean	0.16	0.12	0.13	0.08
Minimum	1	1	1	1
Maximum	5	5	5	5

4.1.3 Descriptive Statistics of Learning Style Inventory

Descriptive statistics related to the types of learning styles (accommodator, diverger, converger and assimilator) were categorized according to gender and given in Table 4.5. As it indicates in Table 4.5, most of the female students (N= 59) and male students (N = 42) were assimilators. The diverger learning style was the next common learning style, with a make up (N=49) female students and (N=36) male students. The distribution of learning styles which are accommodator, diverger, converger and assimilator according to gender are given in Table 4.5.

Table 4.5 Distribution of Learning Style Types According to Gender

Learning Styles	Female	Male	Total
Accommodator	22	19	41
Diverger	49	36	85
Converger	26	30	56
Assimilator	59	42	101
Total	156	127	283

In terms of frequency, as seen in Table 4.5, assimilators had the highest frequency (101) when compared to other learning styles. Divergers were the second highest category with a frequency of 85. The lowest frequency (40) belonged to accommodators in the whole sample.

Distribution of the four learning styles according to gender in terms of percentages was presented in Table 4.6. As shown in the table, the highest percentage belonged to assimilators with 35.8 % as compared to other learning styles. Diverges with 30.2 percent was the next common learning style while the accommodators had the lowest percentage 14.1 of the four learning styles. In table 4.6 percentages of four learning style types was shown.

Table 4.6 Percentages of the Four Learning Styles According to Gender

Learning Styles	Female	Male	Total
Accommodator	7.4	6.7	14.1
Diverger	17.4	12.8	30.2
Converger	9.3	10.6	19.9
Assimilator	20.9	14.9	35.8
Total	55.0	45.0	100

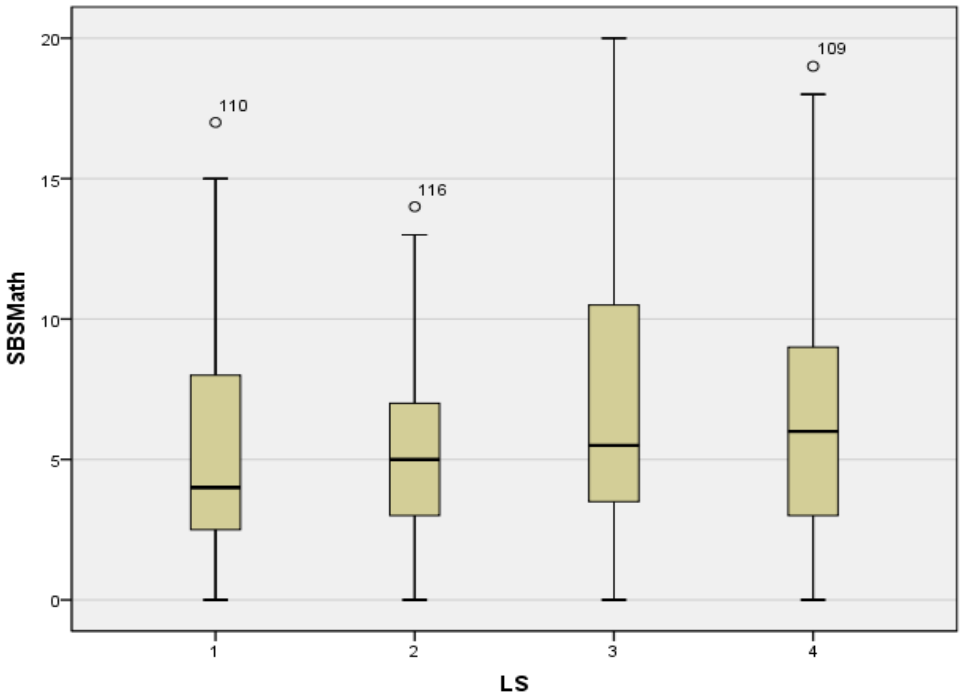
In Table 4.7, the mathematics achievement mean scores on the SBS subtest of students who have different learning styles are presented. According to the findings of the study, students who have a converger learning style had the highest mean value (M = 7.04). This result may be interpreted as convergers' mathematics achievement scores on the SBS subtest were higher than the others.

Table 4.7 Mean of Mathematics Achievement Scores in the subtest of SBS According to Learning Styles

Learning Styles	Mean of SBMATH
Accommodator	5.15
Diverger	5.22
Converger	7.26
Assimilator	6.79

Box plots are useful when the distribution of scores is compared. Box plots can be used to explore the distribution of continuous variables or, alternatively, box plots can be used to break down scores in to different groups (Pallant, 2005, p.70). Referring to the box plot, Dally and Bourke (2000) stated that "A rectangular box shows where most of the data lie (between the quartiles), a line in the box marks the center of the data and the 'whiskers' which encompass nearly all of the remaining data extend from either end of the box" (Dally & Bourke, 2000). Pallant (2005) emphasized the importance of the line in the box as follows: "The line across the inside of the box represents the median value" (Pallant, 2005, p.70).

The distribution of achievement scores in the mathematics SBS subtest according to learning styles of students was indicated in Figure 4.1. From this figure, the whiskers show that the range of achievement scores for convergers is larger than achievement scores for the other learning styles of students. Besides, spread in the students have converger learning style is larger than other learning styles, pointing to students having converger learning styles show larger diversity on mathematics achievement than other ones. When the boxes of four learning styles are considered, according to edges of rectangles, achievement of most of the converger students are higher than students having other learning styles since the values of lower quartile and upper quartile are higher than other learning styles. According to box and its edges, achievement of most of the students have accommodator learning styles are lower than the other learning styles.



1: Accommodator, 2: Diverger, 3: Converger, 4: Assimilator

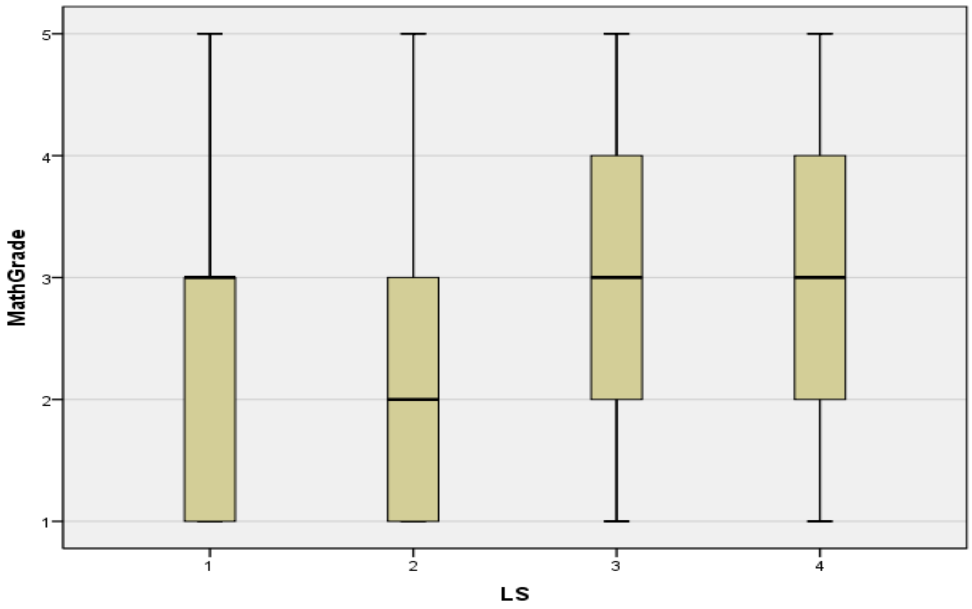
Figure 4.1 Box Plot for SBS Mathematics Achievement Scores and Learning Styles

Teacher assigned mathematics mean scores of students having different learning styles were presented in Table 4.8. As shown in the table, students with converging learning styles had the highest mean value (M = 3), which may be interpreted as convergers' teacher assigned mean scores were higher than the others.

Table 4.8 Teacher Assigned Mathematics Mean Scores of Students Having Different Learning Styles

Learning Styles	Mean of TAMS
Accommodator	2.52
Diverger	2.11
Converger	3.03
Assimilator	2.83

Distribution of teacher assigned mathematics scores according to the learning styles of students is indicated in Figure 4.2. From this figure, the whiskers show that the range of all learning styles are the same due to the boundaries of the teacher assigned mathematics scores. The medians of teacher assigned mathematics scores of students have accommodator, converger and assimilator students are the same but the median of the students with a diverger learning style is the lowest. Distribution of most of the teacher assigned mathematics scores for students with converger and assimilator learning styles are the same in terms of values between the quartiles meaning that achievement in teacher assigned mathematics scores of students have converger and assimilator learning styles is similar. Distribution of most of the teacher assigned scores for students with accommodator and diverger learning styles have similar boxes, but in terms of median, accommodators have a higher score than divergers.



1: Accommodator, 2: Diverger, 3: Converger, 4: Assimilator

Figure 4.2: Box Plot for Teacher Assigned Mathematics Scores and Learning Styles

4.2 Inferential Statistics

In the statistical analysis of research, the distribution of variables was analyzed according to convenience of normal distribution by the Kolmogorov–Smirnov test and the Shapiro–Wilk test. Since the normal distribution was not provided for variables, the Kruskal–Wallis one-way analysis of variance test was used and the Mann–Whitney U test was used for analysis among the groups. The relationship between variables was analyzed by Pearson correlation coefficient and the level of significance was accepted as .05 in this study.

4.2.1 Reason of Use and Assumptions of Mann-Whitney U Test

Pallant (2005) stated that Mann-Whitney U Test is a non-parametric statistical technique to test differences between two independent groups on a continuous measure. This test is the non parametric alternative to the t-test for independent samples. The t-test has five assumptions: level of measurement, random sampling, and independence of observations, normal distribution and homogeneity of variance (Pallant, 2005, p.197). According to results presented in Table 4.9, mathematics achievement scores on the SBS subtest of (Kolmogorov-Simirnov (155) = .000; $p<.05$, Kolmogorov-Simirnov (127) = .000; $p<.05$) and teacher assigned mathematics scores (Kolmogorov-Simirnov (155) = .000; $p <.05$, Kolmogorov-Simirnov (127) = .000; $p<.05$) did not have normal distribution. As a result of this situation, the Mann-Whitney U test was used.

The Mann-Whitney U test has two assumptions: random sampling and independent observations which were held for the variables and methods of this study. Because of this reason, the Mann-Whitney U test was used to analyze the differences between the SBS mathematics achievement scores and the teacher assigned mathematics scores according to gender.

To provide independent observation, Learning Style Inventory was administered in together with the teachers of course and researcher in the schools. Data of teacher assigned mathematics scores and SBS mathematics achievement scores were collected under the observation and permission of authorized personnel of national directorate and assistant principals of the schools.

4.2.2 Reason of Use and Assumptions of Kruskal – Wallis Test

The Kruskal – Wallis test is the non parametric alternative to one-way between groups analysis of variance (ANOVA) (Pallant, 2005, p.294). ANOVA has the same assumptions as the t-test. As presented in Table 4.9, mathematics achievement scores in the subtest of SBS and teacher assigned mathematics scores did not provide the normal distribution. As a consequence of this status, the Kruskal-Wallis Test was used.

The Kruskal-Wallis test has the same assumptions as the Mann-Whitney U Test. As stated in the previous section, the assumptions of non parametric techniques were held. In this study, the Kruskal-Wallis test was used to analyze scores which define significance of difference among the groups which are difference in mathematics achievement scores according to learning styles, gender of students and students' schools in the specified regions of town.

4.2.3 State of Normal Distribution for Study's Variables

For the analysis of two variables to be inferred, the state of normal distribution for variables is important. Kolmogorov – Smirnov test assesses the normality of distribution of scores. A non-significant result (significance value of more than .05) indicates normality. (Pallant, 2005, p.57) Tests of normality results for SBS mathematics achievement scores (abbreviated as SBSMATHS) and teacher assigned mathematics scores (abbreviated as TAMS) according to gender were presented in Table 4.9. According to the findings, mathematics achievements scores of the SBS subtest according to gender had a significance value ($p < .05$) which did not violate

the assumption of normality. In addition, teacher assigned mathematics scores according to gender also had a significance value ($p < .05$) which did not violate the assumption of normality. In other words, the SBS mathematics achievement scores and teacher assigned mathematics scores regarding to gender did not have normal distribution.

Table 4.9 Test of Normality Scores for SBS Mathematics Achievement Scores and Teacher Assigned Mathematics Scores According to Gender

		Kolmogorov - Smirnov			Shapiro – Wilk		
	Gender	Statistic	df	Sig.	Statistic	df	Sig.
SBSMATHS							
	Female	.162	155	.000	.919	155	.000
	Male	.169	127	.000	.886	127	.000
TAMS							
	Female	.178	155	.000	.869	155	.000
	Male	.210	127	.000	.860	127	.000

Tests of normality results based on the learning styles related to mathematics the SBS achievement scores and teacher assigned mathematics scores are presented in Table 4.10. According to findings in Table 4.10, the values of normality test of SBS mathematics achievements scores and teacher assigned mathematics scores regarding all the learning styles were lower than the value of significance ($p= .05$) meaning that the SBS mathematics achievement scores and teacher assigned mathematics scores regarding learning style did not violate the assumption of normality.

Table 4.10 Test of Normality Scores for SBS Mathematics Achievement Scores and Teacher Assigned Mathematics Scores According to Learning Styles

	Kolmogorov – Smirnov			Shapiro – Wilk		
L.S	Statistic	df	Sig.	Statistic	df	Sig.
SBSMATHS						
Accommodator	.191	40	.001	.895	40	.001
Diverger	.162	85	.000	.926	85	.000
Converger	.176	56	.000	.917	56	.001
Assimilator	.163	101	.000	.900	101	.000
TAMS						
Accommodator	.195	40	.001	.868	40	.000
Diverger	.283	85	.000	.787	85	.000
Converger	.142	56	.006	.867	56	.001
Assimilator	.153	101	.000	.893	101	.000

4.2.4 Analysis of Variance for Variables of Study

4.2.4.1 Learning Style Types and SBS Mathematics Achievement Scores

The Kruskal-Wallis Test is the non-parametric alternative to a one-way between-groups analysis of variance. It allows you to compare the scores on some continuous variable for three or more groups (Pallant, 2005, p.294). The Kruskal – Wallis Test makes no assumption about the distribution of data such as normal distribution. Pallant (2005) stated that the assumptions of the Kruskal – Wallis test are random samples and independent observations each person or case be counted only once they cannot appear in more than one category or group, and the data from one subject cannot influence the data from another." (Pallant, 2005, p.287)

Results of Kruskal – Wallis test for SBS mathematics achievement scores among the learning styles are given in Table 4.11. According to the results, the significance level (.024) was less than the alpha level (.05) indicating that there is a

statistically significant difference in SBS mathematics achievement scores across the learning styles. [$\chi^2(3) = 9.436$; $p = .024$; $p<.05$]

Table 4.11: Kruskal – Wallis Test Scores of SBS Mathematics Achievement Scores among Learning Style Types

Test Statistics [a, b]	Learning Styles
Chi – square	9.436
Df	3
Asym.Sig	.024

a. Kruskal Wallis Test
b. Grouping Variable : LS

Pallant (2005) stated that the value of significance level is as follows: "If this significance level is a value less than .05 then you can conclude that there is a statistically significant difference in your continuous variable across groups. You can then inspect the Mean Rank for the groups. This will tell you which of the groups had the highest overall ranking that corresponds to the highest score on your continuous variable."(Pallant, 2005, p.295)

The mean ranks of learning styles are presented in Table 4.12. Since the significance value (.024) is less than the alpha level (.05), comparisons on SBS mathematics achievement scores can be made among the learning styles. In Table 4.12, convergers had the highest mean rank (158.32) suggesting that students with a converger learning style had the highest SBS mathematics achievements scores. In addition, the assimilators' SBS mathematics achievement scores were higher than SBS mathematics achievement scores of divergers and accommodators.

Table 4.12: Mean Ranks of SBS Mathematics Achievement Scores Regarding to Learning Styles

Learning Style Types	N	Mean Rank of SBSMATHS
Accommodator	41	120.68
Diverger	85	127.32
Converger	56	158.32
Assimilator	101	152.35
Total	283	

In order to conduct pair wise comparison among the four learning styles (accommodator, diverger, assimilator and converger) the Mann – Whitney U test was performed. Results of Mann-Whitney U test of SBS mathematics achievement scores of students regarding learning styles are determined in pairs as follows:

SBS Mathematics Achievement Scores regarding Accommodators and Divergers are presented in Table 4.13. Results indicates that p value (.618) of Accommodators and Divergers was higher than value of significance (p =.05) meaning that there is not a significant difference in mathematics achievement scores between students having accommodating learning style and diverger learning style. (U=1606.500; p=.618; p>.05).

Table 4.13: SBS Mathematics Achievement Scores Regarding Learning Styles of Accommodators and Divergers

Test Statistics [a]	SBSMATHS
Mann – Whitney U	1606.500
Asymp. Sig. (2 – tailed)	.618

a. Grouping Variable: LS

[*] p<.05

According to findings, Mann – Whitney U test indicates that there is a significant difference (p=.030) for SBS mathematics achievement scores between accommodators and convergers. This means that there is a significant difference in accommodators and convergers regarding SBS mathematics achievement scores. In addition, SBS mathematics achievement scores of convergers were higher than that of accommodators (U=829, p=.030). SBS Mathematics achievement scores among accommodators and convergers were presented in the Table 4.14.

Table 4.14: SBS Mathematics Achievement Scores Regarding Learning Styles of Accommodators and Convergers

Test Statistics [a]	Mean Rank	Sum of Ranks	Mann-Whitney U	Asymp. Sig. (2 - tailed)
Accommodators	41.23	1649.00	829.000	.030
Convergers	53.70	3007.00		

a. Grouping Variable: LS

The Mann – Whitney U test is significant (p=.039) between accommodators and assimilators that is to say that there is a statistically significant difference between accommodators and assimilators regarding SBS mathematics achievement scores. In addition, students having diverger learning styles had higher mathematics scores than that of accommodators (U= 1571.5; p=.039). Results are given in Table 4.15.

Table 4.15: SBS Mathematics Achievement Regarding Learning Styles of Accommodators and Assimilators

Test Statistics [a]	Mean Rank	Sum of Ranks	Mann-Whitney U	Asymp. Sig. (2 - tailed)
Accommodators	59.79	2391.50	1571. 500	.039
Assimilators	75.44	7619.50		

a. Grouping Variable: LS

* p<.05

Similarly, the Mann – Whitney U test is produced significant results (p = .025) between the scores of divergers and convergers which mean that there is a statistically significant difference in SBS mathematics achievement scores of divergers and convergers (U=1851; p=.025). Those findings are shown in Table 4.16.

Table 4.16: SBS Mathematics Achievement Scores Regarding Learning Styles of Divergers and Convergers

Test Statistics [a]	Mean Rank	Sum of Ranks	Mann-Whitney U	Asymp. Sig. (2 - tailed)
Divergers	64.78	5506.00		
			1851.00	.025
Convergers	80.45	4505.00		

a.Grouping Variable: LS

* p<.05

Divergers and assimilators had a statistically significant difference in their SBS mathematics achievement scores with a significance level of p=.034. In addition, SBS mathematics achievement scores of divergers are higher than that of assimilators which presented in Table 4.17 (U= 3523; p=.034).

Table 4.17: SBS Mathematics Achievement Scores Regarding Learning Styles of Divergers and Assimilators

Test Statistics [a]	Mean Rank	Sum of Ranks	Mann-Whitney U	Asymp. Sig. (2 - tailed)
Divergers	84.45	7178.00		
			3523.00	.034
Assimilators	101.12	10213.00		

b.Grouping Variable: LS

* p<.05

The significance level (p=.654) of the SBS mathematics achievement scores among assimilators and convergers which is not significant according to the Mann – Whitney U test. It means that there is no statistically significant difference in SBS mathematics achievement scores of assimilators and convergers (U=2706.5; p=.654). Those findings are shown in Table 4.18.

Table 4.18: SBS Mathematics Achievement Scores Regarding Learning Styles of Convergers and Assimilators

Test Statistics [a]	SBSMATHS
Mann – Whitney U	2706.000
Asymp. Sig. (2 - tailed)	.654

a. Grouping Variable: LS

* p<.05

4.2.4.2. Learning Styles and Teacher Assigned Mathematics Scores

The Kruskal – Wallis Test Scores for the teacher assigned mathematics scores regarding the learning styles are presented in Table 4.19. According to the results, the significance level was less than the alpha level (p=.05) meaning that there is a statistically significant difference in teacher assigned mathematics scores across the learning styles. [$\chi^2(3) = 19.229$; $p<.05$]

Table 4.19: Kruskal – Wallis Test Scores of Teacher Assigned Mathematics Scores Regarding Learning Styles

Test Statistics [a, b]	Learning Styles
Chi – square	19.229
Df	3
Asym.Sig.	.000

a. Kruskal Wallis Test
b. Grouping Variable : LS

Since there is a statistically significant difference among learning styles in terms of teacher assigned mathematics scores, comparison can be made among the learning styles for teacher assigned mathematics scores. The mean rank of teacher assigned mathematics scores for each learning style is presented in Table 4.20. According to the results, convergers had the highest mean rank, suggesting that teacher assigned mathematics scores of convergers were higher than that of assimilators, accommodators and divergers.

Table 4.20: Mean Ranks of Teacher Assigned Mathematics Scores Regarding Learning Styles

Learning Style Types	N	Mean Rank of TAMS
Accommodator	41	137.60
Diverger	85	112.37
Converger	56	164.63
Assimilator	101	154.73
Total	283	

4.2.5 Analysis of SBS Mathematics Achievement Scores and Teacher Assigned Mathematics Scores According to Gender

Pallant (2005) explained the analysis for the difference between two independent non parametric variables as follows: "This technique is used to test for differences between two independent groups on a continuous measure. This test is the non-parametric alternative to the t-test for independent samples. Instead of comparing means of the two groups, as in the case of the t-test, the Mann-Whitney U Test actually compares medians. It converts the scores on the continuous variable to ranks, across the two groups. It then evaluates whether the ranks for the two groups differ significantly. As the scores are converted to ranks, the actual distribution of the scores does not matter." (Pallant, 2005, p. 291)

The Mann – Whitney U Test scores for the SBS mathematics achievement scores according to gender are presented in Table 4.21. According to the results, the significance level for SBSMATHS (p=.015) is less than the alpha level (p=.05) which shows that there is statistically significant difference between SBS mathematics achievement scores of males and females (U=8246; p=.015). Since there is statistically difference for both SBS mathematics achievement scores of males and females, comparisons can be made for mathematics achievement scores in SBS mathematics achievement scores between males and females. The mean rank of SBS mathematics achievement scores for females and males is also presented in Table 4.21. According to the findings of SBS mathematics achievement scores, females' mean rank score (152.64) is higher than males' rank score (128.93)

showing that mathematics achievement scores of females in SBS is higher than males'.

Table 4.21: Mann – Whitney U Test Significance Scores for the SBS Mathematics Achievement Scores According to Gender

Test Statistics [a]	Mean Rank	Sum of Ranks	Mann-Whitney U	Asymp. Sig. (2 - tailed)
Females	152.64	23.812		
			8246. 000	.015
Males	128.93	16374.00		

a. Grouping Variable: Gender
* p<.05

The Mann – Whitney U Test scores for the teacher assigned mathematics scores according to gender is presented in Table 4.22. The results showed that significance level for TAMS (p=.036) is less than the alpha level (.05) implied that there is a statistically difference in teacher assigned mathematics scores of female and males. (U=8510; p=.036). The mean rank of teacher assigned scores for females and males is also presented in Table 4.22. The results of teacher assigned mathematics scores shows that the mean ranks scores of females (150.95) is higher than males' rank score (131.01), meaning that females' teacher assigned mathematics score are higher than males'.

Table 4.22: Mann – Whitney U Test Significance Scores for Teacher Assigned Mathematics Scores According to Gender

Test Statistics [a]	Mean Rank	Sum of Ranks	Mann-Whitney U	Asymp. Sig. (2 - tailed)
Females	150.95	23.548	8510. 000	.036
Males	131.01	16638.00		

a. Grouping Variable: Gender
* p<.05

4.2.6 Analysis of Students' Mathematics Achievement Scores According to Their Schools' Location in the Specified Regions of Town

Kruskal – Wallis test scores for students' SBS mathematics achievement according to their schools' located in the specified region of the town are presented in Table 4.23. According to the results, the significance level was less than the alpha level (p=.05) meaning that there is a statistically significant difference in SBS mathematics achievement scores related to the students' schools location in the specified regions of town where this study was conducted. [$\chi^2(2) = 80.888$; p = .000; p<.05]

Table 4.23: Kruskal – Wallis Test Scores of Students' SBS Mathematics Achievement Scores According to Their Schools Located in Specified Regions of Town

Test Statistics [a, b]	SBS Mathematics Scores
Chi – square	80.888
Df	2
Asym. Sig.	.000

a. Kruskal Wallis Test
b. Grouping Variable : Schools Located in Different Regions

Since there is a statistical difference for SBSMATHS according to the students' schools locations in the specified regions of the town, comparisons in terms of SBS mathematics achievements scores can be made. The mean rank of students' SBS mathematics achievement scores according to their schools location in the specified regions of the town are presented in Table 4.24. According to the results, students who attended schools located in the city center had the highest mean rank scores (194.05) when compared with the students attending schools located in the village region (116.82) and suburban region (99.61). In conclusion, students who attended schools located in the city center region were the best achievers in terms of SBS mathematics achievement scores in this study.

Table 4.24: Mean Ranks of Students' SBS Mathematics Achievement Scores According to their Attended Schools' Location in the Specified Regions of Town

Schools Located in the Specified Regions	N	Mean Rank of SBSMATHS
Village	66	116.82
City Center	115	194.05
Suburban	102	99.61
Total	283	

SBS mathematics achievement scores in SBS are also determined regarding to the students' schools in pair wise. Firstly, the SBS mathematics achievement scores students who attended schools located in village and the city center regions were considered. The Mann – Whitney U Test Scores for the mathematics achievement scores in SBS between the students who attended schools located in village and the city center regions were presented in Table 4.25. According to the results, the significance level for SBSMATHS is (p=.000) between the students who attended schools located in the village and the city center regions was lower than the alpha level (p=.05) which shows that there is a statistically significant difference in SBS mathematics achievement scores between students who attended schools located in the village and city center regions. (U=1583; $p < .05$)

Table 4.25: Mann – Whitney U Test Significance Scores for the SBSMATHS According to Students Attendance in Schools Located in the Village and the City Center Regions

Test Statistics [a]	Mean Rank	Sum of Ranks	Mann-Whitney U	Asymp. Sig. (2 - tailed)
Village	57.48	3794.00		
			1583.000	.000
City Center	110.23	12677.00		

a. Grouping Variable: Students who Attended Schools Located in the Village and the City Center Regions

Since there is a statistical difference in SBS mathematics achievement scores between the students who attended schools located in the village and the city center regions, comparisons in terms of SBS mathematics achievement scores can be made. According to the results, the mean rank scores of students who attended schools in the city center region (110.23) is higher than the mean rank score (57.48) of students who attended schools located in the village regions which shows that students who attended schools located in the city center region had higher mathematics achievement scores than students who attended schools located in the village regions.

Secondly, SBS mathematics achievement scores of students who attended schools located in the village and the suburban regions were considered. The Mann – Whitney U Test Scores for the SBS mathematics achievement scores between the students who attended schools located in village and suburban regions is presented in Table 4.26. According to the results, the significance level for SBSMATHS

(p=.071) between the students who attended schools located in village and the suburban regions was higher than the alpha level (p=.05). This demonstrated that there is no statistically significant difference in SBS mathematics achievement scores between students who attended schools located in village and suburban regions.

Table 4.26: Mann – Whitney U Test Significance Scores for the SBSMATHS According to Students Attended Schools Located in Village and Suburban

Test Statistics [a]	SBSMATHS
Mann – Whitney U	2816.000
Asymp. Sig. (2 tailed)	.071

a. Grouping Variable: Students who Attended Schools Located in the Village and Suburban Regions of the Town

Lastly, SBS mathematics achievement scores of students who attended schools located in the city center and the suburban regions were considered. The Mann – Whitney U Test Scores for the SBS mathematics achievement scores between the students who attended schools located in city center and suburban regions are presented in Table 4.27. As the results show, the significance level for SBSMATHS (p< .05) between the students who attended schools located the in city center and the suburban was lower than the alpha level (p=.05). This result indicates that there is a statistically significant difference in SBS mathematics achievement scores between students who attended schools located in the city center and the suburban regions. (U=2091; p< .05)

Table 4.27: Mann – Whitney U Test Significance Scores for the SBSMATHS According to Students Attended Schools Located in City Center and Suburban

Test Statistics [a]	Mean Rank	Sum of Ranks	Mann-Whitney U	Asymp. Sig. (2 - tailed)
City Center	141. 82	16309.00		
			2091.000	.000
Suburban	72.00	7344.00		

a. Grouping Variable: Students who Attended Schools Located in the City Center and the Suburban Regions of the Town

Since there is a statistically significant difference in SBS mathematics achievement scores between the students who attended schools located in the city center and the suburban regions, comparisons in terms of SBS mathematics achievement scores can be made. The Mann – Whitney U Test mean ranks of students who attended schools located in the suburban and the city center regions was presented in Table 4.27. According to results, mean rank of students who attended schools in the city center region (141.82) is higher than the mean rank score of students who attended schools located in suburban region (72.00). This shows that students attended schools located in city center had higher mathematics achievement scores than students attended schools located in the suburban.

4.3Assessment of Hypotheses of Study

In this part of the chapter, the study's hypotheses will be assessed.

4.3.1 Null Hypothesis 1

As a reminder, the null hypothesis 1 was stated as follows: There is no statistically significant difference in the SBS mathematics scores of 8th grade students with different learning styles. The Kruskal – Wallis Test was conducted to determine differences among the 8th grade students with different learning styles regarding their SBS mathematics scores. As seen in Table 4.11, Kruskal – Wallis was significant ($\chi 2$ (3) = 9.436, p=.024) and the null hypothesis 1 was rejected. In other words, there is a statistically significant difference in the SBS mathematics scores of 8th grade students with different learning styles.

4.3.2 Null Hypothesis 2

It is also important here to state again the second null hypothesis as follows: There is no statistically significant difference in teacher assigned mathematics grades of 8th grade students with different learning styles. The Kruskal – Wallis test was performed to determine difference among the 8th grade students with different learning styles regarding their teacher-assigned mathematics grades. As seen in Table 4.19, Kruskal – Wallis was significant [$\chi 2(3) = 19.229$; $p<.05$] and the second null hypothesis was rejected. In other words, there is a statistically significant difference in teacher assigned mathematics grades of 8th grade students with different learning styles.

4.3.3 Null Hypothesis 3

The third hypothesis of study was stated as follows: There is no statistically significant difference between female and male 8th grade students regarding their SBS mathematics scores. The Mann – Whitney U test was performed to determine

difference between female and male 8th grade students regarding their SBS mathematics scores. Table 4.21 indicates that Mann Whitney U was significant (p = .015) for SBS mathematics achievement regarding gender and the third hypothesis was rejected. That is to say that, there is a statistically significant difference between female and male 8th grade students regarding their SBS mathematics scores.

4.3.4 Null Hypothesis 4

The fourth and final hypothesis of study was stated as follows: There is no statistically significant difference in SBS mathematics scores of 8th grade students according to their schools' location in the specified regions of town which are the city centre, suburban and village. The Kruskal – Wallis Test was performed to determine difference among 8th grade students in city center, suburban (belde) and village school regions regarding their SBS mathematics scores. Results stated in the Table 4.23 indicates that Kruskal – Wallis score [$\chi 2(2) = 80{,}888$; $p < .05$] was significant and null hypothesis four was rejected. In other words, there is a statistically significant difference in SBS mathematics scores of 8th grade students according to their schools' location in the specified regions of town which are the city centre, suburban and village.

4.4 Summary of Descriptive and Inferential Statistics

- It can be easily understood that the mean of SBS mathematics achievement scores was very low for the participants of this study.
- It can be inferred that the mean of teacher assigned mathematics scores was low.

- Female's mathematics achievement scores both on the SBS and teacher assigned mathematics scores were higher than the male's.

- The most common learning style was assimilator for the subject of this study. Divergers were the second highest learning style observed. Convergers were the third highest learning style and accommodators were rare among the subjects of this study.

- Means of both SBS mathematics achievement scores and teacher assigned mathematics scores for convergers were higher than that of assimilators, accommodators and divergers.

- Students who attended schools located in the city center region had a higher mean of SBS mathematics achievement scores and teacher assigned mathematics scores than that of students who attended schools located in the village and suburban regions.

- There was a statistically significant difference in SBS mathematics achievement scores regarding the learning styles of students. Students who had a converger learning style had a higher SBS mathematics achievement score than that of assimilators, accommodators and divergers.

- There was a statistically significant difference between teacher assigned mathematics scores based on learning styles of students. Students who had a converger learning style had higher teacher assigned mathematic scores than that of assimilators, accommodators and divergers.

- There was a statistically significant difference in SBS mathematics achievement scores regarding the gender of students. Female students had higher mathematics achievement scores than males.

- There was a significant difference in SBS mathematics achievement scores among the students who attend schools located in specified regions (the city center, suburban and village) of town. Students who attended schools located in the city center region had higher SBS mathematics achievement scores than that of students in suburban and the village regions.

- In pair wise comparisons, there was a statistically difference in SBS mathematics achievement scores between students who attended schools located in the city center region and students who attended schools located in the village regions.

- There is not a statistically difference in SBS mathematics achievement scores between students who attended schools located in the village regions and students attended schools located in suburban region.

- There was a statistically difference in SBS mathematics achievement scores between students who attended schools located in the city center region and students who attended schools located in suburban region.

CHAPTER V

CONCLUSIONS, DISCUSSIONS AND IMPLICATIONS

In this chapter, summary of research study, conclusions and discussions of the results, internal and external validity, implications of study and recommendations for further studies were presented.

5.1 Summary of Research Study

Learning Style Inventory (LSI) was administered to 283 eighth grade students who were chosen from an accessible population. They were students at different schools located in different regions of Mustafakemalpaşa Town of Bursa during the spring semester of 2009 – 2010. The regions which the schools were located were taken into consideration as geographical places in Mustafakemalpaşa town which are city center, suburban (belde in Turkish) and villages. Mathematics achievement scores in the subtest of SBS and teacher assigned scores of the students were obtained from authorized personnel of district national education directorate. Representative sample was chosen by purposive sampling method which was used together with a convenience of access to schools. Research methodologies used during the study were descriptive and comparative.

5.2 Conclusions

Results of the study showed that there was a significant difference in mathematics achievement scores in SBS with respect to learning styles of the students. During the study, most common types of learning styles among the students of this study were assimilator and converger types, former were being the highest. Although assimilators were in the majority of this study; students who have converger learning style found to be more successful than the ones who are assimilators, accommodators and divergers when mathematics achievement scores in the subtest of SBS was considered.

The results of study also showed that there was a significant difference in teacher assigned mathematics scores regarding to the learning styles of students. Like in the mathematics achievement scores in SBS, students having converger type of learning styles, were found to be more successful than assimilators, accommodators and divergers in terms of teacher assigned mathematics scores.

There was also significant difference between male and female students in terms of mathematics achievement scores in SBS and teacher assigned mathematics scores. In both mathematics achievement scores in SBS and teacher assigned mathematics scores, female students were found to be more successful than male students.

The results of the study also pointed out that there was significant difference in mathematics achievement scores in SBS regarding to the schools located in different regions, such as city centre, suburban and village of the town where research study was conducted. Students attending to the schools located in the city

center were found to be more successful than the ones in the village and suburban in terms of mathematics achievement scores in SBS. Besides, students in schools located in the villages were found to be more successful than students in school located in suburban in terms of mathematics achievement scores in SBS.

Results of this study indicated that the learning mode of abstract conceptualization (AC) and mathematics achievement scores in SBS were positively correlated. Besides, abstract conceptualization scores (AC) and combined scores of the abstract conceptualization and concrete experience (AC – CE) was positively correlated. Moreover, a significant difference was found between the male and female students in terms of learning mode of reflective observation (RO) in favor of female students.

5.3 Discussion of the Results

The difference in the mathematics achievement scores in SBS regarding to learning styles of the 8^{th} grade students was a major concern of this study. Difference in the achievement in both SBS and teacher assigned mathematics scores regarding to gender has been emphasized and is going to be discussed respectively. Difference in the SBS mathematics achievement scores regarding to students in the schools located in the different regions which was also important finding for this study and is going to be discussed in details.

The discussion of this study was organized so as to compare results of the current study with previous researches or studies. It is observed that the results of

current study have similarities with some previous researches. On the other hand, it is seen that it contradicts with some previous researches.

In the research studies conducted with Turkish participants, assimilating type of learning style, generally, was the most common learning style among the students. As reported in the studies of Aşkar and Akkoyunlu (2002), Mutlu (2006) and Özkan (2003) assimilators were the most common learning style. Beside, in the study of Koçakoğlu (2010), it was decelerated that assimilating type of learning style was the most common type of learning style among the pre-service teachers. And also Peker and Mirasyedioğlu (2007) detected that assimilators were most common seen type of learning style among the elementary school (from first grade to eighth grade) teachers. At this point, it is important to remember the specifications of an assimilator learner. Kolb (1984) stated that an individual with an assimilating learning style has AC and RO as dominant learning abilities. Assimilating learners give more importance to ideas and abstract concepts rather than its practical sounds (Kolb, 1984). That is why lecturing can be enough to understand the logical exploring of ideas or making analytical judgments among the concepts for assimilators. At this point, Collinson's determination on forming learning styles in individual's mind is important so that stated that students indicate that significant changes in how they select to learn in a classroom environment (Collinson, 2000). In the investigated studies during research of this study, it was witnessed that in some of the research convergers and diverges were second most common learning styles in the selected samples (Aktaş & Mirzeoğlu, 2009; Kaya 2007; Peker & Aydın, 2003).

Finding high rate of assimilators in the selected samples of investigated researches can be seen as a coincidence but, according to researcher, this situation should be interrogated. Learning modes of assimilator type of learning style has abstract conceptualization and reflective observation in dominance. Abstract conceptualization means establishing analytic thinking abilities and make connections between ideas. Reflective observation means seeing events from different perspectives or seeing facts to get an inference. Actually, this situation indirectly suggested the passivity in classroom setting because neither thinking nor observation requires activeness in the learning environment. Researcher believes that learning styles of students are shaped by the often repeated instructional methods because students feel instinctually ready to change his/her way of learning according to instructional model of the teachers to understand what is narrated by teachers in the class. The high percentage of assimilators found in this study might be a reflection of teacher – centered instruction model. In this model, teacher is the source of knowledge, that is active, and students are perceiver, that is passive. As stated in the beginning of the introduction chapter, reform movements in curriculums of courses were made to change lecturing based and teacher – centered instructional model which is still unfortunately widely preferred instead of activity based and student centered instructional model.

Another distinctive support of this situation can be seen in the results of investigated research. The current study and other mentioned studies in this chapter (Akkoyunlu, 2002; Aktaş & Mirzeoğlu, 2009; Delialioğlu, 2003; Kaya 2007; Koçakoğlu, 2010; Mutlu 2006; Özkan 2003; Peker & Aydın, 2003) reported that

accommodators were the least common learning style type. Besides that, Orhun (2007) conducted a study with senior university students of mathematics department and found that there were no students who had accommodator learning style. Since learning modes of accommodator type of learning style has concrete experience and active experimentation in dominance, an accommodator individual is good at practical applications in learning environment. When the dominance of lecture based and teacher centered instructional model is taught in Turkey, situation of minority in accommodators among students is an expected result since the most of the time learning styles of students are affected by repeated instructional model.

Mathematics achievement in the subtest of SBS and teacher assigned mathematics scores were accepted as mathematics achievements of students in this study. Moreover, difference in mathematics achievements of students regarding to different learning styles was the main concern of this study. Previously conducted studies give a light to discuss the results of the current study. Interestingly and unfortunately, no study was found in the investigated literature related with the relation between the learning styles of students and mathematics achievement scores in a nation wide applied examination. It is observed that mathematics achievement scores were obtained from either standardized tests or teacher assigned scores.

In general, in the related literature (Arslan & Babadoğan, 2005; Delialioğlu, 2003; Hall, 1993; Kopsovich; 2001; Ok, 2009; Orhun; 2007; Özkan, 2003; Raiszadeh, 1997; Treacy, 1996; Yazıcı, 2004; Yenilmez and Çakır, 2005) achievement scores of students and learning styles were sought. Results of some studies showed parallelism with the results of studies. For example, in Yazıcı's

(2004) study, there is an obvious parallelism with the current study's results because there was a statistically significant difference among the mathematics achievement scores and convergers who had the highest mean mathematics achievement scores in the subtest of SBS. In addition to this, like in the Yazıcı's study, assimilator type of learning style had the second rank in terms of mean mathematics achievement scores like in the results of current study. As also in the Kopsovich (2001) and Hall (1993) studies, even the learning styles of students were determined from different instruments, it can be seen that mathematics achievements scores could be shown difference regarding to learning styles of students. However, in some studies, Delialioğlu (2003) and Raiszadeh (1987), mathematics achievements and learning styles of learners showed no significant relation.

In current study, there was significant difference in mathematics achievements of genders and females' mathematics achievement scores were higher than male ones. However, Ma (2005) determined a study to investigate gender differences in mathematics achievements regarding to scores of internationally applied standardized tests. According to the findings of this study, there was significantly difference in mathematics achievement scores in the test of PISA 2003 regarding to gender. The results showed that boys were outperformed girls. However, there was no significant difference in mathematics achievement scores regarding to gender in the test of TIMMS (1999). Moreover, Over the review of 100 studies of meta – analysis which was done by Hyde, Fennema, and Lamon (1990) male students had better mathematics achievement score than females. However, in the some sated studies (as in Özkan's study) achievement scores of females were better than males.

Inconsistency in the results of studies could be related to types of assessment tools and inequality in opportunity between genders, cultural differences and so on.

Difference in the mathematics achievements according to students at schools which is located in different regions of town where study conducted was another concern of this study. In literature, there are some studies (Bengiç, 2009; Cox, 2000; Işıksal & Çakıroğlu, 2008) reported which investigate the regional differences in mathematics achievement of the students which measured by standardized tests. Results of some studies (Cox, 2000; Işıksal & Çakıroğlu, 2008) showed that students live in the socio economically developed areas were statistically more successful in the examinations than students live in socio economically underdeveloped or developing areas. However, in Bengiç's study, there is no significant difference was found among the students who live in socio economically developed areas and the students live in underdeveloped areas. Whether there was a significant difference among the students who live in developed or undeveloped areas was found or not, there was no study reported students who live in underdeveloped areas were successful than the ones who live in developed areas. Reason of this situation could be originated from the inequality in opportunity between the areas because, in general, infrastructure of schools in developed areas is better than the schools in undeveloped areas. Although it is just a thought of me, one another reason of this situation could be associated with the priorities of people live in different economical segments since in cities, educated parents give more importance to their children. Actually, main reason could be economical difficulties of people who live in socioeconomically underdeveloped areas.

As a general approach to the variables of gender and location of students, the result of the current study had parallelism with some studies. In the present study, there was statistically difference in mathematics achievement scores in regard to gender and females had higher mean mathematics achievement scores than males. Although some studies in the literature did not support the current study's results, it can be thought that male and female students have different tendency in approaching learning from different point of views. It is observed; both in studies related with mathematics or other courses that regional differences in the achievements of students can be vary according to location they live in, and the schools they attend. In some studies, it was reported that mathematics achievements of the students had significant differences in regard to location of the student. It has observed that students who live in socio economically developed locations outperformed better than the ones who live in lower socio economically developed locations in terms of mathematics achievements. PISA 2003 results (National Ministry of Education, 2005) also showed that students in economically developed countries had higher mean mathematics achievement scores as compared to students in lower economically developed countries. Those findings support the results of the current study which was students attend schools in city centre had the highest mean scores.

So far, investigations related with the problems of the current study were determined. As stated earlier of discussion, researcher thinks that learning styles of the students can be shaped by teachers of them. Researcher observed in the applications of classroom that mathematics achiever students or students who like to

do mathematics in the class, who has learning styles which are close to teachers' teaching or learning styles. Peker, Mirasyedioğlu and Yalın (2003) administered a study whose concern was learning style based mathematics instruction. They administered their study with 500 tenth grade students and used Kolb's learning style inventory to define learning styles of students. In their study, whether mathematics teachers' instructional strategies used in the classroom is suitable for learning styles of students was questioned. The results showed that mathematics teacher gave little attention to students' learning styles. It is shown that instructional methods which was not fit to students' thinking of mathematical concepts. Only in the majority of students who have Converger type of learning styles found that mathematics teachers' instructional model was often fulfilled basic learning ways of mathematics. Students who have assimilator type of learning style found that their ways of learning mathematics was rarely the concern of mathematics teacher. Students who have accommodator type of learning style implied that mathematics teachers were never pay attention to their ways of learning by stating teacher had no plan to handling lessons with activities have concrete materials or manipulative. Half of divergers in this study stated that mathematics teachers were never trying to provide opportunities for students to see mathematical concepts from different point of views.

From broader perspectives, to increase the achievement of students, learning styles of students can be associated with the learning strategies of students. Çelenk & Karakış (2007) accomplished a study to investigate the relation between level of usage in general learning strategies and different learning styles with first year

university students and Kolb's learning style inventory was used. Findings of this study showed that accommodators, divergers, convergers and assimilators very often preferred to use Attention, Elaboration, Cognitive, Memory and Meta-cognitive Strategies. Although Affective learning strategy was sometimes preferred by Accommodators, Divergers and Convergers, it was frequently used preferred by Assimilators.

Both studies of Çelenk & Karakış and Peker, Mirasyedioğlu & Yalın indirectly implied that if learning styles of the students taken into account by teachers and knowing learning strategies of students in together with their learning styles, then students' approach toward mathematical concepts would develop in positive direction.

5.4 Implications of the Study

The results of the current study and previously determined researches give a light for making suggestions which may be practically sounds is going to be stated in this section. Important measurement tool of this study was the Kolb's learning style inventory (LSI) which defines the learning style of students can be used by teachers.

In the current study, it was detached that assimilators were the most common type of learning style. Divergers were the second common learning style type, convergers were the third and accommodators were the least common learning style type in this study. Hence, the number of students in the classroom which have the same learning style can be showed difference. In this manner, teachers can

administer learning style inventory to detach spread of the frequency in learning style types in classroom settling.

In this study, the mean of mathematics achievement scores of students in SBS and the mean of teacher assigned mathematics scores of students were low. One of the reasons of this situation can be originated from the instructional methodologies implemented in the classroom. Teachers can implement instructional methods which are taken into account learning styles of students.

In the sample of this study, assimilators were the most common type of the learning styles. Besides, the mean of mathematics achievement scores in SBS of students who have assimilator type of learning style were the second best score. Such a situation can be seen in the classroom as well. In such case, teachers can give more importance to instructional methods which fits with the learning styles of the assimilators. Those strategies can be lecturing, problem solving, reading and investigating on articles, laboratory experiments and simulations.

Divergers were the second common learning style type. However, students who have diverger learning style type were in the third rank among the other learning styles when the means of mathematics achievement scores in SBS are considered. In case of such a situation, teachers can implement the brainstorming, creative – drama, generating discussion groups, open ended questions, giving prompt feedback methods for the improvement of mathematics achievements of assimilators.

Although convergers were the third common learning style type, they had the highest mean mathematics scores in SBS in this study. Teachers can use generating

and solving mathematics puzzles, model buildings, project and performance based works as instructional models for the sustainability of success of convergers.

Accommodators were the least common learning style type and they had the lowest mean mathematics achievement scores in SBS. In this case, it is seen that accommodators need a special interest in classroom environment because the learning styles of accommodators could not be matched with the instructional strategies which implemented by teachers in the classroom environment. For the improvement of students who have accommodator type of learning style, teachers could be more sensitive to use instructional strategies which are suitable for accommodators. Manipulative, hands – on activities, group project or individual performance works, solving real life based mathematics are the methods which are best fit with the learning ways of accommodators.

The mean of teacher assigned mathematics scores were ranked as convergers, assimilators, accommodators and divergers. In this case, it can be stated that there may be a parallelism between the mean mathematics achievement scores in SBS and teacher assigned mathematics scores.

Abstract conceptualization scores had a low correlation with mathematics achievement scores in SBS. Besides, there was a low correlation between abstract conceptualization scores and teacher assigned mathematics scores. Hence, it is seen that instructional methods used by teachers were emphasized the abstract thinking. However, the instructional methods implemented by teachers should be addressed to the other learning modes (concrete experience, reflective observation and active

experimentation) of learning circle which are suggested in Experiential Learning Theory (ELT).

In general, as the results of current study indicated, teachers should remember that every student has learning preferences which shape their learning styles. Mathematics teachers should keep in mind that there might be a difference in the mathematics achievements of students regarding to their learning styles that is why teachers should organize their instructional methods according to students' learning styles. Besides, to address every learning style of students, teacher should organize the classroom infrastructure by providing posters, manipulative, projection machine or mathematical puzzles.

In mathematics achievements of the students, the current study found that female students have higher mathematics achievement scores in SBS and teacher assigned mathematics scores than male students. Mathematics teachers should know that there might be a difference in approaching to learning activities because of gender difference.

As stated previously, mathematics achievement scores of the students in current study were low. However, it was seen that there was a dramatic difference in mathematics achievement scores according to regions where students attend the schools. Mathematics achievement scores of the students in schools located in city center doubled the mathematics achievement scores of students attend schools located in suburban and villages.

In this manner, authorized personnel in National Ministry of Education, teacher educators and teachers should identify the reasons and find solutions for

underachievement in mathematics scores in nationwide standardized mathematics tests and internationally applied examinations. Moreover, authorized personnel in National Ministry of Education should identify the reasons and find solutions for underachievement scores in under developed regions of Turkey.

5.5 Recommendations for Further Studies

The problems of this study have suggested new ideas to investigate in further studies. To give an illustration, topics of current study can be used as a research problem for other studies to investigate in different grade levels.

For a different perspective, topics of the current can be inspired for other courses and achievements of students in different courses regarding to learning styles of students can be studied in the eighth grade or in other level of grades.

This study was concerned the differences in mathematics achievement of eighth grade students regarding to learning style of students. Since this study was dealt with the details of big picture but it does not interest with the reasons of topic. Because of this reason, qualitative studies are needed to find cause of differences in mathematics achievements of eighth grade students regarding to learning styles.

In addition with previous ideas, more detailed researches can be carried out for finding relation between learning preferences in regard to gender differences. Moreover, relation between learning modes of students and course achievement of students can be researchable. From a broader perspective, the effect of the learning style based instruction to the mathematics achievements of students can be needed to be studied.

Learning styles cannot be an only reason in explaining the achievements of students. That is why effect of learning styles can be associated with other determinants like motivation or attitudes to investigate reasons of achievements in future studies.

REFERENCES

Aktaş, İ. P., & Mirzeoğlu, D. E. (2009). İlköğretim II. Kademe Öğrencilerinin Öğrenme Stillerinin Okul Başarılarına ve Beden Eğitimi Dersine Yönelik Tutumlarına Etkisi. *Spormetre Beden Eğitimi ve Spor Bilimleri Dergisi*, *7* (1), 1 – 8.

Aruilommi, T.O., Nurmi, J.E., & Aunola, K. (2002). The development of achievement strategies and academic skills during the first year of primary school. *Learning and Instruction*, *12,* 509–527.

Arslan, B., & Babadoğan, C. (2005). İlköğretim 7. ve 8. Sınıf Öğrencilerinin Öğrenme Stillerinin Akademik Başarı Düzeyi, Cinsiyet ve Yaş ile İlişkisi. *Eurasian Journal of Educational Research*, *21,* 35 – 48.

Aşkar, P., & Akkoyunlu, B., (1993). Kolb Öğrenme Stili Envanteri. *Eğitim ve Bilim, 87*, 37 – 47.

Atkinson, G. (1991). Kolb's learning style inventory: A practitioner's perspective. *Measurement & Evaluation in Counseling & Development, 23* (4): 149 – 162.

Atherton, J. S., (1999). Resistance to Learning: a discussion based on participants in in-service professional training program. *Journal of Vocational Education Training, 51* (1), 77 – 90.

Babadoğan, C. (2000). Öğretim Stili Odaklı Ders Tasarımı Geliştirme. *Milli Eğitim Dergisi, 147*, 61 – 63.

Bacanlı, H. (2001). *Gelişim ve Öğrenme, (4th Ed.),* p. 11 – 22. Ankara: Nobel Yayıncılık.

Bailey, P., Onwuegbuzie, A.J., & Daley, C.E. (2000). Using Learning Style to Predict Foreign Language Achievement at College Level. *System, 28*, 115-133.

Bengiç, G. (July, 2008). *İlköğretim 6. ve 7. sınıf öğrencilerinin öğrenme stilleri ile sosyal bilgiler dersindeki başarıları arasındaki ilişki*. Unpublished Master's Thesis, Pamukkale University, Denizli, Turkey.

Blanch-Payne, E. (2000). *Teaching styles of faculty and learning styles of their students: Congruent versus incongruent teaching styles with regards to academic disciplines and gender*. Unpublished Ph.D. Dissertation, Kent State University, Ohio, USA.

Boydak, A. (2001). *Öğrenme Stilleri*, p. 95. İstanbul: Beyaz Yayınları.

Buchanan, R. (1992). Wicked problems in design thinking. *Design Issues, 8* (2), 5-21.

Burke, K., & Dunn, R. 2002. Learning style-based teaching to raise minority student test scores. There's no debate!. *The Clearing House 76* (2), 103-106.

Butler, K.A, (1987). *Learning and Teaching Style: In Theory and Practice*, p. 318. Colombia CT, The Learners Dimensions.

Carthey, J. H. (1993). *Relationships between learning styles and academic achievement and brain hemispheric dominance and academic performance in business and accounting courses*. Unpublished Master's Thesis, Winona State University, Minnesota. USA

Cano-Garcia, F., & Hewitt Hughes, E. (2000). Learning and Thinking Styles: an analysis of their interrelationship and influence on academic achievement. *Educational Psychology, 20* (4): 413 – 431.

Caskey, L.C. (1981). A Study Of Cognitive Style And Selected Attribute Variables of Community College Students. Unpublished Ph.D. Dissertation, Texas Tech University, Texas, USA.

CEMCA. Sampling. Retrieved April 20, 2011 from: http://www.cemca.org/books/chap13.htm

Chin, C., & Brown, D. (2000). Learning in Science: A Comparison of Deep and Surface Approaches. *Journal Research in Science Teaching, 37* (2), 109 – 138.

Clark, D. R. (2008). Kolb's Learning Styles and Experimental Learning Model. Retrieved January 25, 2010 from: http://nwlink.com/~donclark/hrd/styles/kolb.html

Claxton, C.S., & Murrell, P.M. (1987). *Learning styles: Implications for improving educational practices*. ASHE-ERIC/Higher Education Report No. 4., Washington, DC, George Washington University.

Collinson, E. (2000). A Survey of Elementary Students' Learning Style Preferences and Academic Success. *Contemporary Education, 71* (4), 42 - 49.

Cox, P. (2000). Regional and Gender Differences in Mathematics Achievement. *Journal of Research in Rural Education, 16* (1), 22 – 29.

Çaycı, B., & Ünal, E., (2007). Sınıf Öğretmeni Adaylarının Sahip Oldukları Öğrenme Stillerinin Çeşitli Değikenlere Göre İncelenmesi. *Bilim Eğitim ve Düşünce Dergisi, 7* (3): 22 – 28.

Çelenk, S., & Karakış, Ö., (2007). Farklı Öğrenme Stillerine Sahip Öğrencilerin Genel Öğrenme Stratejilerini Kullanma Düzeyleri A.İ.B.Ü. Örneği. *A.İ.B.Ü. Eğitim Fakültesi Dergisi, 7* (2), 34 – 52.

Delialioğlu, F. A. (2003). *The Roles of Gender And Learnıng Styles On Tenth Grade Students' Kinematics Graphing Skills*. Unpublished Master's Thesis, Middle East Technical University, Ankara, Turkey.

Demirbaş., Ö.O. (2001). *The Relation of Learning Styles and Performance Scores of the Students in Interior Architecture Education*. Unpublished Ph.D. Dissertation, Bilkent University, Ankara, Turkey.

Deniz, R. (2003). Öğrenme Modelleri ve Öğretme Biçimleri, *İTÜ Jeodezi ve Fotogremetri Bölümü Eğitim Geliştirme Komisyonu Yayınları, 1*, 1–6

Dunn, R., & Dunn, K. (1983). *Teaching Secondary Students Through Their Individual Learning Styles Practical Approaches for Grades 7 – 12*. Boston: Allyn and Bacon.

Dunn, R., & Dunn, K. (1992). *Teaching elementary students through their individual learning styles: Practical approaches for grades 3-6*. Boston: Allyn & Bacon.

Dunn, R., & Dunn, K. (1993). *Teaching secondary students through their individual learning styles: Practical approaches for grades 7-12*. Boston: Allyn & Bacon.

Dunn, R., & Griggs, S. (1995). *Multiculturalism and learning styles: Teaching and counseling adolescents*. Westport, CT: Greenwood Publishing.

Dunn, R., Sklar, R., I., Beaudry J.S., & Bruno J., (2001). Effects of Matching and MisMatching Minority Developmental Collage Students' Hemispheric Preferences on Mathematics Scores. *Journal of Educational Research, 83* (5), 283 – 288

Dunn. R., Beaudry, J.S., & Klavas, A., (2002). Survey of Research on Learning Styles. *California Journal of Science Education, 2* (2), 75 – 85.

Ehrman, M., & Oxford, R. (1990). Adult language learning styles an strategies in an intensive training setting. *The Modern Language Journal, 74* (3), 311 – 327.

Ekici, G. (2003). *Öğrenme Stiline Dayalı Öğretim ve Biyoloji Dersi Öğretimine Yönelik Ders Planı Örnekleri, (1st Ed.)*. Ankara: Gazi Yayınları.

Eren, A. (2002). *Fen Sosyal ve Eğitim Bilimi Alanlarında Öğretim Gören Üniversite Öğrencilerinin Öğrenme Biçimleri Arasındaki Farklılığın İncelenmesi*. Unpublished Master's Thesis, Abant İzzet Baysal Üniversitesi, Bolu, Turkey.

Ergür, D.O. (1998). *Hacettepe Üniversitesi dört yıllık lisans programlarındaki öğrenci ve öğretim üyelerinin öğrenme stillerinin karşılaştırılması*.

Unpublished Ph.D. Dissertation, H.Ü. Sosyal Bilimler Enstitüsü, Ankara. Turkey.

Farkas, R.D. (2003). Effects of Traditional Versus Learning-Styles Instructional Methods on Middle School Students. *Journal of Educational Research, 97* (1), 43 – 81.

Fer, S. (2003). The Learning Activities among Learning Styles of Math, Phycics, Chemistry. *Çağdaş Eğitim Dergisi, 28* (304), 33 – 43.

Felder, R., & Soloman, B.A. (1998). *Learning Styles and Strategies.* Retrieved June 29, 2009, from: http://www.ncsu.edu/felder-public/ILSdir/styles.html

Fraenkel, J. R., & Wallen, N. E. (2003). *How to Design and Evaluate Research in Education (5th Ed.).* New York: The McGraw-Hill Companies.

Gay, L. R. (1987). *Educational research: Competencies for analysis and application (3rd Ed.).* New York: Merrill.

Gammon, R.B., Shin M.S., & Groves R.H. Jr. (1995). Clinical risk factors for pulmonary barotrauma: a multivariate analysis. *Am J Respir Crit Care Med, 152*, 1235–1240.

Gregorc, A. F. (1982b). *Gregorc style delineator: Development, technical and administration manual*. Columbia, CT: Gregorc Associates.

Guild, P. (1994). Making Sense of Learning Styles. *School Administrator, 51* (1), 8-13.

Güneş, C. (September, 2004*). Learning Style Preferences of Preparatory School Students*. Unpublished Master's Thesis, Gazi University, Ankara.

Güven, B. (2008). İlköğretim Öğrencilerinin Öğrenme Stilleri, Tutumları Ve Akademik Başarıları Arasındaki İlişkinin İncelenmesi. *TSA, 12* (1), 36 – 54.

Hall, L.A. (1993). Critical Exploration of Learning Style Preferences and the Mathematical Achievement of Chapter 1 Middle School Students: Administrative and Instructional Implications. Unpublished Ph.D. Dissertation, Oklahoma State University, Oklahoma.

Harland, L. K. (2002). *Forced-choice personality tests in management development contexts: An experimental study of test taker reactions*. Paper presented at Midwest Academy of Management Meetings, HR and Careers Division.

Hancock, C.W. (2000). *Impact of the 4MAT Lesson Planning System on Number of Times Off – task in a Fifth, Sixth and Seventh Grade Classroom*. Unpublished Ph.D. Dissertation, Baylor University, Texas.

Henke, H. (2001). *Learning theory: applying Kolb's learning style inventory with computer based training*. Retrieved October 15, 2007, from: http://www.chartula.com/learningtheory.pdf.

Hickcox, L. K. (1991). *An historical review of Kolb's formulation of experiential learning theory*. Unpublished Ph.D. Dissertation, University of Oregon, Corvallis.

Hinson, K.E. (2002). *Black and White Adolescents' Aspirations and Achievement in Mathematics: A Regional Comparison*. Unpublished Ph.D. Dissertation, Virginia Polytechnic Institute and State University, Virginia.

Hinterthuer, R. J. (1995). The Relationship of Developmental College Students Learning Styles to Computer Assisted and Programmed Instruction,. *Dissertation Abstracts International, 45* (8), 22 – 40.

Hyde, J.S., Fennema, E., & Lamon, J.S. (1990). Gender Differences in Mathematics Performance: A Meta-Analysis. *Psychological Bulletin, 107* (2): 139 – 155.

Işıksal, M., & Çakıroğlu, E. (2008). Gender Differences Regarding Mathematics Achievement: The Case of Turkish Middle School Students. *School Science and Mathematics, 108* (39), 113 – 120.

John**,** R. L. **(**1995**).** *Classroom learning & teaching***,** *White Plains***.** New York**:** Longman Publishers**.**

Kaplan, E. J., & Kies, D. (1994). Strategies to increase critical thinking in the undergraduate college classroom. *College Student Journal, 28,* 24-31.

Kaya, F. (2007). *İlköğretim Öğrencilerinin Öğrenme Stillerine Dayalı Fen ve Teknoloji Dersi Öğretim Düzeylerinin İncelenmesi*. Unpublished Master's Thesis, Osmangazi Üniversitesi, Eskişehir, Turkey.

Kaya, F., Özbacacı, N., & Tezel, Ö. (2009). Investigating Primary School Second Grade Students' Learning Styles According to the Kolb Learning Style Model in terms of Demographic Variables, *Türk Fen Eğitimi Dergisi, 6* (1), 11 – 25.

Koçakoğlu, M. (2002). Determining the Learning Styles of Elementary School, (1st-8th Grade) Teachers. *International Online Journal of Educational Sciences, 2* (1), 54 – 64.

Kolb, D.A. (1973). On management and the learning process. *Massachusetts Institute of Technology Journal of Alfred P. Sloan School of Management*, 652 – 673.

Kolb, D.A. (1984). *Experiential Learning: experience as the source of learning and development*. New Jersey: Prentice-Hall.

Kolb, D.A. (1985). Learning-style inventory: Self-scoring inventory and interpretation booklet (2nd ed.). Boston: McBer & Co.

Kolb, D. A. (1999a). *Learning Style Inventory, Version 3*. Boston: Hay / McBer, Training Resources Group.

Kolb, D. A. (1999b). *Learning Style Inventory-version 3, Technical specifications*. Boston: Hay / McBer, Training Resources Group.

Kolb, D.A. Boyatsiz., R. E., & Mainemelis. C., (1999). *Experiential Learning Theory: Previous Research and New Directions*. Department of Organizational Behavior, Weatherhead School of Management, Case Western Reserve University, Cleveland, OH.

Kolb, A., & Kolb, D. A. (1999). *Bibliography of research on experiential learning theory and the Learning Style Inventory*. Department of Organizational Behavior, Weatherhead School of Management, Case Western Reserve University, Cleveland, OH.

Kolb, D., & Kolb A.Y. (2005). Learning Styles and Learning Spaces: Enhancing Experiential Learning in Higher Education Experience-Based Learning Systems. *Academy of Management Learning & Education, 4*, (2) 193 – 212.

Kopsovich, R. D. (2001). *A Study of Correlations between Learning Styles of Students and Their Mathematics Scores on the Texas Assessment of Academic Skills Test*. Unpublished Ph.D. Dissertation, University of North Texas. Texas.

Lynch, T.G., Woelfl, N.N., Steele, D.J., & Hanssen, C.S. (1998). Learning style influences student examination performance. *The American Journal of Surgery, 176*, 62 – 66.

Ma. X. (2005). *Gender Differences in Mathematics Achievement: Evidence from Latest Regional and International Student Assessments*. Paper presented at the 11th International Congress on Mathematical Education, Mexico.

Matthews, D.B., (1996). An investigation of learning styles and perceived academic achievement for high school students. *Clearing House, 69* (4), 249 – 255.

Matthews, D. B. (1991). The effects of learning style on grades of first-year college students. *Research in Higher Education, 32* (3), 253-267.

McCarthy, B. (1990). Using the 4MAT system to bring learning styles to schools. *Educational Leadership, 48* (2), 31-37.

McCarthy, B. (1987). *The 4MAT system: Teaching to learning styles with right/left mode techniques*. Barrington: Excel, Inc.

Merriam-Webster's collegiate dictionary, (10th ed.), 1993. Springfield, MA: Merriam-Webster.

Ministry of National Education [MNE], (2005). *OECD PISA – 2003 Araştırmasının Türkiye ile İlgili Sonuçları, PISA 2003 Projesi Ulusal Nihai Rapor*. Ankara, Tukey: MNE.

Ministry of National Education [MNE], (2005*). İlkögretim matematik dersi ögretim programı 1-5. sınıflar: Ögretim programı ve kılavuzu*. Ankara, Turkey: MNE.

Ministry of National Education [MNE], (2006). *İlkögretim matematik dersi öğretim programı 6-8. sınıflar: Ögretim programı ve kılavuzu*. Ankara, Turkey: MNE.

Ministry of National Education [MNE], (2010). *OECD PISA – 2006 Araştırmasının Türkiye ile İlgili Sonuçları, PISA 2006 Projesi Ulusal Nihai Rapor*. Ankara, Tukey: MNE.

Morris, S., & McCarthy, B. (1990). *4MAT in action II: Sample lesson plans for use with the 4MAT system*. Barrington: Excel Inc.

Mutlu M., & Aydoğdu M. (2003). Fen Bilgisi Eğitiminde Yaşantısal Öğrenme Yaklaşımı. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 13*: 1 – 28.

Mutlu. M, & Aydoğdu, M., (2003). Fen Bilgisi Eğitiminde Kolb'un Yaşantısal Öğrenme Yaklaşımı. Pamukkale *Üniversitesi Eğitim Fakültesi Dergisi, 1*, 13 –15.

Mutlu, M. (2006). The Relation between the Learning Styles of the Students in Anatolian High Schools, Anatolian Teachers' High Schools Science High Schools and Their Attitudes towards Biology Course. *International Journal Of Environmental and Science Education, 1* (2), 148 – 162.

Ok, G.E. (2009*). İlköğretim Öğrencilerinin Öğrenme Biçimlerinin Sınıf Düzeyi, Cinsiyet ve Akademik Başarı ile İlişkisi*. Unpublished Master's Thesis, Uludağ Üniversitesi, Bursa, Turkey.

O'Keefe, D. J. (1982). *The concepts of argument and arguing: Advances in argumentation theory and research*. Carbondale: Southern Illinois University Press.

O'Keefe, D. J., & Shepherd, G. J. (1982). Interpersonal construct differentiation, attitudinal confidence, and the attitude-behavior relationship. *Central States Speech Journal, 33*, 416-423.

Ong, W. (1981). *Fighting for life*. Ithaca: Cornell University Press.

Orhun, N., (2007). An investigation into the mathematics achievement and attitude towards mathematics with respect to learning style according to gender. *International Journal of Mathematical Education in Science and Technology, 38* (3), 321 — 333

Owens, M. E., (1999). *The Relationship of Cognitive Learning Styles: Mathematics Attitude and Achievement in a Problem Posing Classroom*. Unpublished Ph.D. Thesis. University of Tennessee. U.S.A.

Özkan, Ş. (July, 2003). *The Roles of Motivational Beliefs and Learning Styles on Tenth Grade Students' Biology Achievements*. Unpublished Master's Thesis. Middle East Technical University, Ankara, Turkey.

Pallant, J. (2005). *SPSS Survival Manual A Step By Step Guide To Data Analysis Using SPSS for Windows (12th Ed.)*. Sydney: Allen & Unwin Press, Australia.

Peker, M., (2003). *Öğrenme Stilleri ve 4 MAT Yönteminin Öğrencilerin Matematik Tutum ve Başarılarına Etkisi*. Unpublished Ph.D. Dissertation, Gazi Üniversitesi, Ankara, Turkey.

Peker, M. & Yalın, H.İ, (2002). *Matematik Öğretmenlerinin Öğrencilerin Öğrenme Stillerine Uygun Öğretim Yapan Düzeyleriyle İlgili Öğrenci Görüşleri*. Paper presented at the V. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresine Sunulmuş Bildiri. Ankara.

Peker, M., & Aydın, B., (2003). Anadolu ve Fen Liselerindeki Öğrencilerin Öğrenme Stilleri. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 2*, 14 – 24.

Peker, M., Mirasyedioğlu, Ş., & Yalın, H.İ. (2005). Öğrenme Stillerine Dayalı Matematik Öğretimi. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 1*, 13 – 20.

Peker, M., & Mirasyedioğlu Ş. (2007). Pre-Service Elementary School Teachers' Learning Styles and Attitudes towards Mathematics. *Eurasia Journal of Mathematics, Science & Technology Education, 4* (1), 21-26.

Purkiss, W. (1994). *Learning Styles and the Changing Face of Community Collage Retrieved in The Importance Of Learning Styles Understanding Implications For Learning, Course Design And Education, 5*, 79 – 99.

Raiszadeh, A.D. (1997). *Relationship between personality type, learning style preference, and mathematics achievement in college developmental mathematics*. Unpublished Ph.D. Dissertation, University of Tennessee, Tennessee, USA.

Reed, P.A. (2000). *The Relationship between Learning Style and Conventional or Modular Laboratory Preference among Technology Education Teachers in Virginia*. Unpublished Ph.D. Dissertation, Virginia Polytechnic Institute and State University, Virginia. USA.

Schroeder, C.C., (1993). *New Students – New Learning Styles. Change, 25* (5), 21 – 31

Sever, E., (2008). *Öğrenme Stilleri: İlköğretim 6–8. sınıf Öğrencilerine Yönelik Bir Ölçek Geliştirme Çalışması*, Unpublished Ms Thesis, Adnan Menderes Üniversitesi, Aydın, Turkey.

Severiens, S.E., & Geert, T.M., (1994). Gender differences in Learning Styles: A Narrative Review and Quantitative Meta Analysis. *Higher Education, 27*, 487 – 501.

Severiens, S.E., Dam, T. G., & Wolters, B., V., H., (1994). Stability of processing and regulation strategies: Two longitudinal studies on student learning *Higher Education*, *42* (4), 437-453.

Shaughnessy, M. F. (1998). An interview with Rita Dunn about learning styles. *The Clearing House, 71* (3), 41-45.

Schwartz, W. & Hanson, K., (1992). Equal Mathematics Education for Female Students. *ERIC/CUE Digest, No. 78.*

Silver, H., Strong, R., & Perini, M. (1997). Integrating learning styles and multiple intelligences. *Educational Leadership, 55* (1), 22-27.

Soylu, M. Y., Akkoyunlu, B. (2002). The Effect of Learning Styles on Achievement in Different Learning Environments. *The Turkish Online Journal of Educational Technology, 43*, 1 – 10.

Stewart, K., & Felicetti, L. (1992). Learning styles of marketing majors. *Educational Research Quarterly*, *15*, 15-23.

Stockdale, S. E. (1995). *Gender Differences in High School Mathematics Achievement: An Empirical Application of the Propensity Score Adjustment*. Unpublished Master Thesis, University of California Los Angles, Los Angles, USA.

Şirin, A., & Güzel, A., (2006). The Relationship Between Learning Styles And Problem Solving Skills Among College Students. *Educational Sciences, Theory and Practice, 6* (1), 255 – 264.

Tabanlıoğlu, S. (2003). *The Relationship between Learning Styles and Language Learning Strategies of Pre-Intermediate Eap Students*. Unpublished Master's Thesis. Middle East Technical University, Ankara, Turkey.

Tatar, E. (2006). *İkili işlem Kavramı ile İlgili Öğrenme Güçlüklerinin Belirlenmesi ve 4mat Yönteminin Başarıya Etkisi*. Unpublished Ph.D. Dissertation, Atatürk Üniveristesi, Erzurum, Turkey.

Teixeira, K. (2001). *An experimental study comparing critical thinking growth and learning styles in a traditional and workshop based introductory mathematics course*. Unpublished Ph.D. Dissertation, New York University, New York, USA.

Treacy, A.L., (1996*). Learning Styles, Feelings and Beliefs about Tecnology and Mathematics Achievement*. Unpublished PhD Dissertation, The Claremont Graduate University, Claremont, USA.

Umay, A., (1996). Matematik Eğitimi ve Ölçülmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 12*, 145 – 149.

Ülgen, G. (1994). *Eğitim Psikolojisi*. Ankara: Lazer Ofset Matbaa Tesisleri.

Vollmeyer, R., & Rheinberg, F. (2000). Does motivation affect performance via persistence? *Learning and Instruction, 10*, 293-309.

Witkin, H.A., Moore, C.A., Goodenough, D.R., & Cox, P.W. (1977). Field-dependent and field-independent cognitive styles and their educational implications. *Review of Educational Research, 47*, 1-64.

Woodard, H.S. (2001). *Description and comparison of the methods of cluster sampling and lot quality assurance sampling to assess immunization coverage.* Paper Presented at the World Health Organization Conference, Geneva**.**

Yenilmez, K., & Çakır, A. (2005). İlköğretim İkinci Kademe Öğrencilerinin Matematik Öğrenme Stilleri. *Kuram ve Uygulamada Eğitim Yönetimi, 44*, 569 – 585.

Yazıcı, E., & Sulak H., (2008). Öğrenme Stilleri ile İlköğretim Beşinci Sınıf Matematik Dersindeki Başarı Arasındaki İlişkisi. *Selçuk Üniversitesi Ahmet Keleşoğlu Eğitim Fakültesi Dergisi, 25*, 217 – 236.

Zenhausern, R. (1978). Imagery, cerebral dominance, and style of thinking: A unified field model. *Bulletin of the Psychonomic Society, 12*, 381 – 384.

Zenhausern, R., & Nickel L. (1979). Hemispheric dominance and maze learning. *Bulletin of the Psychonomic Society*, *14*, 435 – 436.

Zenhausern, R., & Repetti, J. (1979). *A comparison of two measures of cerebral dominance*. Paper presented at the Eastern Psychological Convention, Philadelphia, PA.

Zull, J. E., (2002). The art of changing the brain: Enriching teaching by exploring the biology of learning. Sterling, VA: Stylus.

APPENDIX A

LEARNING STYLE INVENTORY (LSI)

Ankete Katılanın:
Adı Soyadı: ***Cinsiyetiniz:***
Doğum Yılınız: ***Son Dönem Matematik Notu:***

ÖĞRENME BİÇİMLERİ ANKETİ

Öğrenme Biçimleri Anketi, öğrenme yolunuzu, problem çözme sırasında izlediğiniz teknikleri, öğrenme sürecinde düşüncelerle nasıl baş ettiğinizi ya da değişen matematik müferadatı ile birlikte yeni matematik konularını nasıl anlamlandırdığınızı anlamaya yönelik bir ankettir.

Anketi nasıl dolduracaksınız?

Bir sonraki sayfada size her birinde 4'er cümle bulunan 12 tane durum verilecektir ve her birinin başında notlandırmanız için boşluk bırakılmıştır. Bu cümleleri, herhangi bir konu öğrenirken yaşadığınız öğrenme sürecinde size en uygun olandan olmayana doğru sıralayınız. Bu anketi doldururken, son günlerde okulda öğrenmek zorunda kaldığınız yeni bir konu sırasında yaşadıklarınızı hatırlamaya çalışınız. Her durum için size EN uygun olan cümleyi 4, ikinci en uygun olan için 3, üçüncü EN uygun olan için 2 ve size EN az uygun olan cümle için 1 notunu veriniz. Aşağıda daha iyi anlayabilmeniz için örnek bir durum verilmiştir. Ankete katıldığınız için teşekkür ederim. Ankete katılım gönüllü olarak yapılmaktadır. İstemediğiniz takdirde anketi yarım bırakabilirsiniz. Bu durum size herhangi bir şekilde olumsuz dönüt getirmeyecektir. Ankette vermiş olduğunuz tüm bilgiler araştırmacı tarafından KESİNLİKLE gizli tutulacaktır.

Örnek Durum:		**Hatırlamanız için:**
Öğrenirken :	___4___ mutluyum	4 – En uygun olan.
	___1___ hızlıyım.	3 – ikinci uygun olan.
	___2__ mantıklıyım.	2 – üçüncü uygun olan.
	___3__ dikkatliyim.	1 – en az uygun olan.

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Araştırmaya katılmayı kabul ediyorum: …… (imza)

Araştırmaya katılmayı kabul etmiyorum: ☐

1.Öğrenirken

___ duygularımı göz önüne almaktan hoşlanırım.
___ izlemekten ve dinlemekten hoşlanırım.
___ fikirler üzerinde düşünmekten hoşlanırım.
___ bir şeyler yapmaktan hoşlanırım.

2. En iyi

____duygularıma ve önsezilerime güvendiğimde öğrenirim.
____ dikkatlice dinlediğimde ve izlediğimde öğrenirim.
____ mantıksal düşünmeyi temel aldığımda öğrenirim.
____ bir şeyler elde etmek için çalıştığımda öğrenirim.

3. Öğrenirken

____ güçlü duygulara sahibimdir ve güçlü tepkiler veririm.
____ sessiz ve çekingen olurum.
____ sonuçları bulmaya yönelirim.
____ yapılanlardan sorumlu olurum.

4.Öğrenirken

____ duygularımla öğrenirim.
____ izleyerek öğrenirim.
____ düşünerek öğrenirim.
____ yaparak öğrenirim.

5. Öğrenirken

____ yeni deneyimlere açık olurum.
____ konunun her yönüne bakarım.
____ analiz yapmaktan ve konuyu parçalara ayırmaktan hoşlanırım.
____ denemekten hoşlanırım.

6. Öğrenirken

____ sezgisel biriyim.
____ gözleyen biriyim
____ mantıklı biriyim.
____ hareketli biriyim.

7. En iyi

____ kişisel ilişkilerden öğrenirim.
____ gözlemlerden öğrenirim.
____ akılcı fikirlerden.
____ uygulama ve denemelerden öğrenirim.

8. Öğrenirken

____ kişisel olarak o işin parçası olurum.
____ işleri yapmak için acele ederim.
____ teori ve fikirlerden hoşlanırım.
____ çalışmamdaki sonuçları görmekten hoşlanırım.

9. En iyi

____ duygularıma dayandığım zaman öğrenirim.
____ gözlemlerime dayandığım zaman öğrenirim.
____ fikirlerime dayandığım zaman öğrenirim.
____ öğrendiklerimi uyguladığım zaman öğrenirim.

10. Öğrenirken

____ kabul eden biriyim.
____ çekingen biriyim.
____ akılcı biriyim.
____ sorumlu biriyim.

11. Öğrenirken

____ katılırım.
____ gözlemekten hoşlanırım.
____ değerlendiririm.
____ aktif olmaktan hoşlanırım.

12. En iyi

____ akılcı ve açık fikirli olduğum zaman öğrenirim.
____ dikkatli olduğum zaman öğrenirim.
____ fikirlerimi analiz ettiğim zaman öğrenirim.
____ pratik olduğum zaman öğrenirim.