DESIGN AND DEVELOPMENT OF DIFFERENTIATED TASKS FOR 5TH AND 6TH GRADE MATHEMATICALLY GIFTED STUDENTS

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ABSTRACT

DESIGN AND DEVELOPMENT OF DIFFERENTIATED TASKS FOR 5^{TH} AND 6^{TH} GRADE MATHEMATICALLY GIFTED STUDENTS

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The purposes of this study were three fold. First of all, it was aimed to design and develop differentiated tasks for 5^{th} and 6^{th} grade mathematically gifted students to satisfy their cognitive, emotional and social needs. Based on this purpose, it was aimed to explore characteristics of these differentiated tasks for 5^{th} and 6^{th} grade mathematically gifted students. The other aims were to examine the benefits of these differentiated tasks for mathematically gifted students in terms of satisfying their cognitive, emotional and social needs and also benefits for teachers.

The participants of the study were the mathematically gifted students from two different public schools. Students in four classrooms with three teachers in Altındağ district of Ankara was used in try outs and students in two classrooms with one teachers in Yenimahalle district of Ankara were used as sample of the study. Seven mathematically gifted students from one hundred fifteen students in try outs and eight students from sixty-one students were diagnosed as mathematically gifted students, based on the teachers' nomination and students' scores in TOMAGS whose adaptation to Turkish Language was conducted within the scope of this study.

Findings obtained from this design based research indicated that characteristics of differentiated tasks for 5th and 6th grade mathematically gifted students are gathered in three categories as characteristics in terms of content, in terms of type and in terms of implementation method. Moreover, the benefits of intervention to the teachers were discussed under three main themes as benefits to teachers' awareness on giftedness and gifted education, self-adequacy and collaboration with other colleagues. Besides, benefits of intervention to students were also gathered in three main headings as benefits to satisfying students' cognitive, emotional and social needs. As these findings reflect, differentiated materials designed and developed through this process helped to satisfy mathematically gifted students' cognitive, emotional and social needs. By this way, they could find opportunities to fulfill their needs in mathematis classrooms and this also enabled the teachers to diminish gifted students' related problems in classrooms.

Keywords: mathematically gifted students, differentiated tasks, design based research

ÖZ

BEŞİNCİ VE ALTINCI SINIF MATEMATİKTE ÜSTÜN YETENEKLİ ÖĞRENCİLERE YÖNELİK FARKLILAŞTIRILMIŞ ETKİNLİKLERİN TASARLANMASI VE GELİŞTİRİLMESİ

Özdemir, Duygu

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Çalışmanın amaçları üç kısımdan oluşmaktadır; ilk olarak, matematikte üstün yetenekli beşinci ve altıncı sınıf öğrencilerinin zihinsel, duygusal ve sosyal ihtiyaçlarını karşılamaya yönelik farklılaştırılmış materyallerin tasarlanması ve geliştirilmesi amaçlanmıştır. Bu bağlamda, beşinci ve altıncı sınıf matematikte üstün yetenekli öğrencilere yönelik geliştirilen materyallerin karakteristik özelliklerini incelemek amaçlanmıştır. Çalışmanın diğer amaçları, geliştirilen materyallerin matematikte üstün yetenekli çocukların zihinsel, duygusal ve sosyal ihtiyaçlarını karşılamak adına faydaları ile çalışmanın öğretmenlere olan faydalarını incelemektir.

Veriler Ankara/Altındağ bölgesinde bulunan bir devlet okulunda görev yapan üç öğretmen ile dört ayrı sınıfta ve Ankara/Yenimahalle bölgesinde bulunan bir devlet okulunda görev yapan bir öğretmen ile iki ayrı sınıfta bulunan öğrencilerden 2014-2015 eğitim öğretim yılı bahar döneminde toplanmıştır. Bu okullarda bulunan 115 öğrenciden yedisi ile 61 öğrenciden sekizi öğretmen aday gösterme ve Türkçe adaptasyonu bu tez çalışması kapsamında yapılan TOMAGS test puanlarına göre matematikte üstün yetenekli olarak tanılanmıştır.

Tasarım tabanlı araştırma modelinin kullanıldığı bu çalışmanın bulguları beşinci ve altıncı sınıf matematikte üstün yetenekli öğrencilere yönelik geliştirilen farklılaştırılmış materyallerin özellikleri; içerik bakımından özellikler, etkinlik çeşidi bakımından özellikler ve uygulama metodu bakımından özellikler olarak üç ayrı alt kategoride toplanmıştır. Ayrıca, bu materyallerin sınıf içerisinde kullanılmasının öğretmenlere faydaları ise, öğretmenlerin farkındalıklarına, öz yeterliliklerine ve diğer çalışma arkadaşlarıyla işbirliklerine faydaları olmak üzere üç ayrı alt kategori altında toplanmıştır. Son olarak, materyallerin matematikte üstün yetenekli öğrencilere yönelik faydası ise onların zihinsel, duygusal ve sosyal gelişimlerine faydası olarak üç alt başlık altında toplanmıştır. Çalışmadan elde edilen bu bulgular göstermiştir ki, süreç boyunca tasarlanan ve geliştirilen farklılaştırılmış materyaller matematikte üstün yetenekli öğrencilerin zihinsel, duygusal ve sosyal ihtiyaçlarını karşılamak adına önemli faydalar sağlamıştır. Böylece, bu öğrenciler matematik derslerinde ihtiyaçlarına cevap verebilecek fırsatlar bulabilmiş ve bu durum öğretmenlerin üstün yetenekli çocuklara ilişkin sınıflarında yaşadıkları problemleri azaltmalarına da yardımcı olmuştur.

Anahtar Kelimeler: matematikte üstün yetenek, farklılaştırılmış etkinlik, tasarım tabanlı araştırma

To My Family

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LIST OF ABBREVIATIONS

MoNE	Ministry of National Education
NCTM	National Council of Teachers of Mathematics
SAT	Scholastic Aptitude Test
SMPY	Study of Mathematically Precocious Youth
TOMAGS	Test of Mathematical Abilities for Gifted Students

CHAPTER 1

INTRODUCTION

In contemporary world, gifted children are one of the prize possessions that a country can have (Hannah, James, Montelle, & Nokes, 2011). It is important to provide systematic support to the gifted student, who "shows, or has the potential for showing, an exceptional level of performance in one or more areas of expression" (National Association for Gifted Children, 2005, p. 4) because it is the social requirement of a country to enhance the potentials of gifted students to the highest possible level (Trna, 2014). Among those, mathematically gifted students, who see the world "through the mathematical eyes" (Krutetskii, 1976, p.302), have the potential to contribute to the development of a society because they have great skills that may reshape their country and its future (Davaslıgil, 2004). Thus, unique qualities of gifted students are valued by most countries (Hannah, James, Montelle & Nokes, 2011; Maryland, 1972) and they engage in studies in order to diagnose and reveal their mathematically gifted students' potential since they now recognize that this potential brings about leadership in terms of economic and social aspects (Fıçıcı & Siegle, 2008).

Although gifted education has recently become prominent and drawn much attention in the area of research, due importance is still not given in practice (Morisano & Shore, 2010; Wilkins, Wilkins, & Oliver, 2006). In most of the countries, gifted students are seen as students who need special education; hence, gifted education is approachedwithin the special education category (Anderson, 2013; Baykoç; 2014, Mogensen, 2011). However, within this category it is the disabled who are given much more emphasis as gifted students are regarded to be the lucky ones (Chamberlin & Chamberlin, 2010; Eris, Seyfi, & Hanoz, 2009). Similarly, an essential part of regular education is mostly designed to reach the fundamental objectives for regular students or the ones experiencing difficulty in the learning process (Chamberlin & Chamberlin, 2010). There is a belief that it is luxury to modify instruction for the able who can succeed without special effort; that is, gifted students do not need extra support; in fact, they even have advantage because of their superiority (Anderson, 2013; Eris et al., 2009; Tomlinson, Tomchin, & Callahan, 1994). However, in reality giftedness is a disadvantage and needs more attention and support (Baykoç, 2010); as a consequence, “the student most neglected, in terms of realizing full potential, is the gifted student…” (National Council of Teachers of Mathematics, 1980, p. 18).

In regular classrooms, where gifted students spend most of their time, they have to do the same tasks, at the same time and at the same pace with other students (Baykoç, 2011; Diezmann & Watters, 2001; Dimitriadis, 2011; Johnson, 2000; Sriraman, 2013; Maryland, 1972). Unfortunately, there are not any modifications for the gifted and they suffer from unequal opportunities due to messy repetitions, simple tasks and memorizations, which do not satisfy cognitive and emotional needs of the gifted student (Baykoç, Aydemir, & Uyaroğlu, 2014; Diezmann & Watters, 2001; Hannah et al., 2011; Johnson, 2000; Sriraman, 2013). Although many of these students seem to be content with their learning process and happy with their academic success, they may actually be dissatisfied and their cognitive or psychosocial needs may go undetected (Maggio & Sayler, 2013). Nonetheless, based on the equity principle of education (Van de Walle, Karp, & Bay-Williams, 2013), it is their right to benefit from differentiated educational opportunities parallel to their needs **(**Wilkins et al.,2006). Furthermore, it is a misunderstanding that all gifted students always have a high level of motivation and a great enthusiasm towards lessons and studying; on the contrary, they lose their motivation easily when they are not interested and are not challenged enough (Johnson, 2000; Shaughnessy, 2004); hence, classrooms may not sufficiently meet gifted students’ needs (Reis & McCoach, 2000; Martin & Pickett, 2013). Therefore, these unsatisfied gifted students cannot achieve their potential and this may result in poor work habits in their future lives (National Research Center on the Gifted and Talented, 1995; Ford, Alber & Heward, 1998; Martin & Pickett, 2013; Winebrenner & Berger, 1994).

Gifted students need specialized help to be successful in educational settings although they can learn easier than other students in classrooms (Johnson 2000; Tomlinson et al., 1994). This is also valid for mathematics classes. The tasks in mathematics classes should effectively meet their needs. However, the mathematics tasks in primary or secondary education mostly focus on arithmetical operations or practice exercises of the learned concepts (Karaduman, 2010). As stated in most studies, challenge at an appropriate level is very important for both cognitive and emotional development of gifted students (Diezmann & Watters, 2001; Johnson, 2000; Freeman, 2000; Lens & Rand, 2000; Wallace, 2000). As well as challenge, tasks that are interesting or require a higher level thinking written in different formats like problem solving, intelligence question, etc could be included in mathematically gifted students' tasks. However, when these modifications or differentiations are not applied or are misapplied, a slow and meaningless pace of the lessons results in dissatisfied students who get bored in classrooms (Shaughnessy, 2004). Even worse, this lack of enjoyment may lead to a negative disposition towards mathematics in which disposition has a crucial role (Maxwell, 2001; Park & Park, 2006).

In addition to these cognitive and emotional needs, gifted students' social developmental needs are another issue that requires emphasis (Colangelo & Davis, 2003). As Vygotsky states, social interactions could shape the students' thoughts (Driscoll, 2000). However, the nature of the difference in their interests and developmental properties may cause difficulty in popularity and communication with classmates (Baykoç, 2014; Cornell, 1990). For example, they sometimes have to develop adverse behaviors like concealing their giftedness in order not to be regarded as a 'geek' by the class (Delisle, 1982; Higham & Buescher, 1987). Likewise, social and emotional problems that gifted students experience in their relationship with their peers may lead to loneliness and serious social drawbacks in gifted students' future life (Morelock & Feldman, 2003). Hence, these cognitive, emotional or social problems may lead to underachievement (Davis & Rimm, 2004; Montgomery, 2000; Philips & Lindsay, 2006; Shaughnessy, 2004). Many gifted underachievers find school work as unattractive, senseless, irrelevant and something not worth the effort (Ford et al. 1998; Martin & Pickett, 2013). Therefore, identification and development of giftedness should be carried out with specified tasks because it may result in unwanted consequences such as underachievement, lack of cognitive, emotional or social satisfaction and related classroom management problems (Baykoç, 2010; Saunders, 2003; Seeley, 2004).

In classrooms, teachers have unique opportunity to see and realize gifted students' potential because those students spend most of their time and engage in different activities at their schools (Diezmann & Watters, 2001; Tiesco, 2003; VanTassel-Baska, 2005). That is, teachers are in the forefront of the educational process of gifted students and this priority gives them the key role to fulfill their needs (Baykoç, 2010; Delisle, 2003; Mogensen, 2011). However, most of the mathematically gifted students are either at a loss and remain unidentified due to their teacher's lack of awareness (Baykoç, 2011; Freehill, 1981; Rotigel & Fello, 2004). For mathematics lessons, it is crucial to provide the gifted with opportunities to use their full potential and increase their self-confidence in feeling the enjoyment of succeeding mathematical tasks (Anderson, 2013; Rotigel & Fello, 2004; Wilkins et al., 2006). If the teacher does not make extra effort, classroom tasks may become uninteresting and unnecessary for gifted students throughout their lives (Martin & Pickett, 2013). For this reason, teachers should use some specialized approaches, methods, revisions and tasks to provide solutions for the problems that their giftedness experience (Park, 2005).

At that point, teachers also need to enhance their knowledge because gifted students may become the more problematic ones in terms of both classroom management and cognitive requirements (Baykoç, 2011). However, even if teachers know students and want to facilitate their giftedness, most of the teachers are not well equipped and do not feel self-adequate in terms of knowledge and skills such as advanced content knowledge and alternative pedagogical strategies for gifted students (Rakow, 2012; Martin & Pickett, 2013). Moreover, gifted students are different from children who are considered to be normally developed in terms of their emotional developments, and this emotionality makes them more vulnerable to their teachers' behaviors and attitudes (Baykoç, 2011; Karnes & Bean, 2001; Uyaroğlu, 2011). That is, being unmotivated, reluctant or uninterested is not a deficiency on the part of students; rather, it is teachers' duty to make classroom tasks appealing by making the tasks interesting and connecting them to students' lives (Seeley, 2004). Therefore, due to the fact that gifted students have differentiated needs in terms of cognitive, social and emotional properties, teachers should modify or use differentiated classroom tasks to meet these needs as well as those of regular students (Martin & Pickett, 2013; McCollister & Sayler, 2010; Gadanidis, Hughes & Cordy, 2011; Reis &McCoach, 2000; Rotigel & Fello, 2004; Uyaroğlu, 2011).

Based on this need and gap in the field, this study aimed to design and develop differentiated tasks for 5th and 6th grade mathematically gifted studentsto satisfy their cognitive, emotional and social needs in mathematics classrooms. In line with this, this study aimed to explore the characteristics of these differentiated tasksdesigned for 5th and 6th grade mathematically gifted students to satisfy their cognitive, emotional and social needs. Moreover, as the other purposes of the study, it was aimed to explore the benefits of these tasksto satisfy 5th and 6th grade mathematically gifted students' cognitive, emotional and social needsand also the benefits toteachers. Hence, the following research question with its sub-questions will be answered.

1) How can differentiated tasks be designed and developed for 5th and 6th grade mathematically gifted students to satisfy their cognitive, emotional and social needs?
    a) What are the characteristics of differentiated tasks designed for 5th and 6th grade mathematically gifted students to satisfy their cognitive, emotional and social needs?
2) What are the perceived benefits of these tasks to the teachers?
3) What are the perceived benefits of these tasks designed to satisfy 5th and 6th grade mathematically gifted students'cognitive, emotional and social needs?

1.1. Significance of the Study

Gifted students differ from regular students in terms of their developmental properties and they attend classes where all other regular and inclusive students are educated together (Anderson, 2013; Baykoç, 2010; Diezmann & Watters, 2003; Freeman, 2000; Karaduman, 2010; Mogensen, 2011). In those environments, gifted students are exposed to repetitions in classrooms, whereas they process new information quickly and are eager to move on to other concepts or problems (Preckel, Götz, & Frenzel, 2010). Nonetheless, they have to wait for the other students to complete their tasks and to process the information by remaining silent in their desks in an orderly fashion, which makes them bored (Hammer, 2002). They are even sometimes not allowed to move on to the following pages in their textbook (Baykoç, 2011; Chamberlin & Chamberlin, 2010). However, this is not fair and reasonable for mathematically gifted students who have the inner ability to perform more than these regular tasks (Johnson, 1994; Karaduman, 2010). Likewise, when it is considered from Vygotsky's (1978) point of view, they have to follow other students' zone of proximal development by proceeding at the same pace with others. However, it is also essential for the gifted to scaffold in their own zone of proximal development to learn more advanced mathematical concepts (Anderson, 2013; Koshy, Ernest, & Casey, 2009; Subban, 2006). For this reason, gifted students need some differentiated opportunities in classrooms enabling them to proceed with their own pace in their own zone ofproximal development.

As previously stated, it is gifted students' right to benefit from educational opportunities (Baykoç, Aydemir & Uyaroğlu, 2014); moreover, it is essential for the well-being of their country. Furthermore, unless they are challenged and their needs are met, they may be perceived as the most difficult students or troublemakers by their teachers (Chamberlin & Chamberlin, 2010). The gifted students may be misbehaving, interrupting instruction or might be trying to do the items quickly and carelessly to do away with the task (Anderson, 2013; Dimitriadis, 2011). Providing proper educational opportunities is not only beneficial for them but also for teachers in terms of classroom management (Anderson, 2013; Diezmann & Watters, 2003; Dimitriadis, 2011). Accordingly, whether they are the most troublesome students or most manageable ones in the classroom, gifted students who are remain unidentified, who are not guided and who are not provided with proper opportunities are at a loss and become underachievers (Martin& Pickett, 2013) because they are deprived of proper and special resources in classroom environments (Hertberg-Davis, 2009; Kanevsky, 2011). Hence, instead of meeting the curriculum requirements in a repeating motion, teachers, educators and curriculum developers should pay attention to "where students are" (Van de Walle et al., 2013, p. 35), and then plan and differentiate curriculum tasks in accordance with the gifted students to perform their full potential accordingly (Colangelo & Davis, 2003; Davis & Rimm, 2004). Moreover, although there are some general characteristics that gifted students have in common, they are not similar in their needs (Morisano & Shore, 2010). Since all gifted students are different, differentiated instructions are required to meet the needs of those students, which is stated in the curriculum as "Individualized Education Programs" (MoNE, 2013, p. 14; Tomlinson, 2002). Moreover, due to their oversensitive and vulnerable characteristics, gifted students need socioemotional support (Callard-Szulgit, 2003; Fonseca, 2011). Hence, it is also important to assess classroom practices in terms of emotional and social benefits to gifted students. To sum up, mathematically gifted students require more systematic support in classrooms due to the nature of both mathematically gifted students and the mathematical content itself (Diezmann & Watters, 2003; Johnson, 2000; Sriraman, 2013; Trna, 2014).

In parallel with these needs, studies have become heavily concentrated on the importance of differentiation and modification in line with the needs of gifted students (Anderson, 2013; Baykoç, 2010; Chamberlin & Chamberlin, 2010; Fıçıcı & Siegle, 2008; Gadanidis et al., 2011; Hekimoğlu, 2004; Pierce, Cassady, Adams, Neumeister, Dixon, & Cross, 2011; Rotigel & Fello, 2004; Sternberg, Ferrari, Clinkenbeard, & Grigorenko, 1996; Tieso, 2002; Tomlinson et al., 1994, Wilkins et al.,2006). Similarly, the existing research studies in the literature about mathematical giftedness have mostly centered on the need for and the importance of differentiating, identifying and guiding mathematically gifted children within schools (Diezmann & Watters, 2003; Dimitriadis, 2011; Fıçıcı & Siegle, 2008; Mogensen, 2011; Rotigel & Fello, 2004; Sriraman, Haavold, & Kyeonghwa, 2013). However, there is an inadequacy in studies on designing applicable tasks for mathematics lessons and how to develop these differentiated tasks with teachers and mathematically gifted students in classrooms. Likewise, as stated by Gavin, Casa, Adelson, Carroll and Sheffield (2009), studies on mathematically gifted students' need for challenge and as stated by Hammer (2002), studies concentrating on the emotional dimensions of mathematically gifted students under the age of 12 are scarce. Although some researchers (Baykoç, 2014; Bicknell, 2009; Cornell, 1990; Cross, 1990; Neihart, Pfeiffer, & Cross, 2015) mentioned about emotional and social needs of gifted students, development of appropriate tasks benefical to satisy these needs are nonexistence. That is, studies reflect the requirement for the development of proper differentiated curriculum tasks in classrooms. In line with this, it is also required to assess these tasks in terms of satisfying gifted students' cognitive, emotional and social needs as well as their benefits to teachersin classrooms.

Additionally, few studies on gifted and mathematically gifted students were carried out in Turkey in the accessible literature (Altıntaş, 2009; Aydemir & Çakıroğlu; 2013; Aygün, 2010; Budak, 2007; Boran, & Aslaner, 2008; Karaduman, 2010). Even though gifted students need unusual and different tasks, according to the few studies in the literature, gifted students have lack of activities, which hinders the development of their potential in mathematics courses in Turkey (Altıntaş, 2009) (Budak, 2007; Karaduman, 2010). According to the findings of a needs assessment study, creative activities are useful in enhancing gifted students' abstract thinking and are needed in the education of gifted students in Turkey (Aygün, 2010). Additionally, gifted students suffer from some limitations in mathematics classrooms, such as being bored, finding the subject easy, performing messy and similar works, being exposed to lack of understanding by the teacher and lack of sources (Aydemir & Çakıroğlu; 2013). To sum up, as is the case with most countries, in Turkey, the educational system is inadequate in providing the required opportunities to their gifted students (Aygün, 2010; Çağlar, 2004; Karaduman, 2010). Moreover, research studies concentrating on the gifted students and gifted education is highly scarce; hence, they should be increased in both quality and quantity (Özenç & Özenç, 2013). To this end, this study aimed to overcome these deficiencies in the area by providing research and practice based suggestions for mathematically gifted students' educational needs in regular classrooms. Furthermore, it was also intended to search about the benefits of these suggestions to gifted students and teachers.

To conclude, as the gap in both theory and practice indicates, students need differentiated tasks, and teachers need to use those tasks in their classrooms. It is a fact that planning of materials or tools based on these students' specialized needs and characteristics is essential and appropriate to maximize their potential (Reger, 2006; Subotnik, Olszewski-Kubilius, & Worrell, 2011). Thus, absence of those tasks result in problems within gifted mathematics education. However, the designing and development of differentiated tasks and their evaluations in terms of benefits to teachers and students in real classroom environments in Turkey have not been studied yet. Due to this gap and crucial need felt in this area, this study aimed to design and develop differentiated tasks for 5^{th} and 6^{th} grade mathematically gifted students in mathematics classrooms as well as exploring the benefits of these tasks to mathematically gifted students and their teachers.

1.2. Definition of Key Terms

***Giftedness*:** "Someone who shows, or has the potential for showing, an exceptional level of performance in one or more areas of expression" (National Association for Gifted Children, 2005, p. 4).

Mathematically Gifted Students: Mathematically gifted students have a relational understanding between numbers and symbols, understand their relation to real life, and they prefer to use mathematical concepts by using different ways with an unusual speed and accuracy (Fıçıcı & Siegle, 2008; Sriraman et al., 2013). In this study, based on the scores of the Test of Mathematical Abilities for Gifted Students (TOMAGS), the students who have a high and very high possibility of mathematical giftedness, obtaining more than 120 quotient scores, were determined as mathematically gifted students.

Differentiated Tasks for Mathematically Gifted Students: These are tasks that are developed in line with the differentiated characteristics of mathematically gifted students to meet their diverse needs in mathematics classrooms. In this study, forty differentiated activities in numbers and operations domain were developed based on the characteristics of differentiated tasks for 5^{th} and 6^{th} grade mathematically gifted students; they were designed and developed throughout the study.

1.3. My Motivation for the Study

As both a researcher and a mathematics teacher, I have had experience in and conducted studies on mathematically gifted students in regular mathematics classrooms for five years. My own experiences, observations and conversations with experts, teachers and students shaped my opinions about mathematically gifted students and their needs in classroom environments. I also conducted scientific studies with gifted students and teachers. All these shaped my own perspective, which makes me feel the need to provide the gifted with the necessary opportunities for their educational and developmental needs. In classrooms, gifted students are ignored due to their high grades; teachers think that they have already learnt everything. However, I believe that these students should be provided with other opportunities that goes beyond and is different from regular curriculum requirements. The gifted have the potential to construct new and creative ideas, learn and reason the logical interrelations among concepts that are beyond their grade level and they can comprehend the exact meaning of mathematics in nature. This understanding can enable the students to see the big picture of mathematics, while involving them in the lessons and generating motivation for their future perspective.

In classrooms, I observed serious deficiencies and inequalities for gifted students. I realized that gifted students have very different characteristics from regular students. This was an indication for me that due to this big difference, it was unjust to make them go through the same process or to do the same tasks in classrooms. What's more, gifted students vary among themselves also. For example, there were some gifted students listening gingerly to what I was teaching with great interest and curiosity. They were highly motivated to learn and perform tasks. However, although they could develop further, I noticed that with regular classroom tasks developed for regular students I inhibit their development. In fact, they can do more challenging tasks and they are keen on being engaged with the depths of mathematics and learning from different perspectives. Furthermore, I also observed that due to their differentiated needs, enthusiasm and success, they experience some social problems with their peers in classrooms. As for another group of gifted students, in fact, I realized that as teachers we experienced most difficulty with these students in classrooms. That is, they were the students who learned easily, got bored owing to the easiness of tasks and began to talk or disrupt the lesson. After some time, they were tagged as "naughty, disrupter or lazy" by their teachers or students, which caused them to experience some social and emotional problems within the classroom. For both type of gifted students, nonrandom, challenging and engaging classroom tasks could help to overcome their motivational or social problems and help to perform their cognitive potentials.

In addition to these, as I deduced from my readings, experiences and observations in different institutions, apart from students in the genius category, gifted students should be educated with regular students in regular classrooms in order to be socially and emotionally healthy individuals. Being in the same environment with other students prevent them from becoming selfish individuals because they could become integrated with people who have diverse abilities and this can make their differentiated characteristics functional for the society (Akkanat, 1999; Baykoç, 2014). Thus, they should be educated in regular classrooms so that they do not feel privileged; that is, regular students and gifted students should not feel that gifted students are different, superior or exclusive. However, gifted children should be provided with differentiated tasks or programs to enhance their cognitive potentials. That is, I arrived at the conclusion that gifted students in regular classrooms should be provided with extra tasks designed and developed in line with their needs in regular classrooms but not as being privileged.

Likewise, when I examined the accessible literature, I saw that studies mostly concentrate on the existing situation that gifted students should be identified and that they need nonrandom, specialized opportunities. Moreover, these studies also report some valuable ideas about how the classroom materials could be differentiated or modified in line with the developmental needs of gifted students. However, studies that produce beneficial resources or tasks for students are highly scarce. Hence, I deduced that the problem situation and related suggestions exist but are dispersed in the literature. Similar to what I observe in my classrooms, the problem described in the literature is reported as mathematically gifted students not being recognized in classrooms and the lack of tasks meeting the needs of the gifted in regular mathematics classrooms. Although many well qualified studies and researchers suggest various methods or content related characteristics for this problem, these characteristics were dispersed, different and many of them were not experienced in real classroom environment. Thus, what I needed to do was to combine, evaluate based on my classroom experience and together with experts, organize and modify them.

With all these in my mind, I was searching a method and research questions that would enable me to conduct these by involving students, teachers, experts and stakeholders in the process and which could be carried out in students' and teachers' real environments. While I was in search of this issue, the missing chain was the "design based study" which would enable me to produce a theory based on a practical product for mathematically gifted students in regular, mixed ability classrooms in Turkey. Reading and searching more about design based studies, I was convinced that steps in the design based study, its requirements and its flexibility were what I was seeking for my dissertation. Hence, I conducted this study because I experienced these deficiencies in areas of students' opportunities as well as teachers' awareness about the issue. Besides, such a study could provide research based findings for the solution of this real-life problem, which could affect the future of our country.

CHAPTER 2

LITERATURE REVIEW

The purposes of the current study are designing, developing and evaluating the 5th and 6th grade differentiated tasks for mathematically gifted students. Based on this primary purpose, the study also aims to explore characteristics of differentiated tasks as well as benefits of these tasks to students and teachers. To achieve this aim, initially, theoretical framework that guided all vital steps of this study was explained. Then, as essential part of this study, giftedness and mathematical giftedness was described with the help of their historical development. Following to these descriptions, gifted education and students' needs in classrooms with gifted education and studies in Turkey were stated. Based on these educational needs, teachers' role in gifted education were mentioned in the next section. Lastly, differentiation in gifted education with differentiated curriculum tasks for mathematically gifted students were addressed. By this way, a comprehensive review of literature in line with the aims of the study was provided through the chapter.

2.1. Conceptual Framework of Study: Zone of Proximal Development

In 1978, Vygotsky highlighted the importance of students' learning in social context by mentioning about actual and potential development levels of children. He related the children's actual development level to their mental age and advocated that children's zone of proximal development could be enhanced by means of social interaction with adults or other more capable peers (Blanton, 1998; Dreszen, 2009; Least, 2014; Maddox, 2015; Riddle & Dabbagh, 1999). At that point, Vygotsky (1978) defined zone of Proximal Development (ZPD) in social constructivism as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (p.86). In other words, Vygotsky believes that ZPD refers to the gap between the current situation that the student already achieved and his/her potential that could be attained with the help of support of others. Hence, in this theory, scaffolding is another mostly used term referring to this process that enable the children progress through their own ZPD (Riddle & Dabbagh, 1999; Tuckman &Monetti, 2011).

Based on this theory, development of intelligence depends on some social factors so that children should move through their own ZPD to perform their full potential. Correspondingly, Vygotsky (1978) believes that proper tools like tasks, activities or mediations like external interventions are the best means to help enhancing children's zone of proximal development. In line with this, since gifted students have different ZPD when compared to regular students (Ktistis, 2014), they couldn't reach their full potential without being supported by these tools because regular tasks lack the challenge and difficulty for gifted students in mathematics classrooms. Hence, to obtain their own ZPD, gifted students should be provided with opportunities that are ahead of their actual level (Subban, 2006). That is, by means of differentiated tasks with their appropriate implementation methods, mathematically gifted students could attain their ZPD.To do this, they need scaffolding to reach more than they could do on their own.

From another perspective, fundamentals and educational implications of this theory coincides with the crucial elements of gifted education. As stated before, gifted students have differentiated cognitive, social and emotional needs when compared to their classmates (Peterson, 2009); by this reason, their education should take the individual needs into attention. In this theory, individual characteristics are important and essential in accommodating the classroom applications in accordance with each students' ZPD (Ktistis, 2014). Based on this, Tomlinson et al. (2003) advocates that teachers have significant role in developing each student's mind through their ZPD with more complex and challenging tasks, which make them become better problem solvers and independent thinkers. Moreover, the teachers' moderate role (Subban; 2006) help each student to reach their own zone of proximal development (Blanton, 1998**)** by motivating and enhancing cognitive skills (Maddox, 2015**;** Kanevsky, 2011).

For this reason, the teachers should incorporate the classroom activities within the students' zone of proximal development (Joseph, Thomas, Simonette, & Ramscook, 2013) so that specific educational needs of gifted students could be met by scaffolding in regular classrooms. Likewise, by means of scaffolding, teachers should provide opportunities to their gifted students to proceed from their current developmental level to the potential level by interrelating the known concepts with the unknown (Riddle & Dabbagh, 1999; Subban, 2006).

Parallel to these ideas, in most studies (Dreszen, 2009; Hawkins, 2009; Kanevsky, 2011; Koshy, Ernest, & Casey, 2009; Least, 2014; Maddox, 2015; Morelock, & Morrison, 1999; Subban; 2006; Tomlinson et al., 2003; Whittington-Jones, 2013 Willard-Holt, 2003) differentiation and giftedness were grounded in the Zone of Proximal Development (ZPD) theory of Vygotsky (1978) in social constructivism. Hence zone of proximal development was used as a framework for this study as the theoretical lenses to investigate the importance of differentiated tasks for mathematically gifted students in regular mixed-ability classrooms. Based on this theory, differentiated mathematical tasks which aim to enhance mathematically gifted students' zone of proximal development were designed and developed in line with gifted students' specific needs, interests and readiness levels.

2.2. Historical Development of Giftedness Identification

Initial studies on giftedness focus on the identification and the characteristics of the gifted (Pitta-Pantazi, Christou, Kontoyianni, & Kattou, 2011). Starting in the 1890s, one of the known initial studies was conducted by Binet and Simon. In this study, gifted individuals were described as differing in attention, memory, ability to understand and reason when compared to their classmates. This led to the development of the first known intelligence test, the Binet-Simon Scale (Binet & Simon, 1916). Another fundamental study was carried out by Terman (1921) to determine the properties and characteristics of gifted students. In this longitudinal study, Terman arrived at the general conclusion that gifted children are superior in terms of not only cognitive properties as stated by Binet and Simon (1916) such as attention and speed of learning but also emotional, social and health properties (Oden, 1968). Furthermore, Terman maintains that children obtaining an Intelligence Quotient (IQ) score of 140 or above are in the genius category.

After these developments, for many years, giftedness was considered parallel to intelligence or IQ scores. In subsequent studies, researchers considered intelligence or IQ scores as one but not the sole possible way of determining giftedness since it was considered that giftedness should be determined by taking into account various dimensions, one of which is creativity. Thus, creativity emerges in many definitions of giftedness (Csikszentmihalyi & Wolfe, 2000; Miller, 2012; Renzulli, 1979; Torrance, 1974). For example, over many years of research Renzulli (1979) developed Three Ring Conception of Giftedness Model with average ability, motivation and creativity as the basis of three rings, referring to the fact that if the student has these three properties, then the gifted potential can be determined (Renzulli, 2011). Consequently, most of the commonly accepted hypotheses about giftedness were constructed based on Renzulli's model (Uyaroğlu, 2011). For example, Sternberg's (1997) Triarchic Theory paralleled that of Renzulli dealing with intelligence in three facets; analytical, creative and practical. Sternberg stated that high levels in all three facets are an indicator of potential giftedness. Moreover, researchers listed some characteristics of gifted students. For example, Davis and Rimm (2004) proposed that quick learning with enjoyment, superiority in academic success and language, retentive memory, efficiency in problem solving, high level thinking, reasoning, curiosity, sensitiveness in justice, task oriented attention and advanced interests are the characteristics of giftedness. Additionally, National Association for Gifted Children (NAGC, 2005) defined a gifted person as "someone who shows, or has the potential for showing, an exceptional level of performance in one or more areas of expression" (p. 4).

In addition to the models and identification criteria highlighted in various studies (Binet & Simon, 1916; Fıçıcı & Siegle, 2008; Pitta-Pantazi et al., 2011; Renzulli, 1979; Sriraman et al., 2013; Terman, 1921), the Ministry of Education (MoNE) in Turkey describes gifted students as displaying higher performance in relation to their peers in terms of general and special abilities. Another frequently used formal determination used in Turkey to identify gifted students is having an IQ score of 130 or above (Eris, Seyfi, & Haroz, 2009). Intelligence tests are frequently applied to gather information about cognitive functions typically measured by standardized testing (Silverman, 2003; Soysal, Tan, & Aldemir, 2012). All over the world, most commonly used tests are Stanford-Binet Intelligence Scales, Wechsler-Adult Intelligence Scale, Wechsler Intelligence Scale for Children and Wechsler Primary & Preschool Scale of Intelligence. Among those, Wechsler Intelligence Scale for Children-Revised Test (Wechsler, 1974), which gives valuable information related to cognitive functions of children, is one of the mostly used tests both in Turkey and in other countries (Soysal et al., 2012; Wechler, 1974). Additionally, according to Baykoç, (2014) giftedness in Turkey is seen as a capacity which exists genetically and can be developed with the help of environmental factors. This capacity is explained as being ahead of peers in one or more of the following aspects: the linguistic ability to comprehend and express oneself effectively, physical development, motor development, and cognitive development, such as analysis, synthesis and problem solving. In addition to these criteria for general giftedness, some researchers had a consensus that giftedness is specific by mentioning gifted at something, in any domain; one or more domains (Mayer, 2005). Based on this, mathematical giftedness is regarded as one of the specific dimensions of giftedness, which was examined in the following section.

2.3. Mathematical Giftedness

Although there is still no clear and commonly accepted definition for mathematical giftedness (Pitta-Pantazi et al., 2011), researchers have tried to identify properties of mathematical gifted students over the years. Most researchers have developed their arguments based on Krutetskii's (1976) organization and determination of mathematical giftedness. Kurtestskii refers to the analytic, geometric and harmonic types of gifted students in mathematics and believes that their unique ability of "mathematical cast of mind" (p. 302) allows them to view the world through mathematics, and these people are mathematically inclined as well as having a higher level of mathematical understanding. Subsequent to Krutetskii's study, some common properties that mathematically gifted students reflect were proposed by other researchers. For example, Greenes (1981) stated that mathematically gifted students differ from other students in some of their ability like creating problem, relating new knowledge to other knowledge, structuring and transmission of the data. In addition, those students offer original interpretation about mathematical concepts and persist in solving problems when compared to their peers (Greenes, 1981; Ashley, 1973; House, 1987). In addition to these, another way of accurately determining whether a child is mathematically gifted is to examine the quality of thinking through a focus on how the child reasons mathematically (Johnson, 2000). Contrary to the general misconception that undertaking arithmetical calculations at a high level is an indication of mathematical giftedness, it is actually regarded as the comprehension of mathematical ideas and mathematical logic (Karaduman, 2010). Furthermore, other studies show that these students are good at organizing tasks, using new statements in patterns, studying advanced concepts, reversal of the operations as well as forming problems (Davaslıgil, 2004; Miller, 1990).

Generally, mathematically gifted students differ from normal developed students in terms of three different fields; speed of learning, depth in understanding and deep interest which is important for mathematics (Dağlıoğlu, 2004). In addition to the features mentioned above, mathematical creativity is also cited as a core dimension in the determination of mathematical giftedness by many other authors (Leikin, 2009; Sriraman, 2005; Sriraman et al., 2013). In line with this, Sheffield (1994) advocated that quick learning process, strong ability in questioning, cause effect relation and creativity are the factors reflecting mathematical giftedness. Furthermore, Pitta-Pantazi et al. (2011) stated that mathematical ability and mathematical creativity are the factors that can directly describe mathematical giftedness. In their study, Kontoyianni, Kattou, Pitta-Pantazi, and Christou (2013) offered a recent method which led to a new conceptualization of mathematical giftedness. Their model was based on Renzulli's (1979) and Gagne's (1991) models and cognitive physiology theory. In Cyprus, 359 students from 4th, 5th and 6th grade participated in this study and they analyzed the constructs of mathematical giftedness by using multiple criteria approach. Findings confirmed that mathematical giftedness can be described by mathematical ability and mathematical creativity; moreover, they concluded that intelligence is a predictor of mathematical giftedness. To sum up, mathematically gifted students have relational understanding between numbers and symbols; moreover, they can relate the mathematics to real life and solve problems with different ways in an unusual speed and accuracy (Fıçıcı & Siegle, 2008; Sriraman, Haavold, & Lee, 2013).

As the last words, it is another fact that gifted students may not always reflect common properties and they may hinder their giftedness because of fear of failure or as a negative response to high expectations put on them by parents, teachers and friends (Anderson, 2013; Morisano & Shore, 2010). On the contrary, those students may become gifted underachievers and fail in exams and tests, even in IQ tests (Morisano & Shore, 2010). Identification of those types of students and taking their attention into mathematics are not easy because they might already have lost their enthusiasm and belief in the challenging and joyful side of the mathematics; hence, they begin to perform below their potential (Rotigel & Fello, 2004). Furthermore, if that student is labeled as lazy and underachiever in classroom, it really needs great effort to notice, diagnose and use that full potential again (Anderson, 2013). Additionally, mathematical talent could be diagnosed in students' very young ages (Freiman, 2006) and mathematically gifted students should face with proper educational opportunities earlier in their life so as not to be gifted underachievers (Karaduman, 2010). By this way, they could maintain and develop their mathematical abilities (Davaslıgil, 2004; Robinson, Abbott, Berninger, Busse, & Mukhopadhyay, 1997). Corresponding to these definitions and characteristics of mathematically gifted students, through the years many tools were developed to identify giftedness in mathematics. These tools with their historical developments and detailed properties were stated in the following subsection.

2.3.1. Tools for Identifying Mathematical Giftedness

When it comes to identification methods of mathematical giftedness, it was a conspicuous issue from the 1900s and above level testing was the most common option for it. Initial efforts to identify mathematically gifted students by using some measurement instruments goes back to 1971 when Stanley introduced the Study of

Mathematically Precocious Youth (SMPY) by using scores in Scholastic Aptitude Test (SAT) which is used as a common strategy to determine giftedness in mathematics (Robinson, Abbott, Berninger, Busse, Mukhopadhypay, 1997; Van Tassel-Baska, 2001). SAT was used in that study because age-appropriate level test lacks in the difficulty for reaching the exact sample of gifted students (Stanley, 1976). Stanley (1991) used the scores obtained from this test and specified the limits as the students scoring from 500-800 could enter to the program in the Study of Mathematically Precocious Youth (SMPY) at Johns Hopkins University. After that, John Hopkins changed this interval as 700 to 800. Similarly, Elementary Student Talent Search program was conducted in Carnegie Mellon University by Lupkowski-Shoplik and Kuhnel in 1995 to search talented students by using above level testing. However, assessment by using above level testing was seen as problematic in some aspects, too (Ryser & Johnsen, 1998). Hence, some additional methods were used after these studies. For instance, using open ended questions or student interviews are seen as required for the assessment of mathematical giftedness although interviews cannot be seen as standardized tests (Sheffield, 1994). Moreover, some other measurement instruments such as intelligent tests, creativity tests, mathematical achievement tests, mathematical ability tests and high level ability tests are used to identify mathematically gifted students (Dağlıoğlu, 2004).

Test of Mathematical Abilities for Gifted Students, whose abbreviation is as TOMAGS is the other instrument determines mathematical ability levels of students aged 6 to 12 years and offer students who are possibly gifted in mathematics. It is a standardized, norm referenced test that assess students' scores in line with their chronological age and determines probability of their giftedness as very low, low, average, high and very high probability (Ryser & Johnsen, 1998). TOMAGS uses both above level testing and open ended question format which is an advantage in quality of determination in mathematical giftedness. Furthermore, it assesses problem solving and reasoning abilities which is a deficiency in achievement tests and provides a useful tool for researchers who need valid and reliable standardized instruments for mathematical giftedness (Ryser & Johnsen, 1998).

In Turkey, there is still not a common and standardized instrument and only subtest scores of the Wechsler Intelligence Scale for Children-Revised (WISC-R) test can be an indication of possible potential for mathematical giftedness (Baykoç, 2010). Still, there are few procedures and instruments developed by some researchers. One of them is a model developed and applied in 3 elementary schools by Budak (2007). It involves teacher, parent and peer nomination forms, Problem Solving Tests, Cognitive Abilities Test (CogAT) and Problem Solving Attitude Questionnaires and they were tested for their reliability and validity in three Science and Art Centers in different parts of Turkey. After assessing validity, he proposed that this model can be a suitable way to identify mathematical giftedness. Moreover, according to Ministry of National Education, some of the characteristics that mathematically gifted students reflect are ability to quickly solve problems that their peers have difficulty, asking unusual problems, focusing on analyzing, synthesizing and evaluating, ability to integrate mathematics to other categories and relate the irrelevant concepts with each other (Karaduman, 2010; Uzun, 2004).

To sum up, as stated above, mathematical giftedness is seen as a unique potential defined by taking various dimensions into account. Hence, independent of the names of those dimensions, these potentials of gifted students need to be identified and improved during their educational life from their earlier age. In addition to these statements addressing the case, gifted education and related studies in Tukey was also stated in the following subsection.

2.4. Gifted Education in Turkey

When it comes to gifted education in Turkey, it dates back to Ottoman Empire when gifted and talented students were brought together and educated at Enderun Systems which were later inspired by the other countries in the world (Akkanat, 1999). In that system, gifted students were selected in accordance with their abilities and educated over a period of 15 years (Baykoç, 2014). However, after Ottoman Empire those systems weren’t used as a way to educate gifted children in the country. Following to the establishment of Republic of Turkey, some efforts were carried out by Student Exchange in 1940, Village Institutes from 1948 to 1956, Talent Groups in

1962, Science High Schools in 1964, Special Classes in 1970, Anatolian High Schools in 1989, Anatolian Fine Arts High Schools in 1994, Science and Art Centers (BILSEM)in 1993 (Baykoç, Uyaroğlu, Aydemir, & Seval, 2012). Among those, Science and Art Centers under the auspices of MoNE are the only formal institutions that play a substantial role in fulfilling educational and developmental needs of gifted students over the past twenty years. Students with a certain IQ score and nominated by their teacher were able to attend to these centers after their school times (Karabey, 2010) and there are approximately 80 in number. In addition, few informal foundations exist for gifted students, but there are not any standardizations and controlling for these foundations. Hence, when all gifted students in the country taken into consideration, few of them have additional proper supports in these Science and Art Centers or in other informal institutions that the case in Turkey seems like not having required attention (Akkanat, 1999).

Turkish Education system in the schools is centrally managed and the same curriculum is applied to each lesson for all students at that grade. More specifically, the objectives, limitation of the objectives and their specified time intervals are determined by Ministry of National Education [MoNE]. Hence, a student attending school in an urban or a rural area whether they are gifted or not they are expected to learn the same mathematics concepts at the same time, at the same pace and at the same depth. That is, differentiation of content, process or product is not an issue for the gifted students in the country (Karaduman, 2010). As in the case in other countries, gifted students in Turkey need nonrandom, special activities or services that are outside the needs of general students and there is a great need for learning and meeting their needs in those classrooms where they have only opportunity to be nurtured (Aydemir & Çakıroğlu, 2013).

2.4.1. Studies about Gifted Education in Turkey

When studies about gifted education in Turkey examined, it was seen that there were few studies and they mostly reveal the current state of the need and inadequency about gifted education in Turkey. For instance, in a need assessment study conducted in Turkey, Aygün (2010) took the opinions of 5 students, 16 teachers and 1 expert by using interview forms individually. According to findings emerged from the categories, the necessity for the enrichment and tasks designed suitable for gifted students' skills and creativity is concluded. Hence, she claimed that using creative activities useful to advance their abstract thinking is a need in the education of gifted students in Turkey.

Additionally, in terms of acceleration, Tortop (2012) emphasized the importance of radical acceleration which addresses the entrance of highly gifted and talented students to the university or high school three or more years earlier for Turkish educational system. Furthermore, he advocates that this acceleration opportunity which is commonly used in lots of countries can provide so many benefits for the gifted and talented students in Turkey.

Furthermore, parents' perceptions and experiences are investigated in Eris and others' (2009) study by conducting semi-structured interviews with 31 parents of gifted and talented children in Turkey. The inadequateness of the support for gifted and talented children are found as the common point for these parents and they also complained about the lack of services for parents and teachers in terms of guidance and information which leads to unconscious and incapable teachers and parents.

Additionally, in Özenç and Özenç's study (2013), multi-dimensional analyses of master and doctoral thesis conducted from 1995 to 2012 years in Turkey was examined. They concluded that thesis studies regarding gifted education were too few that master thesis or more detailed doctoral dissertations should be conducted to develop gifted education in Tukey. Moreover, they also concluded that due to the fact that available studies mostly concentrate on the quantitative analysis, qualitative analysis should be conducted, too.

All in all, gifted education and accommodating the classroom practices in line with the needs of gifted students is a problem in education of most countries including Turkey. Gifted students confront both academic and psychosocial problems because formal requirements in education do not match with their differentiated needs, nature and skills (Robbins, 2007). In order not to lose their potential, particularly in mathematics, more attention should be paid to their needs (Diezmann & Watters, 2003; Dimitriadis, 2011). However, at their schools where they receive basic education, students have some differentiated needs and face problems regarding these needs, which will be explained in the following section.

2.5. Gifted Students' Needs in Classrooms

Schools, where gifted students are educated and spend most of their time, devote critical attention to cultivating students' cognitive, social and emotional well-being (Bicknell, 2009). Students engage in different classroom tasks as part of their learning process at schools. However, these classroom tasks are too easy; do not satisfy gifted students' needs, do not draw their attention and neither are they challenging enough since they have faster learning speeds compared to their peers (Kaplan, 2004; Mendoza, 2006; Preckel, Götz, & Frenzel, 2010). Correspondingly, boredom or discouragement is faced as an inevitable consequence of this problem and classrooms lose their gifted potentials (Johnson, 2000; Waxman, Robinson, & Mukhopadhyay, 1996).

To overcome this problem, the need to design classroom tasks appropriate for mathematically gifted students' differentiated needs emerges (Johnson, 2000). However, schools lack the quality to provide such classroom tasks to these students (Baykoç, 2010; Dimitriadis, 2011). Consequently, students lose their enthusiasm to learn new concepts, do not use their full potentials in their lessons (Freiman, 2006). A good example that can be cited for this need is Project M3: Mentoring Mathematical Minds, which is well-known for its significant contributions to both regular and gifted students' mathematical understanding and achievements (Gavin, Casa, Adelson, Carroll, Sheffield & Spinelli, 2007; Gavin et al., 2009). In this project, a collaborative team made crucial modifications to the standard curriculum based on the recommendations in the literature in order to address the specific needs of gifted students, which differ from regular students in classrooms. The study also provided a beneficial example by highlighting the proper tasks and program for mathematically gifted students. Likewise, in another study named Challenging Situation Approach, students' need of challenge was taken into consideration in the regular mathematics curriculum, which highlights the individual needs and learning pace of gifted students cited in literature (Freiman, 2006). As highlighted in these studies, designing classroom tasks by taking gifted students' needs into consideration is important to overcome problems in gifted education.

In addition to these need for modification in classroom tasks, studies that concentrate on emotional aspects of gifted education are also exist. For example, Hammer (2002) empirically examined what is the case in elementary precocious mathematics students' attitudes when they were not challenged appropriately. The students from second to sixth grade were provided enrichment and accelerated activities and it was seen that math achievement was significantly increased. Moreover, the increase in students' interest in mathematics and self-confidence, positive attitudes towards mathematics were other findings of the study from the affective perspective. Thus, they concluded that if students are not appropriately being challenged in their early years, they may be discouraged or disinterested in mathematics (Hammer, 2002).

As it is stated in the three ring model of Renzulli about giftedness, motivation, which is handled initially as task commitment, is seen as a necessary factor in the achievement of gifted behavior (Renzulli, 1986, Mönks & Mason, 2000; Philips & Lindsay, 2006). Moreover, as most of the authors (Csikszentmihalyi, Rathunde, & Whalen, 1997; Howe, 1995; Schneider, 2000; Sternberg, 2000) state, motivation and emotional well-being plays crucial role in school success and performance of students. Likewise, Martin and Pickett (2013) conducted an action research to solve motivation and engagement problem of gifted math and music students. Differentiated instruction was implemented as intervention to increase motivation and engagement of students. In their study, 25 students and 4 teachers were surveyed as pre and posttest to reveal their opinions. Additionally, two researchers used behavior checklist before and during intervention to observe students' disruptive behaviors and they concluded that the intervention positively changed students' perception, engagement and motivation (Martin, Pickett, 2013). Similarly, in Philips and Lindsay's (2006) study, 15 gifted students from five secondary schools in England were interviewed to explore the factors effecting motivation. After these interviews, their teachers and parents were interviewed for validation of data taken from students. At the end of the study, it was stated that participation in extracurricular activities, praising and encouraging gifted students are factors that affect their motivation. Lastly, Fennema and Sherman (1976) stated that enthusiasm and persistence at complex problems, self-perception and confidence, believing the usefulness of mathematics and willingness for advanced and challenging tasks are important for students to become successful in higher mathematics. Moreover, for mathematically gifted students, their educational process should have enjoyable tasks or activities (Baykoç, 2010) and enjoyment is seen as a positive learning disposition, which increases young mathematicians' self-esteem (Maxwell, 2001). Therefore, gifted students in classrooms should be faced with interesting tasks that engage them with the depth and joyful side of mathematics (Johnson, 2000; Karaduman, 2010; Wilkins et al., 2006).

In addition to cognitive and emotional needs in classrooms, Wiley (2015) mentioned about gifted students' social needs that their giftedness brings some difficulty in gifted students' relations with their peers or environment. Likewise, Cross (2015) emphasized that they are either emotionally immature or more mature then their peers that they have difficulty in finding similar peers. Hence, not to be isolated from their environment, they have to overcome these feel of differences. That is, students' social needs regarding their classmates constitute the other rings of the chain in gifted education (Baykoç, 2014; Bicknell, 2009; Neihart, Pfeiffer, & Cross, 2015). As studies reflect, students have some problems with their classmates. For example, the nature of difference in their interests and developmental properties cause difficulty in popularity and communication with classmates (Baykoç, 2014; Cornell, 1990). Moreover, Martin (2002) states that due to negative attitudes toward gifted students, they develop negative behaviors towards their friends by hiding their giftedness. Additionally, social and emotional problems that gifted students experience in relation to their peers may lead to loneliness and serious social drawbacks in gifted students' future life (Morelock & Feldman, 2003). As a good example for this, Diezman and Watter (2001) concluded in their qualitative study that, when the students challenged appropriately, they prefer collaboration, which lead to increase in their interaction by providing scaffolding with their peers. At that point, the role of teachers in classrooms is very important in enhancing gifted students' cognitive, emotional and social developments and this role was presented in the following section.

2.6. Teachers' Role in Gifted Education

As much important as students' giftedness, the people who have the basic role has such importance, too. These are the teachers that they have critical mission not only on the identification of the students but also on the applications suitable for these students' differences (Çapan, 2010; Katerina, Maria, Polina, Maria, Constantinos, & Marios, 2010). Nonetheless, among many teachers, it is a common fallacy that gifted students can learn concepts easily and independently, hence there is no need to do something extra for them (Anderson, 2013; Baykoç, 2010; Chamberlin & Chamberlin, 2010; Eris et al., 2009). Due to this unawareness of teachers, many mathematically gifted students are not noticed and lost in educational settings (Baykoç, 2011; Freehill, 1981; Rotigel & Fello, 2004). That is, since teachers are unaware of methodological or cognitive needs of gifted students (Freehill, 1981), they do not make modifications in their regular classroom instruction to help gifted students work at their own pace (Delisle, 2003; Tieso, 2003; VanTassel-Baska, 2001) or they offer similar tasks to gifted children, which results in the demotivation of gifted students (Dial, 2011). Even in some schools where special programs or tasks are developed for gifted students, these programs are not implemented effectively due to teachers' inadequate knowledge and skills as regards gifted students (Gadanidis, Hughes & Cordy, 2011; Westberg, Archambault, Dobyns, & Salvin, 1993).

As Freehill (1976) states, through the years, teachers are seen inadequate to identify the gifted students accurately; they missed most of students or they misidentified them. To avoid this, he believed the importance of using combination of some measurements and assessments, not relying blindly on test scores, achievement scores or observations in classroom settings. Furthermore, in Ktistis's (2014) study, teachers' importance and beliefs regarding critical thinking skills to gifted students were examined and it was revealed that teachers are inadequate and unaware to enhance their gifted students' critical thinking in mixed ability classrooms.

In Fıçıcı and Siegle's (2008) study, the secondary mathematics teachers from South Korea, Turkey, and the United States were surveyed and they were wanted to state their opinions about characteristics of mathematically gifted students. Two hundred ninety-six teachers from South Korea, 389 teachers from Turkey and 262 teachers from USA teachers completed mailed survey instruments about forty behaviors of students reflecting the mathematical giftedness. The results indicated that the more teachers get experience on teaching mathematics, the more they believe in computational skills, ability of relate to everyday life and ability to generate unique or multiple solutions for problems as the indicators of mathematical giftedness. Moreover, they highlighted the stress level factor for the teachers of Turkey and Korean that in these countries, teachers give less value to relationship of mathematical concepts with real life and creative problem solving due to the university entrance exam; hence, in these countries, this environment may not provide these gifted students to reveal their potential. That is, there are some critical points in the education of gifted students like development of teachers about gifted students and a supporting system which develop cognitively and emotionally by motivating them in their proper social environment (Trna, 2014). However, teachers may be intolerant to students asking complex questions and not liking routines (Soonhey, 2009) and as Weiner's (1986) study indicated, teachers who lack necessary knowledge about gifted students, behave irrelevant, unfriendly and even hostile to their gifted students. Similarly, Thomas (1973) come up with the idea that teachers have mostly negative attitudes and fallacies about gifted students.

Furthermore, from the teachers' perspective, it is a very challenging tasks to teach the gifted students appropriate thinking skills (McCollister & Sayler, 2010). Especially critical thinking is among those skills that the teachers have vial role (Dixon, Prater, & Vine, 2004; Ktistis, 2014). Herein, teachers' pedagogical content knowledge directly shed light on students' educational life and it is crucial in terms of providing proper opportunities to students (Carpenter, Fennema, Peterson, & Carey, 1988; Geddis, Onslow, Beynon, & Oesch, 1993; Grossman, 1990; Marks, 1990; Shulman, 1986, Soonhey, 2009). As highlighted in Park's (2005) study, to overcome challenges that teachers face about their gifted students in their classrooms, they need to enhance their pedagogical content knowledge. She states that gifted students may have differentiated needs and problems due to their curiosity, quick learning, boredom from similar and easy practices, and they need for extra challenging tasks. Hence, teachers' instructional decisions and teaching practices are affected from gifted students' characteristics such as asking challenging questions in classrooms, being impatient with slowness about others, perfectionism, not liking routine and similar works, awareness about being different (Clark, 1988). In her study, teachers had to improve their subject matter knowledge to provide more accurate and detailed answers to gifted students' questions and they had to learn different grouping and teaching methods to fulfill students' needs. Furthermore, they differentiated their teaching tasks and assessments to develop both in class and individualized support for those students. Hence, Park (2005) concluded that more enhanced pedagogical content knowledge is necessary for providing proper educational opportunities to gifted students than average students in classrooms.

From another perspective, collaboration of teachers and parents are one of the essential factors for gifted and talented students because this collaboration helps to know and understand the different needs of these students and provide options to fulfill their needs (El-Zraigat, 2012). As stated before, teachers are the key factors that shape the today and future of these gifted students not only by providing modified opportunities like differentiation and acceleration, but also by guiding them to the needed services with the help of collaboration with parents (Baykoç, 2011). Hence, teachers' knowledge of the needed processes and services for these students and guiding the students and their parents in terms of this need is essential and critical (Eris et al., 2009; Baykoç, 2011).

To sum up, it is crucial to diagnose, understand and provide proper educational opportunities to those students so that gifted one can be a healthy, successful and satisfied person in his/her future life (Baykoç, 2011; Johnson, 2000; Siegle, 2004). Teachers who are the key men of gifted education process have severe and crucial responsibility on several counts; thus teachers' awareness and knowledge in terms of identification, differentiation, educational and guidance opportunities is worth stressing and should be handled with caution (Baykoç, 2014; El-zraigat, 2012; Fıçıcı and Siegle, 2008; Gadanidis et al., 2011; Gavin et al., 2007; Park, 2005; Tieso, 2005; Westberg et al.,1993). That is, if the aim is to develop gifted students' existent abilities and not to lose them in educational environments, teachers should know gifted students' cognitive, social and emotional characteristics, and how they can differentiate lessons in accordance with these (Anderson, 2013; Diezmann & Watters, 2003; Johnson, 2000; Ktistis, 2014; Mogensen, 2011; Wilkins et al., 2006). In line with this, in the following section, literature review about differentiation in gifted education and its crucial components for regular classrooms were provided.

2.7. Differentiation in Gifted Education

As it is stated before, due to the fact that gifted students are in the same environment with regular students, their needs and potentials are not fulfilled in these regular classroom environments (Gadanidis et al., 2011). According to Westberg and others (1993), gifted students have little opportunity for taking different instructional and curricular practices suitable and needed for their nature and skills. In addition, they claim that even gifted program exists in a school, there are variety of reasons not to implement these programs such as teacher inadequacy, classroom environments, curricula and needs of normal developed students. On the other hand, differentiating the instructional programs, which allow homogenous groups, questioning practices and differentiation practices including advanced content or details, are seen as effective for the developmental needs of gifted students (Westberg et al., 1993).

Although there is not a common definition of differentiation (Hertzog, 1998; Kaplan, 2004, Olenchak, 2001), it provides improvements for not only gifted students but also for all other students (Dreeszen, 2009; Heacox, 2002). In classrooms, students having variety of needs exist and differentiation enables to meet these various needs by modifying the curriculum, instruction and materials (Tomlison, 1999), which is a challenging task (Hertberg-Davis, 2009; Kanevsky, 2011). This is the mostly used definition of giftedness as stated by Tomlinson (1999, 2001, 2003) that it takes the individual characteristics, needs and interest into attention. Winebrenner (2001) proposed four differentiation elements as content, process, product, environment and assessment. To differentiate content, usage of advanced material, curriculum compacting, interdisciplinary or beyond level tasks were suggested. Additionally, process could be differentiated by means of flexible grouping and complex learning opportunities while product could be differentiated by changing students' way of accomplishment of a product. Lastly, environment was addressed as related with physical setting or conditions while assessment was the method to show the gains of the curriculum requirements. Furthermore, curriculum compacting is another differentiation method that enable students mastering of a subject to struggle with other tasks that are modified with more challenging and interesting ones (Renzulli, J. S., & Reis, S. M., 2004) To differentiate the instruction effectively, there are some missions that should be completed like identification of students' readiness, interests, preferences, learning styles and proper modification of product, process and content in line with the needs of students (Pham, 2012; Santangelo & Tomlinson, 2009). Moreover, providing collaboration among students as well as individuation (Pham, 2012) and usage of enjoyable activities (Dotger & Causton-Theoharis, 2010) are the other missions of differentiation.

Studies about differentiated, enriched or accelerated programs and their impact for gifted students are very scarce (Gavin et al, 2009). Among those, in Tieso's (2003) study, when effect of the differentiated curriculum developed for high ability elementary students and regular curriculum compared, it was found that differentiated curriculum provided significant achievement gains for abled students. According to Ysseldyke, Tardrew, Betts, Thill, and Hannigan (2004), literature indicates that most gifted students do not have opportunities in diverse learning environments where they can construct their own learning with higher abilities. However, they propose that providing some tools, which enable to follow with their own pace as well as regular classroom curriculum gains, have lots of benefits. Parallel to this, in their experimental study, achievement scores of 1,130 students in experimental group and 1,072 students in control group were compared. A self-directed mathematics program, whose principles are based on the individual abilities, goals and practices, named as Accelerated Math, is applied to students in experimental group and this system enabled mathematically gifted ones to move ahead according to their own understandings and pace. This study continued about 4-months process and they found a significant difference on the post test results of the groups favoring the gifted students' scores and they concluded that any tiny effort to present an option for acceleration can lead to biggest changes in the mathematically gifted students' development. Similarly, in Tieso's (2005) study, thirty-one teachers and their fourth and fifth grade students in New England were used in a pretest posttest quasi experimental study. Four groups as three of them in treatment groups were constructed and again each of these groups were divided into high-medium and low ability groups to see the effects of both the grouping arrangement and curriculum design on achievement scores of posttest by using repeated measures analysis of variance. After experimentation, gifted students exposing to differentiated curriculum showed significantly higher achievement in mathematics than the students in control groups, who used a unit from the regular mathematics textbook. Moreover, this showed the greater need for ability grouping and instructions with enrichment practices and highlighted the textbooks' lack of adequate complexity for gifted students.

Similar findings come from Gavin and others' (2007) study that their five yearlong study is designed to construct a mathematics curriculum unit based on enrichment and acceleration for conceptual understanding and mathematical thinking of the gifted and talented students. At each grade level, the content was above one or two grade level. 200 mathematically talented third grade students in 11 different schools, nine in Connecticut and two in Kentucky were constituted their sample. At the end of the study, the students were 5th grade and there was a significant increase in the students' understandings of all mathematical concepts in each unit. Their study highlighted the teachers' importance of including acceleration into their lessons and using enriched units to remove the gap in curriculum.

Furthermore, in the Gadanidis and others' (2011) study with 7^{th} and 8^{th} grade students, they designed an environment for gifted students to use creative thinking skills with differentiation of the classroom instruction to better meet the needs of gifted students. The students initially stated that mathematical concepts are not challenging and meaningful; they are procedural. However, after differentiated instruction based on these technology and art rich tasks, they become more engaged and began to comprehend mathematical concepts conceptually by involving in this more joyful, challenging and real life environment (Gadanidis et al., 2011).

All in all, although there are some reasons that differentiation is not mostly used in classrooms such as time restrictions, focus on testing, lack of understanding about the needs of less and more abled students in classrooms (Hertberg-Davis, 2009), mathematically gifted students in regular classrooms should be provided with some differentiation opportunities. In line with this aim, the curriculum materials or tasks should be differentiated so as to use in their educational environment. The details of the literature review about the characteristics of these differentiated curriculum tasks was addressed in the following sub-section.

2.7.1. Differentiated Curriculum Tasks for Mathematically Gifted Students

As heavily stated in this literature review, gifted students have differentiated needs when compared to their peers; in accordance with this, they need more effort and attention in their classroom tasks. Teachers are the ones who can change this disadvantage to advantage by designing or looking for additional tasks proper to these students (Deizmann & Watters, 2001; Johnson, 2000; Sriraman et al., 2013). However, most of the teachers have not enough, even no knowledge about which tasks they should use due to deficiencies in their pre-service and in-service education (Baykoç, 2010; Chamberlin & Chamberlin, 2010; Cramond & Martin, 1987; Hekimoğlu, 2004). Likewise, books may not always have necessary characteristics suitable for gifted students (Johnson, 1994) although activities that develop gifted students' abilities should be provided in their tasks (Sheffield, 1994). As accessible literature reflected in the beginning part of this chapter, there are lots of suggestions and opportunities that teachers can use in their mathematics classrooms to differentiate their tasks. However, they were disconcerted and need some grouping. In this part, these suggestions about differentiated tasks for mathematically gifted students were provided.

To differentiate instruction proper to gifted students' needs, they should be provided with tasks promoting higher level thinking and creativity (Chamberlin & Chamberlin, 2010; Sriraman, 2003). Tasks involving problem solving activities may serve this purpose when they are planned and given in a manner that catch gifted students' interest and need of challenge (Karaduman, 2010; Pierce et al., 2011; Tieso, 2002). Thus, as it was mostly stated by researchers (Ktistis, 2014; Reger, 2006; VanTassel-Baska & Stambaugh, 2006, Winebrenner, 2001), challenging tasks should be included in gifted students' education. However, it may be misunderstood that teachers may try to differentiate and challenge their lessons by exposing similar routine problems or exercises to those gifted ones. That is, challenging is mostly regarded as mandating repetitions, completing tasks in the next page of book or activities that are not planned in accordance with properties of gifted students (Philips &Lindsay, 2006; Sriraman, 2013). However, students should neither get bored from repetition nor get lost in unnecessary difficulty of problem (Chamberlin & Chamberlin, 2010). Hence, challenging and meaningful complexity of problems should be involved in their instructions so that their interest can be taken and maintained during the lessons (Chamberlin, 2002; Deizmann & Watters, 2001; Sriraman et al., 2013). As an example of this, Friman (2006) stated that gifted students chose more challenging tasks and they were creative in open ended problems and puzzles in differentiated classroom activities. For these aims, teachers can use problems in their regular instructions that all students in classroom can benefit or they can provide those tasks as an extra individual work when gifted ones complete their tasks (Chamberlin & Chamberlin, 2010). Nonetheless, at this point, problem's attraction, difficulty, presentation and attitude of teacher are vital because students shouldn't see the task as punishment (Johnson; 2000; Rotigel & Fello, 2004). Moreover, context of the task is also crucial that mandating extra heavily exercises will not serve its goal (Rotigel & Fello, 2004). That is, extended, complex and depth content which are integrated with discovery and problem solving enrich students' mathematical lives (Johnson, 1994; Karaduman, 2010).

In addition to challenging characteristics of tasks in classrooms, some other characteristics are critical, too. Gifted students' tasks should also catch their interests since they may not always have intrinsic motivation (Wilkins et al.,2006). That is, as Park and Park (2006) stated in their study, gifted students' materials should be developed in line with their interest (Park & Park, 2006). Moreover, the tasks should also develop thinking skills of mathematically gifted students to reveal and perform their full potential. Bloom's taxonomy provides a structured example about teaching of thinking skills to the students (Berger, 1991). Especially top three levels of this taxonomy are used for gifted students' task that promote their thinking skills (Davis & Rimm, 2004; Ennis 1985; Jacobson & Lapp, 2010). That is, gifted students should be more engaged with these higher level thinking skills (Davis & Rimm, 2004). At that point, thinking skills are used by some researchers (Black, 2005; Davis & Rimm, 2004; Ivie, 1998; Ktistis, 2014; Tan, 2006) as the synonym for critical thinking or higher-order thinking. Although gifted students have an ability to think critically in their nature, this does not mean that all gifted students could think critically. To become an effective critical thinker, they should experience with some activities that enhance their critical thinking and they should learn how to think critically (Dixon, Prater, & Vine, 2004; Facione & Facione, 2007; McCollister & Sayler, 2010) because it is a teachable skill (Elder & Paul, 2007; Snyder, & Snyder, 2008). However, studies regarding gifted students' critical thinking and how to enhance their skills in heterogonous classrooms are very scarce (Ktistis, 2014). Similarly, schools are inadequate (Law & Kaufhold, 2009; Willingham, 2008) and lack in the appropriate materials and pedagogical strategies in promoting gifted students' critical thinking (Alagozlu, 2007; Black, 2005; Dixon et al., 2004; Elder & Paul, 2007; Hammer, 2002; Snyder and Snyder, 2008). In addition to this, Ktistis (2014) mentions that there are some barriers that prevent improvement in students' critical thinking in schools, like time limitations or teachers' own perception about their self-adequacy to teach these skills (Law & Kaufhold, 2009). In his study, he also concluded that gifted students' critical skills are superior than regular ones and teachers have vital role in promoting these skills. Besides, in his comprehensive review about some methods, questioning that allow challenging questions (Snyder & Snyder, 2008), debate (Oros, 2007; Scott, 2008) and problem based learning (McCrae, 2011; Miri, David, & Uri, 2007) are found as enhancing students' critical thinking skills. Nonetheless, critical thinking has not an emphasis in Turkey's educational system and there is a deficiency in the proper tasks promoting higher level thinking (Alagozlu, 2007). Thus, gifted students' programs and tasks should include emphasis about teaching thinking skills; especially critical thinking (Newman, 2008; VanTassel-Baska, 2010).

Moreover, open ended problems, mathematical modeling problems, authentic and complex problems that link both academic, nonacademic or beyond curriculum topics are proper for the developmental needs of mathematically gifted students, too (Pierce et al., 2011; Tieso, 2002). As proposed by Ysseldyke and others (2004), advanced activities should be included in the gifted students' program. As stated in the curriculum; problems that are novel, interesting, challenging and having multiple entry points are consistent with what experts and researchers state as needed definition of problem in gifted education field (MoNE, 2013). In addition to problems, intelligence questions, mathematical games, interesting books are the things that gifted students show great curiosity (Baykoç,2010; Johnson; 2000). For those tasks, restriction of those students to a time line may create problem; hence students' involvement with self-directed tasks and freedom for their own choice without a time limit would decrease anxiety as well as increase their enthusiasm. Similarly, being independent and preceding with their own pace would get their desire to work on the task (Wilkins et al., 2006). As another option, "A Mathematics Investigation Center" can be created so that the teacher does not have to prepare everyday separate activities for gifted ones **(**Wilkins et al., 2006, p. 7). Teacher can include some challenging tasks in that center, or students themselves can prepare for each other. The teacher may present this center in such a way that all students in classroom can benefit from there and it is not novel and special to only gifted ones, anyone who wants can do after completing their own work (Diezmann, & Watters, 2001; Hannah et al. 2011; Sriraman, & Sondergaard, 2009).

As another alternative, usage of mathematical history, which should be included in both undergraduate courses and regular mathematics lessons, may be beneficial (Alpaslan, Işıksal, & Haser, 2012; Göktepe & Özdemir, 2013; Sözen, 2013). Especially gifted students have great curiosity about historical background of concepts and wonder about issues that happened in the past (Yevdokimov, 2007). A focus on lives and experiences of famous mathematicians, logical, historical background and changeability of concepts; all may satisfy their curiosity (Aydemir & Çakıroğlu, 2013). They may find the answers of their questions, which they usually wonder and ask about, such as why people needed to use fractions; why people needed a common symbol for representation of fractions; what other fraction symbols used in the past. Therefore, usage of mathematical history, which is included in curriculum in Turkey, can be interesting for gifted students (MoNE, 2013; Yevdokimov, 2007). Furthermore, integrating technology is another issue which is known to be effective in allowing students to proceed at their own pace (Kaput, 1992; Özçakır, 2013). Most of the gifted students are very abled, motivated and successful in technology usage and the role of the technology in their motivation could be used as another option to fulfill their needs (Johnson, 2000; Siegle, 2004; Periathiruvadi, & Rinn, 2012).

For the revised curriculum, more time is available for doing mathematics, touching mathematical tasks and making hands-on activities (MoNE, 2013), which coincides with the required characteristics of differentiated tasks. Discovering concepts by means of abstract tasks may catch gifted students' interest and fulfill their needs to learn the logic and rationale behind concepts and procedures (Johnson, 2000; Van de Walle et al., 2013; Wilkins et al. 2006). In addition to this, effective usage of other instructional approaches, may be important to find the ways to satisfy their special needs (Baykoç, 2010). For illustration, involving why, how and what if questions to probe students' thinking makes them alert and interested (Johnson, 2000). Similarly, teachers may use this technique in their regular instruction or they may provide those questions as tasks to consider about reasons behind the concepts (Sriraman & Sondergaard, 2009). Furthermore, discussion method provides to extend their knowledge and meet their need of elaborating more on the concepts by communicating with others (Johnsen & Ryser, 1996) and should be included in their classrooms (VanTassel-Baska, 1998). Likewise, cooperative learning is another method because while it enables gifted students to work together, it also provides improvement for other students (Baykoç, 2010; Chamberlin & Chamberlin, 2010; Deizmann, & Watters, 2001).

In addition to individual tasks, gifted students need interaction and guidance from other students and teachers; hence these approaches may enable them to benefit from those opportunities (Baykoç, 2010). Moreover, interdisciplinary approach may be a good option on gifted education (Karaduman, 2010; Sriraman & Sondergaard, 2009). For example, combining mathematics and environmental issues may be a practical way to increase environmental awareness and to provide real life applications (Aydemir & Teksöz; 2014; Jianguo, 2004). Like relating to science, relating to other disciplines, such as music or art, can be useful way to show the usage and importance of mathematical concepts in other courses (Sriraman & Sondergaard, 2009). In addition to all, to involve them in the process, it may be good to use some effective strategies like giving responsibility, mentoring other students, creating a list for the classroom, guiding them to study and contributing in competitions or Olympiads (Baykoç, 2010; Johnson, 2000). To sum up, constructivist classrooms are suggested for gifted students that they could discuss with open ended questions (Hanley, 1994) and use problem solving abilities in inquiry activities (Reger, 2006). That is, questioning and tasks that promote collaboration should be in the process of gifted education (VanTassel-Baska, 1998).

Last but not least, assignments are another vital ring of the chain and it is important to take gifted students' attention while planning them (Sternberg, Ferrari, Clinkenbeard, & Grigorenko, 1996). Gifted students complain about doing the same things at home although they learnt and repeated so much in school; hence, messy and easy assignments should be avoided for these students (Aydemir & Çakıroğlu, 2013). To state it differently, they should be provided differentiated assignments leading them to use their creativity and higher order thinking or they should have options they can choose as an assignment (Johnson, 2000). Likewise, rather than solving a lot of similar exercises that their friends may need but they don't, assignments may be given as interesting, challenging tasks, or hands on materials (Rotigel & Fello, 2004; Sriraman, & Sondergaard, 2009). That is to say, they may be given assignments that are enhanced in quality and complexity rather than quantity (Baykoç, 2010).

To conclude, while differentiating classroom practices or tasks, gifted students should have opportunities to appreciate the value of mathematics in their classroom activities (Karaduman, 2010). On the basis of "one does not fit all", it may be better to shape these suggestions by taking each gifted students' properties, needs and interests into attention in classrooms (Baykoç, 2011; Baykoç, 2014; Van de Walle, Karp & Bay-Williams, 2013, p. 147). Hence, gifted students should have different levels of support in classroom in line with their differentiated needs and properties (Gavin et al., 2009). By this way, they would not be lost in classroom environments; on the contrary, they could find opportunities that reveal and use their exact potential.

2.8. Summary of Literature Review

To sum up, giftedness is a unique and valuable potential and mathematically gifted students differ from regular students in their relational understanding between numbers and symbols and they use mathematical concepts with unusual accuracy (Fıçıcı & Siegle, 2008; Sriraman et al., 2013). It is the fact that these differences should be improved in positive ways and this comprehensive literature review reflected that identification and development of students' giftedness is crucial (Colangelo & Davis, 2003; Çapan, 2010; Davis, & Rimm, 2004; Ktistis, 2014; Morelock & Morrison, 1999; Rakow, 2012; Schneider, 2000); Tomlinson, Tomchin, & Callahan, 1994). Due to the fact that mathematically gifted students attend regular classrooms and engage cognitive, emotional and social activities in these classroom, these environments should be shaped in accordance with their needs (Bicknell, 2009; Diezmann & Watters, 2001; Dimitriadis, 2011; Gavin et al., 2009; Hammer, 2002; Karaduman, 2010; Leikin, 2010; McComas, 2011; Rotigel, & Fello, 2004; Sheffield, 1994; Sriraman & Sondergaard, 2009). Although it is crucial to differentiate lesson for gifted students' needs, teachers in classroom mostly have lack of knowledge about how to differentiate their lessons (Baykoç, 2014). At that point, differentiated tasks and how teachers will use these tasks are crucial. Thus, development of differentiated tasks that serve their needs in classrooms and increasing the teachers' awareness and adequateness about the issue should be given importance.

To differentiate the classroom tasks, some characteristics of tasks as proper to developmental needs of gifted students were mentioned in literature. Challenging Chamberlin, 2002; Deizmann & Watters, 2001; Gavin et al., 2007; Karaduman, 2010; Sriraman, 2003) and interesting activities (Johnson, 2000; Karaduman, 2010; Wilkins et al.,2006) as well as tasks that enhance students' thinking skills were stated mostly (Chamberlin & Chamberlin, 2010; Freiman, 2006; Karaduman, 2010; Sriraman, 2003). To develop tasks that promoting higher level thinking, top three thinking levels of Bloom's taxonomy was suggested mostly. Moreover, problem solving (Freiman, 2006; Gavin et al., 2009; Greenes, 1997; Karaduman, 2010; Pierce et al., 2011; Renzulli, 1986; Tieso, 2002), intelligence questions (Baykoç, 2011; Johnson, 2000; Freiman, 2006), interdisciplinary tasks (Berger, 1991; Freiman, 2006; Greenes, 1997; Karaduman, 2010; Renzulli, 1986; Sriraman, & Sondergaard, 2009), technology integrated tasks (Johnson, 2000; Siegle, 2004; Periathiruvadi & Rinn, 2012) advanced or beyond learning activities (Rotigel & Fello, 2004; Johnson, 2000; Karaduman, 2010 are the other methods that were mentioned as drawing gifted students' attention and enhance their skills. In addition, usage of some teaching methods like discovery (Johnson, 2000; Wilkins et al. 2006; Van de Walle et al., 2013), discussion (Johnsen & Ryser, 1996) or questioning were also suggested for gifted students' differentiated needs.

To conclude, although literature review underlined the importance of mathematically gifted students and necessary educational opportunities, the studies exactly focusing on practices in classroom environments are very scarce. Even, studies concentrating on the design and development of proper classroom tasks for mathematically gifted students is not available in the accessible literature. Therefore, this study aimed to fill this gap in mathematics and gifted literature. Moreover, it also aimed to draw mathematics educators' and instructors' specialized in the field of giftedness attention on the lack of opportunities in real classroom environments. Moreover, an exemplary framework about how this lack could be compensated by involving theory and practice in development process could be constructed. By this way, mathematically gifted students and teachers could find an opportunity to benefit from these differentiated tasks. Thus, designing and developing the differentiated tasks for 5^{th} and 6^{th} grade mathematically gifted students were the main aim of this study. Based on this aim, characteristics of these differentiated tasks and their benefits to students and teachers were also explored in this study.

CHAPTER 3

METHODOLOGY

The first purpose of this study was to design and develop differentiated tasks for satisfying 5th and 6th grade mathematically gifted students' cognitive, emotional and social needs in mathematics classrooms. Design based research studies have primary functions as in the form of characteristics of interventions as well as other research functions (Plomp, 2013). Correspondingly, based this aim of the study, it was aimed to explore the characteristics of these differentiated tasks. Moreover, as the other aims of this study, contributions of this intervention for satisfying mathematically gifted students' needs and also contibutions to teachers were explored. To achieve those aims, formative evaluations were carried out to create a theory-based practical product for 5th and 6th grade mathematically gifted students in regular mathematics classrooms. In those evaluations, the study was examined in terms of relevance, consistency, practicality and effectiveness which were defined as four criteria for high quality interventions of design based research (Nieveen, 1999; Nieveen & Folmer, 2013).

In this regard, the focus of this chapter is to provide main idea of research paradigm and the methodology of how to use this paradigm in this study. So then, as research paradigm, design based research and its crucial steps with the details of prototypes, participants and data collection procedures were explained to comprehensively clarify the methodology. Moreover, draft design principles that guided the characteristics of the differentiated tasks were presented as the departure point of this study. After this clarification, data analysis procedures were presented and trustworthiness, assumption and limitations of this study and lastly researcher role and bias were explained in the remaining sections of this chapter.

3.1. Research Paradigm: Design Based Research

The objective of this study comes from the problems in the practice and need support from the theory. Due to the fact that there is a lack in educational opportunities for mathematically gifted students in mathematics classrooms in Turkey, this study is aimed to design and develop differentiated tasks for these students. Furthermore, after development of the relevant and consistent tasks, it is crucial to test and observe whether the tasks are practicable and effective in classroom environments for the context (Nieveen, 1999). That is, development of differentiated tasks in line with students' developmental needs and classroom environment are an issue that should be deliberated from both theory and practice. Hence, design based research was found as the most useful for the requirements and objectives of this study.

Over the years, design based research was used in various studies with different denotations such as; development research (van den Akker, 1999), design research (Reeves, Herrington & Oliver, 2005), developmental research (McKenny & Van den Akker, 2005), design experiments (Brown, 1992; Hawkins &Collins 1992), formative research (Newman, 1990). Despite these differences in the names, as the initial users of design based research, Brown (1992) and Collins (1992) described it as a methodology that solves the real problems in contexts with the help of practitioners and design principles by conducting reflective and rigorous inquires. Similarly, Van den Akker, Gravemeijer, McKenney, and Nieveen (2006, p.5) summarized common points that these design studies have; the interventions and iterations, concurrent orientation to the theory and practice, focusing on the process not solely on product, direct involvement of practitioners withcollaboration to obtain a practical product that solves a real world problem (Plomp & Nieveen, 2013). Based on these descriptions, design based research yields systematics studies so as to design and develop educational interventions as the solution of a problem in real life (Bannan-Ritland, 2003; Kelly, 2006; Plomp, 2013; Nieveen 2013) Hence, this study is a design based study which consists of all these common characteristics for designing and developing an intervention to improve the practice. In the field of education, design research studies were addressed from different perspectives (Van den Akker et al., 2006) such as; design research from a learning perspective (Gravemeijer & Cobb, 2006), from a technology perspective (Reeves, 2006) and from a curriculum perspective (McKenney, Nieveen, & Van den Akker, 2006). This study is much closer to the curriculum perspective since its main elements; the curricular products, associated design principles and contributions for the professional developmentare the endpoints of this study.

Design studies depart from the problems that teachers or learners confront in real educational contexts and try to solve these problems by producing proper design principles that was developed during the design process (Reeves, 2006). Therefore, they enableimprovement in educational practice and creation of a new theory based product (Trna, 2014; Trna & Trnova, 2012).Hence, while contributing to theory, design based research presents a practical product that is designed and developed through the study (Kennedy-Clark, 2013; Masole, 2011; Van den Akker et al., 2006).In educational environments, this method helps to bridge between theory and classroom practice so that more useful results could be obtained by involving teachers, researchers, experts and practitioners in research and development process (Van den Akker et al., 2006). By this way, both practical and methodological values are taken into consideration in the development of theoretic based practical product (McKenney, 2001; McKenney & Van den Akker, 2005). In other words, designing and developing a theory oriented product improved in the practice (Collins, 1992) is one of the purposes of design based research (Jonassen, Cernusca, & Ionas, 2007; McKenney et al., 2006), which is the main of this study.

Furthermore, as different from other research methods, design based research allows collaboration among people both from theory and practice; that is design and development of the activities provides a team work among the practitioners in the field as well as researchers and experts of the issue (McKenney, 2006). This interventionist side of the design based research also helps the theories to suit well and work in the real context and provides innovations in the education (Cobb, Confrey, Lehrer, & Schauble, 2003). Besides, although it is not common, it is such useful and suitableto use design based research in gifted education field that it enables to focus on process and context (Jen, Moon & Samarapugavan, 2015). Hence design based research really fits the aims of this study about generating a theory based practical product for gifted students and evaluating it in the real context.

In this study, problems that mathematically gifted students and their teachers face in practical contexts were explored. Based on the assumption that existing practices are inadequate for those students, solutions to this problem as differentiated tasks were provided by using design principles which are handled from both theory and practice (Van den Akker et al., 2006; Reeves, 2006). It is the fact that systematic study within the design based process presents two valuable outputs in terms of designed artifacts and scientific outputs (Herrington, McKenney, Reeves & Olives, 2007). In a similar vein, from the curricular perspective; design principles, curricular products and professional development are the three main outputs of the design research as presented in Figure 3.1 (McKenney, Nieveen, & Van den Akker, 2006).

Figure 3.1 Three main outputs of design research (McKenney, Nieveen, &Van den Akker, 2006, p.73)

Designed artifacts (Herrington, McKenney, Reeves & Olives, 2007) or curricular products (McKenney, Nieveen, & Van den Akker, 2006) of this study, is high quality interventions which are differentiated tasks developed for 5th and 6th grade mathematically gifted students to solve their educational problems in mathematics classrooms (Nieveen, 2013). In addition to this, due to the collaboration and active involvement of all practitioners, teachers' professional development (McKenney, Nieveen, & Van den Akker, 2006) is the other indirect output of this study.

Furthermore, well-articulated design principles (McKenney, Nieveen, & Van den Akker, 2006) that give details about the characteristics and working procedure of the intervention are the scientific outputs (Herrington, McKenney, Reeves & Olives, 2007) of this study (Herrington, McKenney, Reeves & Olives, 2007; Nieveen, 2013; Van den Akker, 1999).

Among those outputs, design principles, which are also called in other sources as design guidelines or design specifications, serve as both a tool and output of design based research (Mafumiko, Voogt, & Van den Akker, 2013). Tentative design principles are constructed by means of information obtained from the literature review and context analysis as the departure or guidance point in the preliminary phase of the design studies (Mafumiko, 2006; McKenney, 2001; Wademan, 2005). Through the study, these principles are implemented, developed and modified by means of the prototypes and expert appraisals. At the end of this process, final generalizable principles are obtained as the solutions for the context related problems (Van den et al., 2006). In this study, data obtained from the teachers, students and experts as well as from the context analysis and literature reviews in preliminary research phase helped to determine the initial design principles. These principles served as the characteristics of differentiated tasks for mathematically gifted students. Hence, each differentiated activity constructed, selected or adopted based on these characteristics and they were implemented during the pilot study, prototypes and fieldtesting. As they implemented, the points that need modification was specified by the teachers as practitioners of the study and they were accommodated in accordance with the discussions among the researcher and teachers. At the end of the prototypes and everlasting discussions, the final design principles were constructed, which was addressed in the findings chapter of this study. Moreover, in the following part of this chapter, this process and general phases of this design based study was presented with details.

3.2. Phases of Intervention

Although its names may differ, design based studies generally involve three fundamental stages; preliminary research phase, prototyping phase and assessment phase (Kennedy-Clark, 2013; Plomp, 2007). Some of the researchers like Masole (2011) only used its first two phases. In this study, these two phases were carried out to obtain both practical and theoretical conclusions about designing differentiated tasks for 5th and 6th grade mathematically gifted students. These phases were grouped into two as preliminary phase and prototyping phaseand development of prototypes and their modifications were concurrent during the study. First of all, some data for design and development of differentiated tasks were obtained in preliminary research phase. After this phase, for the prototyping phase, first prototype of intervention with initial draft principles were constructed. After this, prototypes were continuously modified with the formative evaluation principles (Scriven, 1967) and the new prototypes were constructed based on these evaluations to improve the intervention. At the same time, evaluations were conducted during those prototypes to obtain evidence for the effectiveness of intervention by means of the teachers and students' pre, intermediate and post interviews and forms (Nieveen, 2013). All these phases with details were presented in Figure 3.2.

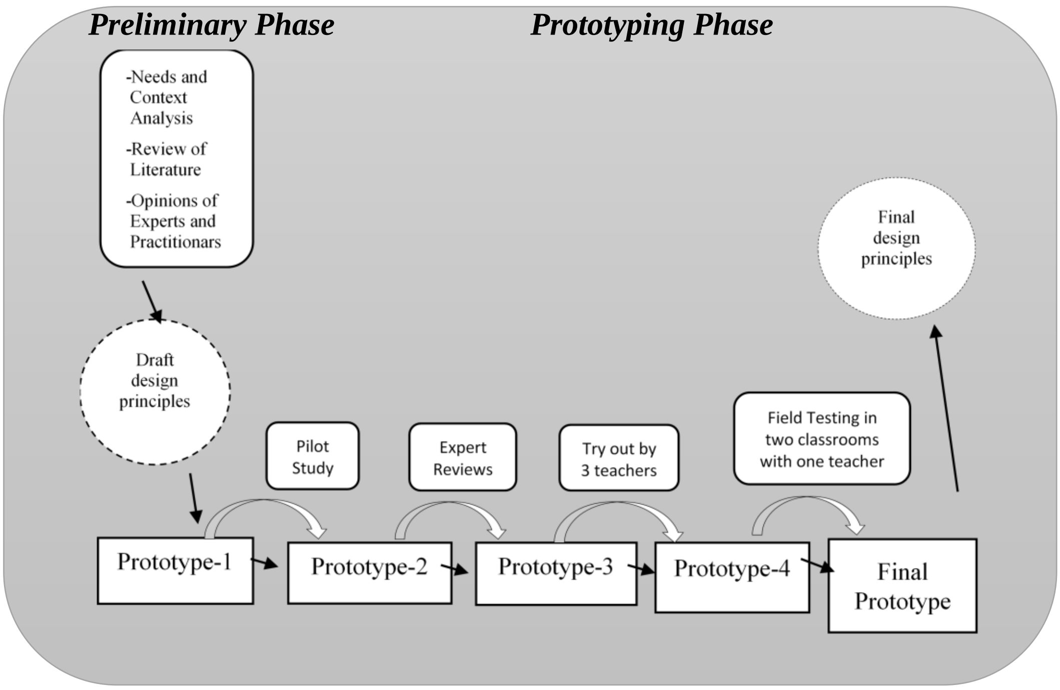


Figure 3.2 Phases of the Study

These phases in Figure 3.2 were adopted and modified from some studies (Mafumiko, 2006 p.48; Masole, 2011, p.83; Plomp & Nieveen, 2013, p.39) focusing on crucial elements of design based study. Study of Mafumiko, (2006) was used as a general framework and some ideas were adopted from other studies of Masole (2011), Plomp and Nieven (2013) who were also originated from the Mafumiko's (2006) study. Instead of versions, prototypes were used as in the Masole's study and only teachers and students were used in the samples of tryouts or field test. Moreover, some parts were replaced in line with the order of this study. For example, pilot study was conducted before expert opinions as different from the Masole's study. In addition to this, instead of reflecting the two steps of overall study as baseline survey and intervention, they were reflected as preliminary and prototyping phases.

As stated before, the phases of this study followed four criteria; relevance, consistency, practicality and effectiveness, to obtain high quality of the intervention as described by Nieveen (1999). In the preliminary phase, analysis of the context, synthesis of literature and previous research revealed that there is a real problem for mathematically gifted students that they lack the proper tasks and activities in accordance with their differentiated needs in mathematics classrooms. Moreover, literature review, context analysis, researchers' own experiences and discussion with critical people as well as experts of the field provided a logical framework as in the form of draft design principles which were based on the state of the art knowledge (Nieveen & Folmer, 2013; Plomp & Nieveen, 2013). Hence, based on these guidelines, initial form of the intervention was developed as the differentiated tasks for these students with relevance and consistency supports. After that, in prototyping-evaluation phase, usability of the tasks in real classroom environment with students was assessed and the intervention was accommodated to provide best usage in classrooms. As the modifications were made, the effectiveness of the tasks in terms of satisfying the differentiated needs of gifted students as well as teachers' professional development was assessed to see whether the desired outcomes were obtained with the help of the intervention (Nieveen & Folmer, 2013; Plomp & Nieveen, 2013). That is, continuing development was carried out and effectiveness in real practice environments was evaluated with the help of these phases (Van den Akker et al., 2006; Clark, 2013). Therefore, the intervention was evaluatedin accordance with the Nieveen's (1999) fourcriteria as summarized in Table 3.1.

Table 3.1 A summary of this study in terms of four criteria for high quality intervention (Nieveen, 1999; Nieveen & Folmer, 2013)

Phase	**Criteria**
Preliminary Phase	Relevance and Consistency
Prototyping and Evaluation Phase	Practicality and Effectiveness

To sum up, during these phases, prototypes were continually assessed regarding their content and usage in mathematics classrooms. Formative evaluation is needed for each phase to ensure the quality of the interventions and its characteristics as in the form of structured design principles (Nieveen & Folmer, 2013). To enhance the quality of prototypes, formative evaluation is conducted in classroom try outs and field test (McKenney, Nieveen & van den Akker, 2006). After completion of all phases, design research presented valuable knowledge as in the form of revised design principles and professional development of teachers as by product (Van den Akker et al., 2006). Moreover, contributions for students and teachers were the other points that resulted from the evaluations of the study. In the following subsections, these preliminary research phase and prototyping phase as methodological processes needed to design and develop differentiated tasks to develop mathematically gifted students' giftedness to the highest possible level in regular mathematics classrooms were handled in depth.

3.2.1. Preliminary Research Phase

Preliminary research is needed to both understand current situation and develop conceptual theoretical framework for the study (Kennedy-Clark, 2013). In this phase, needs and context analysis was carried out so that problems needed to be solved in real context can be defined. Gifted students' views and expectations from their regular mathematics classrooms in Turkey were received and it was seen that gifted students complain about the lack of suitable opportunities in their mathematics lessons (Aydemir & Çakıroğlu, 2013). Additionally, teachers' opinions about opportunities that they can provide to their gifted students were gotten and the lack intheir knowledge about gifted students and the need for developing proper tasks for the usage of teachers were explored (Baykoç & Aydemir, 2014). Furthermore, literature was also reviewed based on mathematically gifted students' current situation and needs as well as teachers' needs about those students and promising examples for differentiated tasks (Anderson, 2013; Baykoç, 2010; Chamberlin & Chamberlin, 2010; Fıçıcı & Siegle, 2008; Gadanidis, Hughes & Cordy, 2011; Hekimoğlu, 2004; Pierce, Cassady, Adams, Neumeister, Dixon, & Cross, 2011; Rotigel & Fello, 2004; Sternberg, Ferrari, Clinkenbeard, & Grigorenko, 1996; Tieso, 2002; Tomlinson, Tomchin, & Callahan, 1994, Wilkins et al.,2006).

As well as formal activities, informal activities like discussion with critical people, own experiences of researcher, feedbacks from conferences were also carried out to reveal the problem in context. In addition to these, consulting to an expert about gifted education field, informal interviews with school principals andteachers as practitioners were carried out to get a clear sense about students' and teachers' needs in classroom environments. Therefore, all the data obtained from those preliminary research phase provided direction and external validation for the study (Van den Akker et al., 2006; Masole, 2011) and lead to the draft design principles which was summarized in the following part of this chapter.

3.2.2. Draft Design Principles

Based on the preliminary research phase, significant points about the characteristics of differentiated tasks for mathematically gifted students were determined. That is, these characteristics were selected in line with the inferences from the preliminary research phase, especially from the literature review. Many researchers suggested some of the characteristics for the tasks as well suiting the needs of gifted students in mathematics classroooms. These points lead to construction of initial design principles as in the form of draft characteristics of differentiated tasks. Hence, these characteristics were addressed as choices for constructing differentiated tasks for 5^{th} and 6^{th} grade mathematically gifted students. That is, at the beginning of the study, these draft principles were determined that if the activity have one characteristic among content characteristics in below, it could be implemented in classrooms by using one of the characteristics in terms of applicationin below. Moreover, because characteristics were divided into two, draft design principles were divided into two as design principles in terms of content and application, as presented in below.

3.2.2.1. Draft Design Principles in terms of Content

Initial design principles in terms of content characteristics were divided into ten sections. That is, some of the characteristics mentioned below were seen as the content related characteristics of differentiated tasks and these principles were addressed in the following subsections as suggestions.

1. **Challenging:** Challenging and meaningful complexity of the tasks should be involved in gifted students' instructions so that their interest can be taken and maintained during the lesson (Chamberlin, 2002; Deizmann & Watters, 2001; Gavin et al., 2007; Karaduman, 2010; Sriraman, 2003) becausechallenging activity compels students with the appropriate difficulty.

2. **Higher level thinking:** Todifferentiate instruction proper to gifted students' needs, they should be provided with tasks promoting higher level thinking (Chamberlin & Chamberlin, 2010; Freiman, 2006; Karaduman, 2010; Sriraman, 2003). Based on revised taxonomy of Bloom, tasks at the analysis, evaluating and creating level serve this purpose and enable students to think in a higher level (Anderson et al., 2001).

   Analysis: Activities in analysis level should be involved in the gifted students' tasks. The tasks in analysis level need to break the concept into meaningful parts which comprise the whole. This should be conducted by comprehending the interrelationship of these parts both with each other and the whole (Anderson et al., 2001).

   Evaluating: Activities in evaluating level should be involved in the gifted students' tasks. The tasks in evaluating level need determination by assessing and evaluating the case depending on some principles that was settled for the case (Anderson et al., 2001).

Creating: Activities in creating level should be involved in the gifted students' tasks. The tasks in evaluating level need to construct a new and meaningful whole by bringing parts together based on the procedure followed through the meaningful steps (Anderson et al., 2001).

3. **Problem Solving:** Problem solving tasks should also be included in the education of gifted students to provide realistic and absorbing concepts which handle in mathematical ways (Freiman, 2006; Gavin et al., 2009; Greenes, 1997; Karaduman, 2010; Pierce, Cassady, Adams, Neumeister, Dixon, & Cross, 2011; Renzulli, 1986; Tieso, 2002). These problems could be non routine and real life problems, which were explained below.

   Non-Routine Problems: Nonrotuine problems are not solved by using knowledge directly and they are not ordinary problems that could be solved routine methods (Arslan & Altun, 2007). It is adviced to use these type of problems as an option for differentiated tasks of mathematically gifted students.

   Real Life Problems.Problems related with the real life and using realistic contextscan be helpful for gifted students (Johnson, 2000; Greenes, 1997; Renzulli, 1981) and it is adviced to use them as an opportunity to differentiate tasks.

4. **Technology Integration:** Most of the gifted students are very abled, motivated and successful in technology usage and the role of the technology in their motivation should be used as another option to fulfill their needs (Johnson, 2000; Siegle, 2004). Moreover, the property of technology as allowing the students to proceed at their own pace (Kaput, 1992; Özçakır, 2013) may allow them to meet their own needs.
5. **Interdisciplinary Tasks:** Interdisciplinary tasks allow integrating more than one discipline into the teaching of any concepts (Beane, 1997). Interdisciplinary tasks should be included because application of math in other fields leads to meaningful and engaging learning process as well as providing answer for related questions of

gifted students (Freiman, 2006; Greenes, 1997; Karaduman, 2010; Renzulli, 1986; Sriraman, & Sondergaard, 2009).

Mathematical History: Usage of mathematical history may be beneficial to meet gifted students' needs of learning depth and background of the concepts (Aydemir & Çakıroğlu, 2013) because gifted students have great curiosity about historical background of concepts and wonder about issues that happened in the past (Yevdokimov, 2007). Hence, including mathematical history to mathematics lessons is another choice for differentiated tasks that lead to positive views of gifted students' motivation to lesson and satisfaction withlearning reasons and depth of the mathematical concepts (Aydemir& Işıksal, 2015).

Integration of Mathematics and Science Lessons: Combining mathematics and environmental issues may be a practical way to increase environmental awareness and to provide real life applications (Aydemir & Teksöz; 2014; Jianguo, 2004). Hence, the tasks integrating mathematics and science lessons should be used as another choice for mathematically gifted students.

Integration of Mathematics and Turkish Lessons: Integration of Turkish lesson and mathematics based on objectives, concepts and thinking may take gifted students attention to see the usage of each discipline. Hence, the tasks integrating mathematics and Turkish lessons should be used as another choice for mathematically gifted students.

6. **Beyond Curriculum:** As another option, content of the tasks should be beyond the curriculum to fulfill gifted students need in learning more (Rotigel & Fello, 2004; Johnson, 2000; Karaduman, 2010). Beyond curriculum activities aim to realize, discover, teach or use any mathematical concepts that are ahead of regular sub learning domain curriculum according to students' grade level.
7. **Interesting Task:** Gifted students need engaging tasks that catch their interests to get rid of boredom and lost in classrooms since they may not always have intrinsic motivation (Karaduman, 2010; Wilkins et al., 2006; Johnson, 2000). Thus,

interesting tasks should be presented to gifted students so as to take their attention and increase their motivation to the tasks.

8. **Intelligence Question:** Providing intelligence question, which one should think in depth and cautiously to provide a proper and meaningful answer, to gifted students is another opportunity that meet their needs to think more and worry about answer (Baykoç, 2010; Johnson, 2000; Freiman, 2006).
9. **Math Puzzle**: Math puzzle, which is an activity that requires mathematics to solve and have some specific rules that the solver must find a solution that satisfies the given condition, is another opportunity for gifted students to differentiate their tasks (Freiman, 2006; Gavin, 2009).
10. **Mathematical Modelling:** Mathematical modeling problems are complicated processes that need to think critically and mathematically in order to reach a goal by using conceptual tools and multiple interpretations developed through the process (English; 2003; English & Watters, 2005). This complicated process may arouse mathematically gifted student's attention and develop their thining skills. Hence, modelling activities should be provided to gifted students as another option to fulfill their needs in classroom.

To conclude, these ten characteristics were determined as characteristics in terms of content for the differentiated tasks of mathematically gifted students. In line with these, content of all forty-tasks used in this study were prepared considering these characteristics. By this way, each of the tasks had at least one of these content related characteristics. In addition to these, some characteristics in terms of application of these tasks in classrooms were also determined. In the following section, thesecharacteristics were addressed as draft design principles in terms of application.

3.2.2.2. Draft Design Principles in terms of Application

In addition to principles in terms of content, design principles obtained from preliminary research phase also offer characteristics in terms of application. These initial draft design principles in terms of application characteristics were divided into seven sections. That is, some of the characteristics mentioned below were seen as the application related characteristics of differentiated tasks and these principles were addressed in the following subsections as suggestions for implementation.

1. **Whole class activity:** It is adviced thatteachers mayuse differentiated tasks in their regular instructions that all students in classroom can benefit (Chamberlin & Chamberlin, 2010).
2. **Individual task for gifted student**: Differentiated tasks maybe provided separately to gifted students as an extra individual work when gifted ones complete their tasks (Chamberlin & Chamberlin, 2010).
3. **A mathematics center:** As another option, “A Mathematic Investigation Center” maybe created **(**Wilkins et al., 2006, p. 7) in clssroom. Teachers can bring some challenging or interesting tasks in that center, or students themselves can prepare for each other (Diezmann, & Watters, 2001; Hannah et al. 2011; Sriraman, & Sondergaard, 2009). Thus, the students can benefit from differentiated tasks by means of this center.
4. **Group working activity:** Cooperative and group learning both enables gifted students to work together and provides improvement for other students (Baykoç, 2010; Chamberlin & Chamberlin, 2010; Deizmann, & Watters, 2001). Teachers mayuse both homogenous and heterogeneous groups based on their aim for the differentiated tasks.
5. **Project based task:** As another application method, tasks maybe given to gifted students as projects that they should be completed as individual or as a group in the specified timeline with specified requirements through the process (Diffily, 2002; Stanley, 2012).
6. **Usage of Some Teaching Methods: Discussion, Discovery and Questioning:** Preliminary research phase offered some teaching methods that are more appriopriate for the usage of the differentiated tasks in classrooms. These are discussion, discovery and questioning methods that the teachers may use these methods while providing differentiated tasks to their gifted students. Among those, discussion method helps to extend gifted students’ knowledge and meets their need of elaborating more on the concepts by communicating with others (Johnsen & Ryser, 1996). Moreover, discovering concepts by the help of abstract materials

may catch gifted students' interest and fulfill their needs to learn the logic and rationale behind the concepts and procedures (Johnson, 2000; Wilkins et al. 2006; Van de Walle et al., 2013). Lastly, questioning method by involving why, how and what if questions may help to probe students' thinking and satisfy their need for learning and thinking more and depth (Johnson, 2000; Sriraman & Sondergaard, 2009).

7. **Assignment:** Differentiated tasks might be provided to gifted students as assignments leading them to use their creativity and higher order thinking (Johnson, 2000). Teachers can give differentiated assignment to gifted students in their classroom or they may provide options to all class and want them to select one of them as assignment, where gifted ones will most likely select the differentiated ones while others prefer easier and routine ones. As another suggestion, teachers may provide these as an extra assignment as well as routine assignments of all students.

In this study, all these application characteristics were determined for the usage of differentiated tasks in classrooms. By this way, a general framework was provided that the activities having content related characteristics could be applied with one of these application related characteristics.

To sum up, these are the initial and draft characteristics of differentiated tasks for 5th and 6th grade mathematically gifted students as in the form of draft design principles. These design principles were designed within the scope of content and application of these tasks. Through the design based process, these draft principles were applied in classrooms and developed based on the opinions of practitioners, researcher and experts. That is, these principles were developed throughout the phases with the help of formative evaluations. In the following section, these phases and their crucial points were specified.

3.2.3. Prototyping Phase

Based on findings from preliminary research phase, differentiated tasks were designed anddevelopedduring the prototypes (Kennedy-Clark, 2013; Masole, 2011;

Van den Akker, Branch, Gustafson, Nieveen& Plomp, 1999). Prototyping helps to solve the problems in real life by evaluating and revising the design products systematically (McKenney, Nieveen &van den Akker, 2006). In the prototyping process of this study, collaboration between researcher, experts and teachers helped to obtain the most structured shape of the design principles as differentiated tasks and to develop these tasks with respect to 5th and 6th grade mathematically gifted students in mathematics classrooms (Masole, 2011). In the following sub-parts of this section how prototyping procedures, reforming of design principlesas as well as determination of practicality and effectiveness of differentiated tasks was addressed.

3.2.3.1. Prototype-1 and Pilot Study

Initial design principles emerged from preliminary research phase shed light on the prototype-1 as differentiated tasks. That is, as prototype-1, draft forms of forty differentiated activities were designed in line with the guidelines of the design principles. After regulating Prototype-1, it was pilot tested in two 5th and one 6th grade regular mathematics classrooms in a private school which was in the Çankaya District of Ankara in the fall semester of 2014-2015 Educational Years. The aim of this pilot study was to explore gifted students' reflections as well as appropriateness and understandability of such tasks in classroom environments. Differentiated tasks were used as a part of the regular lessons and they were called as "task of the week" in mathematics lessons. During this process, researcher had multiple roles as researcher and teacher because I was the mathematics teacher of the classrooms. This may be seen as an advantage in terms of increasing the chance of evaluator effect and gaining deeper insights about strengths and weaknesses of materials (Patton, 1990; McKenney, Nieveen, & Van den Akker, 2006; Van den Akker et al., 2006). Additionally, this both "designer and developer; the facilitator and evaluator" (Kennedy-Clark, 2013.p.28) role of the researcher provided many gains that I was able to observe all students' reflections directly as well as gifted ones. By this way, I could immediately make modifications to the tasks when needed and I could see the tasks from the teachers' viewpointsbecause I developed them as a researcher.

These tasks were used during one semester and when the researcher faced problems, revisions were made at that moment. Additionally, after completion of the semester, semi structured interviews with mathematically gifted students were carried out and their opinions about usage of those tasks in mathematics courses were explored. Data obtained from those interviews was compared with observation notes which researcher-teacher took during the semester. Hence, tasks were revised in line with the problems, such as ambiguity of items, time management, language, grade level problems and students' individual opinions about each task (Masole, 2011).

3.2.3.2. Prototype-2

Based on data obtained from Prototype-1, required modifications were done and prototype-2 was designed. After that, appraisal of Prototype-2 to four experts was consulted based on the idea that "size and type of research team depends on the purpose of the research" (Kennedy-gtClark, 2013, p. 28). Three of the experts were in the field of mathematics education while the fourth one was in the field of gifted education and each of the experts individually assessed the tasks. Besides, parallel evaluations were made through one to one interviews to evaluate the content and technical adequacy of tasks (Masole, 2011). The differentiated documents were provided to experts to analyze them with regard to some critical issues important for the gifted education. The documents included following tables and checklists:

- Differentiated activities for gifted students
- A table about characteristics of each differentiated tasks (design principles) (Last version of characteristics in Appendix A)
- Explanation of the characteristics with related references
- Related objectives for these activities from middle school mathematics curriculum (MoNE, 2013) (Appendix B)
- A table for operational definitions about characteristics of differentiated tasks
- A table for possible classroom usage of those activities (Appendix C)
- A checklist which the researcher would like from experts to check about the suitability of tasks (Appendix D)

Hence, prototype-2 was assessed by the experts in terms of mathematical background, suitability for gifted students; usability in mathematics classrooms and characteristics of tasks. Their ideas and suggestions were taken into account to make proper revisions for the prototype-3. Furthermore, collaboration with experts as well as practitioners helped to revise design principles and develop more suitable tasks for solving context based problems (Cobb et al., 2003; Masole, 2011). Hence, this stage provided validity and practicality of the differentiatedtasks for mathematically gifted students because experts assessed them in terms of both content and practicality in classroom environments (Plomp & Nieveen, 2007).

3.2.3.3. Prototype-3: Try outs

After completion of the process with expert reviews, prototype-3 was developed by taking their feedback and revisions into consideration. Following to this development, third prototype was tried out in four classrooms by three mathematics teachers concurrently in a public school in the spring semester of 2014-2015 Educational Years. This public school was a middle school in the Altındağ District of Ankara, the classroom sizes were approximately twenty-five for each classroom and the families of the students had generally low socio-economic status. Moreover, the academic success of the school was not in good position and the school was placed in a lower social class environment that it was one of the reasons for the researcher to select this school. That is, the researcher purposively selected this school due to two main reasons: one of them is the purposive selection of one of the teachers, who will be described later. The other reason was such that as the researcher, I conducted the pilot study in a private school with students whose families have high socioeconomic levels. For the try outs, I would like to observe the case for the public school and test the tasks whether it works even in a school having low academic success and this enabled me to increase the generalizability of my design and findings.

As stated before, one of the teachers as the participant of this study was selected purposively; she was an effective teacher that uses student centered teaching in her classrooms. Moreover, she was experienced about conducting a research study due to her master's thesis and she was experienced in development of 5th grade mathematics curriculum and textbook. After purposive selection of this teacher, two other teachers, one of them is a male and other is a female teacher, from the same school were selected conveniently. All three teachers were in their thirty something and at least eight years experienced in teaching mathematics. A summary for the the information about these teachers were given in Table 3.2.

Table 3.2 A Summary of Characteristics of Teachers in Try-Outs

Teachers	**TS (Teacher1)**	**TN (Teacher2)**	**TM (Teacher3)**
Gender	Female	Female	Male
Professional Qualification	Master's Degree	Bachelor's degree	Bachelor's degree
Teaching Experience	10 Years	8 years	12 years

When it comes to process and data collection procedure of try outs, within the framework of design based research, triangulation strategies in data collection was used to get a holistic idea about design, development and evaluation process of tasks in terms of both students' and teachers' viewpoints (Masole, 2011; Maxcy, 2003). For this aim, some specific data collection instruments were used as summarized in Table 3.3. It is more meaningful to combine the items when any instruments do not match with the points that you aim to explore (Masole, 2011). Hence, they were constructed by integrating and modifying the items from other sources as well as new constructed ones. To sum up, interviews, observations and document analysis was used to reach both the research and methodological objective of the study.

Table 3.3 A summary of the Data Collection Instruments in Try-outs

Data Obtained from Teachers' Data	**Data Obtained from Students' Data**	**Data Obtained from Researcher's Data**
Pre-interviews Informal talk Post-interviews After sheet forms Unstructured interviews	Pre-interviews Informal talk Post-interviews After sheet forms Assessment forms Unstructured interviews	Observation Logbook Audiotapes

At the beginning of the try outs, first of all, researcher conducted a meeting with three teachers and school administrator to informthem about the aim of the study. After this meeting, at the beginning of the try outs, individualized semi structured pre-interviews were carried out to obtain teachers' initial ideas, current state of their knowledge and awareness about gifted students and gifted education (See Appendix E). After those interviews, another meeting with teachers was also conducted. In this second meeting, teachers were informed about the properties of gifted students and differentiation practices needed in classrooms. In addition to these, each teacher was given a book about gifted students and they were wanted to skip this book to learn gifted students more. Most importantly, differentiated tasks with tentative design principleswere given to the teachers. They were wanted to examine each activity in terms of suitability for their classrooms and how they can use those in their classrooms. By the way, while examining these tasks in a week, teachers were asked to nominate students that reflect properties of mathematical giftedness in their classrooms. After this nomination, Test of Mathematical Abilities of Gifted Students (TOMAGS), whose adaptation to Turkish language was conducted within the scope of this study, provided in the data analysis part of this chapter, was implemented to all of the studentsin these classrooms so as to identify mathematically gifted students in classrooms. Among those, the ones having the high and very high possibility of mathematical giftedness were determined based on the TOMAGS scores as well as teachers' nomination. The information about the students in the classrooms was given in Table 3.4.

Table 3.4 A Summary of Characteristics of Participants in Try-Outs

Students	**C1 Classroom-1**	**C2 Classroom-2**	**C3 Classroom-3**	**C4 Classroom-4**
Grade level	5th grade	5th grade	6th grade	6th grade
Number of Students	26 students	29 students	31 students	29 students
Number of Gifted Students	1 student	3 students	2 students	1 student

When all is said and done, the teachers' ideas were again taken in their informal talks. In those interviews, their ideas about the students who were found as high or very high possibility of mathematically gifted in TOMAGS were obtained. Moreover, the teachers were asked about their prior opinions about the differentiated tasks and their implementation in classroom. They shared their modifications and suggestions for the activities so as to obtain more valid and practicable activities and the parts that need modification werereviewed together. After that, they were wanted to specify their selection and usage of tasks in classrooms. Hence, the teachers determined the usage of each task and a timetable that specifically notify which activity would be used in which lesson was constructed together. Due to individual curriculum requirements and individual characteristics, each teacher wanted to construct their own timetable. Additionally, for each activity, teachers also specified their application method which was determined as design principles in terms of application.

After these processes, they tried out the tasks in their regular mathematics lessons through six weeks. During this process, teachers and researcher were continuously involved in an interaction. They shared opinions about the content, corrections, usability and suggestions for tasks by means of unstructured interviews. Hence, the activities were continuously revised in line with the needs of the teacher and students as well as the classrooms, which were mentioned in the evaluation section of this chapter. By this way, during this try out process, researcher and teachers collaboratively assessed and developed those tasks (Masole, 2011) and the activities were continuously revised so as to obtain most suitable activities for satisfying mathematically gifted students' needs in classrooms and mathematics classroom environment. Hence, tasks' success was measured by its practicality in real contexts (Gravemeijer, 2006). In addition to these formative evaluations, when try outs were completed in six weeks, semi-structured post interviews were carried out with the same teachers so as to reveal their awareness about mathematically gifted students, differentiating opportunities for these students and usage of the tasks in their own classrooms as well as students' reflections to these tasks (See Appendix F). That is, in order to compare the initial state of the teachers with the current state of their knowledge and awareness, post interviews were conducted.

On the other hand, when it comes to other participants of these tryouts, the students, especially the ones who was selected as mathematically gifted in this study, were the other rings of the chain. That is, they were interviewed at the beginning of the study about their ideas on mathematics lessons, their needs and expectations about this lesson (See Appendix G). As the process progress, unstructured interviews were also carried out when the researcher needed to make the issues obtained in observations, students' sheets or forms more explicit. At the end of the process, as teachers, the semi-structured post interviews were carried out with these students in order to learn their experiences through the process, their opinions about regular mathematics lessons and usage of these tasks in their lessons (See Appendix H). Hence, as seen from the procedure, interviews were most frequently carried out and they were audio-recorded so as to obtain rich information from both the teachers and students.

When it comes to written documents, both the teachers and the students were asked for filling some forms through the process. First of all, the teachers were wanted to fill the "teacher after sheet" forms after each activity (See Appendix I). Their ideas about content, usability, difficulty or benefits of each activity were taken in these forms immediately after completing the task. Likewise, students' opinions, how s/he felt during the activity and which solution strategy s/he used for each task were also handled with the help of "student after sheet" forms (See Appendix J). They filled the after sheet forms immediately after each activity as well as recording their answer-sheets. At the end of six weeks, the students' last ideas about the activities were also gathered by means of the "student assessment form" to check, support and triangulate the data in post interviews (See Appendix K).

In addition to these, the researcher made observations during all process of the study and used log-book to record the activities carried out in classrooms. The researcher used this log-book to take her field notes like difficulties that the teacher experienced during the intervention, the students' nonverbal reflections or the points that need correction. Moreover, all the lessons were audio-typed in order to analyze or check the details later on. The researcher gathered all these data obtained from observations in log-book and audio recording to reveal the significant points in terms of characteristics, practicality or effectiveness of the differentiated tasks for the usage in 5th and 6th grade mathematics classrooms. Moreover, this data also enabled the researcher to analyze the cases in a chronological order. To sum up, all these data collection procedures were carried out to obtain a holistic data about the development of differentiated tasks and its evaluation in terms of mathematically gifted students' and teachers' experiences, as well as practicality and effectiveness in mathematics classrooms. By this way, the process of tryouts was completed to form the fourth prototype which was explained in the following section.

3.2.4. Prototype-4 and Field Testing

As stated above, third prototype was tried out with three different teachers in one public school and the fourth prototype was constructed with the necessary revisions. After this step, fourth prototype was field tested in order to explore the practicality and effectiveness of differentiated tasks in terms of satisfying 5th and 6th grade mathematically gifted students' needs in mathematics classrooms. In this process, fourth prototype was applied by a different teacherin a different public school. This public school was a middle school from the Yenimahalle District of Ankara. As explained earlier, the pilot study was carried out with students from a private school in the Çankaya district of Ankara while the tryouts were conducted in a public school in the Altındağ district of Ankara. As the researcher, I wanted to see the tasks' usage, practicality and effectiveness with the teachers and students from different social economic classes. Hence, in the field test, the teacher was purposely selected from one of the schools placed in middle social class environment due to her experience in conducting a research in her master's study and 9 years' experience in effective teaching. The teacher used the activities through five weeks in her regular mathematics lessons and general process of this field testing was similar to the try-outs. However, this time, the teacher was the focus point that the researcher didn't provide immediate revision to the classroom usage or to the activities. It was aimed to see usability and effectiveness of the activities in any mathematics classrooms with the teachers'own efforts. During the study, the teacher used and developed the tasks in terms of students' reactions and her own experiences with tasks.

When it comes to the detailed procedure of this field testing, as similar to the try-outs, first of all, mathematically gifted students were determined by means of TOMAGS (Ryser & Johnsen, 1998) as well as teacher nomination. The information about these students in the classrooms were given in Table 3.5.

Table 3.5 A summary of Characteristics of the Students in Field Test

Classroom	**C5** **Classroom-5**	**C6** **Classroom-6**
Grade Level	5^{th} grade	6^{th} grade
Class Size	28 students	33 students
Number of Gifted Students	2 students	6 students

After this process, again similar to try outs, the teacher was pre-interviewed and then informed about the properties of gifted students as well as their specific differentiated needs in regular classrooms. After this short training period, the differentiated tasks were introduced to teacher and she was informed about specific characteristics of these tasks for her own classrooms. Through one week, the teacher analyzed the tasks and then, researcher and teacher made a timetable and they scheduled the activities in teacher's own lesson plan. For this time, classroom observations were carried out by the teacherin order to put the researcher on the back burner. By doing this, it was aimed to see clearly whether the tasks are usable for a regular teacher in a regular classroom without researcher's direct suggestions. She also collected the after sheet forms from her own students after each activity and filled the teachers' after sheet form after each activity. In leisure times of the teacher, researcher and teacher continuously interacted and made revisions to the tasks. After five weeks, field test was completed and mathematically gifted students were post-interviewed to reveal their opinions about usage of these tasks in their mathematics lessons. Additionally, the teacher was interviewed to reveal her opinions about independent usage of these tasks in her own classroom, her experiences, suggestions and also students' reflections about tasks. In the following part of this chapter, how the data obtained from these processes was anaysed was presented as data analysis procedures of the study.

3.3. Data Analysis Procedures

In this part of the chapter, data analysis procedures for both adaptation of Test of Mathematical Abilities for Gifted Students (TOMAGS) and general design based process were addressed.

3.3.1. Data Analysis Procedure for the Adaptation of Test of Mathematical Abilities for Gifted Students (TOMAGS)

During the design based process, some of the students in classrooms were identified as mathematically gifted in the pilot study, try outs and field test by means of TOMAGS. For this identification process, as stated before, adaptation of TOMAGS to Turkish language was conducted before actual study. Thus, in this sub-section, the process with the required sample and data analysis methods for this adaptation requirement were explained. Before going on the data analysis procedure for this adaptation, in the first three sections; brief information, reliability and validity information, administration and interpretation procedure about TOMAGS were explained with detail.

3.3.1.1. Brief Information about TOMAGS

Test of Mathematical Abilities for Gifted Students (TOMAGS) is a standardized and norm-referenced test that aims to identify students who are talented or gifted in mathematics (Callahan, 2006; Ryser & Johnsen, 1998). The test has two distinct parts as primary and intermediate levels. Primary level is for students whose ages range from six to nine years while the intermediate level is for the nine to eleven years old students. In this study, the parts developed for the students in intermediate level were used as the initial step for the identification of the mathematically gifted students. Hence in this section, the information regarding TOMAGS-intermediate was presented.

TOMAGS-intermediate is an assessment tool that uses 47 open ended questions in a problem-solving format with appropriate difficulty that could test the limits of the gifted students. These forty-seven questions are in the learnig domains of numbers and operations, geometry and measurement and statistics and probability. Furthermore, students' capability to transfer their mathematical knowledge in novel situations or their ability to produce new strategies as a solution for a problem is assessed in this test (Ryser & Johnsen, 1998). TOMAGS satisfy the needs of researchers who need to use standardized instruments about mathematical giftedness could be used as an identification instrument for mathematically giftedness due to its strong validity and reliability scores (Ryser & Johnsen, 1998). The test consists of items that the students should reason mathematically and use their problem-solving skills as well as mathematical thinking and it is developed based on the curriculum standards as well as characteristics of gifted students obtained from the literature (Sriraman, 2008). Three curriculum standards of NCTM; mathematical problem solving, mathematical communication and mathematical reasoning were reflected in construction of TOMAGS. Furthermore, these standards are aligned with the basic skills that are targeted to be developed in mathematics curriculum in Turkey (MoNE, 2013).

3.3.1.2. Reliability and Validity of TOMAGS

TOMAGS gives desirable results in terms of being a reliable and valid instrument. More specifically, to evaluate the reliability of TOMAGS, three types of errors were investigated due to their effect on the reliability of the instrument as content sampling which indicates the degree of homogeneity, time sampling which reflects the constancy over time and scorer differences which means errors caused by scoring differences. Results of the TOMAGS demonstrated high reliability in all three types of error as seen in Table 3.6 because reliability coefficients approximating or exceeding .80 are found reliable and .90 or above found as most desirable (Ryser & Johnsen, 1998; Salvia & Ysseldyke, 1995). Hence it was concluded that the results of TOMAGS could be used confidently (Ryser & Johnsen).

Table 3.6 A summary of TOMAGS reliability related to three sources of test errors (Ryser & Johnsen, 1998, p. 28).

	Sources of Test Error				
	Content Sampling		Time sampling	Scorer	Average
	Normal	Gifted			
TOMAGS Intermediate	.88	.86	.94	.99	.93

When it comes to validity studies of TOMAGS, it was examined in terms of content, criterion and construct validity. To be more precise, for the content validity of TOMAGS, two methods were used. First of all, content and format selection, were based on the principles from the NCTM standards as well as in depth literature review. Moreover, TOMAGS went through a process consisting of pilot testing and rewritten several times. After these processes, best items were taken in the last form of the TOMAGS. Secondly, classical item analysis as in the form of median item discrimination was conducted and the coefficients of .2 or .3 found as acceptable according to Anastasi and Urbina (1997). The results from this analysis, provided in the Table 3.7, indicated the quantitative evidence of content validity.

Table 3.7 Median Discrimination Powers for the TOMAGS Intermediate (Ryser & Johnsen, 1998, p. 34).

	Age				
	9	**10**	**11**	**12**	**All**
Normal	.30	.34	.42	.33	.33
Gifted	.32	.35	.32	.32	.31

Criterion related validity of TOMAGS was also examined by correlating it with other test scores. That is, two concurrent validity studies were conducted with Cognitive Abilities Test (CogAT, Thorndike & Hagen, 1986) with 55 children and Mathematics Total score of the Iowa Tests of Basic Skills with 38 children identified as gifted in mathematics (ITBS, Hieronymous & Hoover, 1985). All the results were statistically significant that they support the concurrent validity of TOMAGS-Intermediate as seen in Table 3.8.

Table 3.8 Correlation Between TOMAGS Intermediate and Selected Tests (Ryser & Johnsen, 1998, p. 35).

Criterion Measures	**TOMAGS Intermediate**
CogAT Quantitative Battery	.67
ITBS Mathematics Total	.44

Lastly, to ensure construct validity; group differentiation, factor analysis, item bias and item validity were conducted. Based on the idea that, TOMAGS could differentiate the mathematically gifted students and the other ones, statistically significance was seen between the students identified as gifted and not. Moreover, in factor analysis, due to the fact that TOMAGS was aligned to the NCTM standards, it was seen that the items were load on factors related to standards. Item bias was another dimension for the construct validity and it was tested via the performances of subgroups in the sample and it was seen that items involve little or no bias between the groups. As a last steep, item validity was supported by selecting good items and strong evidence was found in the discriminating powers. Hence, they all indicated that TOMAG is valid that it could be used confidently (Ryser & Johnsen, 1998).

3.3.1.3. Administration and Interpretation Procedure of TOMAGS

TOMAGS could be administrated as individually or as group whose size is not more than twenty-five. There is no time limitation for the administration of TOMAGS thatthe students can use it as much time as they need. In a general sense, TOMAGS provides students' scores in three forms as raw scores, percentiles and quotients. After students completed the test, their raw scores could be calculated by giving 1 point to the correct responses while giving 0 point to the incorrect ones. After that, it is crucial to calculate students' age in years, month and days. Hence, these two information helps to obtain quotient scores and percentiles by means of the tables converting raw scores to quotations or percentiles, which was provided in the TOMAG examiner manual. After that, interpretations could be made by using these results as well as guidelines for interpreting quotients tables. After this process, TOMAGS provide information about assessing talent in mathematics as in the form of "Very Low", "Low", "Average", "High" or "Very High" probability of mathematical giftedness. In the identification part of this study, these steps were followed and the students'' quotients were interpreted to determine their giftedness. For this aim, the guidelines, some parts were presented in Table 3.9, from the TOMAGS Examiner's Manual were followed.

Table 3.9 Guidelines for Probability of Mathematical Giftedness (Ryser & Johnsen, 1998, p.17).

Quotient	% Included	Probability of Mathematical Giftedness
>130	2, 37	Very High
121-130	6, 87	High
111-120	16, 12	Average
90-110	49, 51	Low
80-89	16, 12	Very Low
70-79	6, 87	
<70	2, 34	

3.3.1.4. Adaptation of TOMAGS to Turkish Language

In this section, the psychometric properties in the adaptation to Turkish language process of TOMAGS was presented. Adaptation process of achievement tests includes steps that shows great similarity to the adaptation process of measurement tools. Hambleton (2002) states that there are some steps that make the adaptation process of an achievement test successful. In this study, these steps which were summarized below were followed respectively.

First of all, expert opinion about the similarity of psychometric structure both in its original and target language was taken because it is expected that the meaning of the actual language and target language of the psychometric structure that was aimed to be measured should be as far as similar. It could be said that the implementation process was appropriate due to similarity in behavioral manifestation of the structure in two cultures. Secondly, it was ensured that adaptation is the best option. Development of a new adaptation is the alternative for adaptation, however, it was more meaningful to adopt a current measurement tool who has enough psychometric properties. Thirdly, as it is proposed by Hambleton (2002), before the implementation, the tool was studied with the language experts that know the two language very well. Due to the fact that it is crucial to save the equivalence of measurement tool, translators should know the two language very well; even they should be knowledgeable about the psychometric properties of tool. Hence, three distinct translators; expert on the English language, mathematics education and measurement and assessment field examined the tool. Fourthly, translation and adaptation of measurement tool was conducted. This was followed through some steps. For example, forward translation was carried out from the original language to target language. Then, back translation was conducted from the target language to original language. By this way, original content was compared with the content in back translation and they were found as equivalence and proper for implementation in terms of language. Fifthly, content of adaptation was examined because direct translation is not enough for the implementation process; hence, it is needed to make some changes so as to provide cultural equivalences. Hence, original form and after translation form were compared and the differences were discussed to obtain the final form of the tool. As the last step which Hambleton (2002) proposes, adopted measurement tool was implemented with students. Evidences for the reliability and validity of the measurement tool, that had many steps up to this point, should also be supported by experimentally. Within this scope, this measurement tool was implemented with the sample as similar to the sample in its original language and the evidences obtained from this implementation were provided in the remaining part of this section.

As sampling procedure, convenient sample was used in the study. Five hundred sixty-three students from different schools in different cities of the country; Ankara, Karaman, Karstamonu and Marmaris, constituted the sample, which was provided in Table 3.10 and 3.11. The data about students' ages in terms of year and month was obtained from each participant. Among those, three hundred eight of them (54,9 %) were male while two hundred fifty-three of them (45,1 %) were female. The average age of the male students was 10.95 years and 6.27 months while the average age of the females was 10.96 years and 6.13 months. When the risk that test results could be effected from the ages for developmental period of the students was taken into consideration, it could be seen that the groups had balanced distribution in this regard.

Table 3.10 A summary about the cities of participants

City	Number of Students	Percentages
Ankara	391 students	69,4 %
Karaman	147 students	26,1 %
Kastamonu	17 students	3,1 %
Marmaris	8 students	1,4 %

Table 3.11 A summary about the participants of the TOMAGS study

Type of the School	City	Number of Students	Percentage
Public School	Ankara	177 students	46,4 %
Public School	Ankara	84 students	
Private school	Ankara	61 students	38, 4 %
Private school	Karaman	147 students	
Private school	Marmaris	8 students	
Science and Art Center	Ankara	10 students	15,3 %
Science and Art Center	Kastamonu	17 students	
School for Gifted Students	Ankara	59 students	

In addition to all these data, reliability and validity studies within the scope of adaptation process were also carried out by using the data obtained from 561 students, who was completed the test with forty-seven items. Results for the Psychometric evidences gathered from this analysis were presented in the following part of the chapter.

3.3.1.5. Results and Psychometric Properties of Test for Adaptation Process

Based on the analysis obtained from the measurement tool, the properties of the distribution, respondent and item-based analysis as well as evidences for validity and reliability were provided in the following sub-sections.

3.3.1.5.1. Distribution and Item Analysis

Distribution of the results with respect to total points that 563 students obtained within the scope of this study was given in Figure 3.3 below.

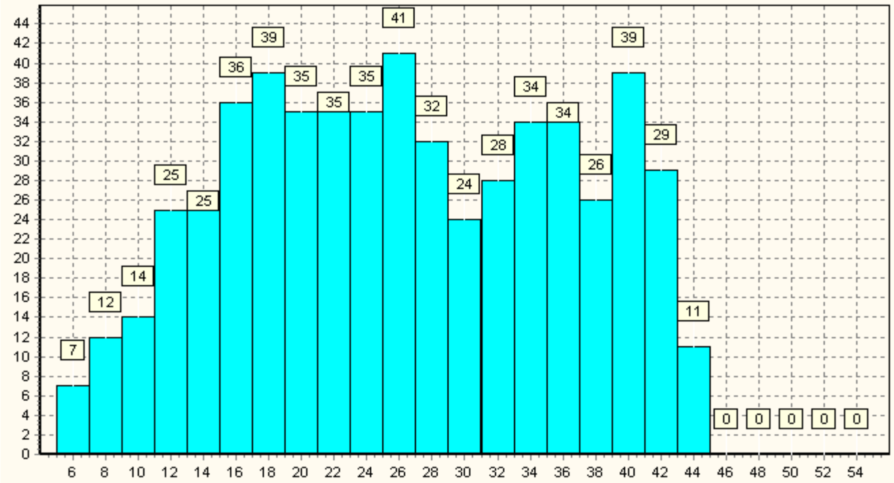


Figure 3.3 Distribution of the total points of 561 students

When the distribution given in Figure 3.3 was examined, it was seen that although it is some kurtosis with respect to the normal distribution, it showed normal distribution with respect to general properties. The other properties regarding this distribution were provided in the Table 3.12 below.

Table 3.12 Values for the distribution of items

Variable	**Value**
Number of Respondents	561
Possible Max Score	47
Minimum Score	5
Maximum Score	44
Median Score	25,00
Mean Score	25,75
Standard Deviation	10,01
Variance	100,25
Skewness	-0,008
Kurtosis	-1,066

Based on the results of the study, it was seen that the responders who have the lowest number of correct answer responded 5 items as correctly, while the responders who have the highest number of correct answer responded 47 items as correctly from the test who involves totally 47 items. The distribution shows rather similarity to the normal distribution due to the fact that median is 25,00 while the mean is 25,75. Another indicator revealing this idea is that; skewness coefficient was calculated as -0,008 and kurtosis coefficient is also calculated as -1,066. Accordingly, because of the fact that both the kurtosis and skewness coefficients are between +2 and -2 (George & Mallery, 2010) it can be said that the distribution shows the characteristics of normal distribution.

Test analysis examines how the test items perform as a set. Item analysis investigates the performance of items considered individually either in relation to some external criterion or in relation to the remaining items on the test" (Thompson & Levitov, 1985, p. 163). Item analysis is a process which examines student responses to individual test items in order to assess the quality of those items and of the test as a whole. Item analysis is also valuable in improving items which will be used again in later tests, but it can also be used to eliminate ambiguous or misleading items in a single test administration and provides evidences for validity. The characteristics of the items in the test were given in Table 3.13 below. Item difficulty and item discrimination index can be seen in this table.

Table 3.13 Item difficulty and item discrimination index for the study

Item	Correct Responses	Item Difficulty	Item discrimination index
1	504	0,90	0,28
2	481	0,86	0,30
3	264	0,47	0,92
4	253	0,45	0,91
5	435	0,78	0,51
6	308	0,55	0,82
7	321	0,57	0,82
8	326	0,58	0,79

Table 3.13 (Continued)

9	341	0,61	0,84
10	314	0,56	0,75
11	285	0,51	0,89
12	224	0,40	0,74
13	216	0,39	0,57
14	234	0,42	0,74
15	247	0,44	0,78
16	481	0,86	0,37
17	218	0,39	-0,61
18	351	0,63	0,58
19	105	0,19	0,42
20	454	0,81	0,47
21	309	0,55	0,81
22	470	0,84	-0,43
23	337	0,60	0,47
24	376	0,67	0,44
25	512	0,91	-0,28
26	512	0,91	-0,27
27	166	0,30	0,55
28	189	0,34	0,46
29	355	0,63	0,75
30	391	0,70	0,63
31	353	0,63	0,80
32	153	0,27	0,63
33	158	0,28	0,74
34	192	0,34	0,70
35	194	0,35	0,74
36	517	0,92	0,16
37	130	0,23	0,52
38	218	0,39	0,72

Table 3.13 (Continued)

39	81	0,14	0,47
40	221	0,39	0,79
41	506	0,90	0,21
42	461	0,82	0,42
43	299	0,53	0,65
44	374	0,67	0,51
45	241	0,43	0,59
46	216	0,39	0,56
47	151	0,27	0,46

When the values in Table 3.13 were examined, it can be seen that the item discrimination of the 17th, 22th, 25th and 26th items are negative in value. In this respect, these items' ratio of correct response in the high performance group was lower than the ratio of correct response in the poor performer group in terms of total score of the test. Therefore, among totally forty-sevenitems, four of them have an undesired qualification with regard to item discrimination. Psychometric characteristics which was obtained when the items were handled as groups were presented in Table 3.14 below.

Table 3.14 Psychometric characteristics for the groups

Variable	**Value**
Number of Items	47
Mean Item Difficulty Index	0,548
Mean Item Discrimination Index	0,525
Mean Item-Total Score Biserial Correlation Coefficient	0,457
Mean Item-Total Score Posint Biserial Correlation Coefficient	0,425
Minimum Number of Correct Responses in High Performance Group (n=161)	34
Maximum Number of Correct Responses in Low Performance Group (n=158)	18

As it can be seen in the Table 3.14, average item difficulty of the test was found as 0,548, which is very close to the value of 0.50. It is the fact that item variance takes its maximum value when the item difficulty is 0,50; hence, this case that the item difficulty is very close to the 0,50 is a positive conclusion for the psychometric characteristics of the test because 0,50 as item difficulty make the item variance its maximum value that is 0,25.

When it comes to item discrimination, it was calculated with three distinct methods; differentiation level of the correct response rate in the high-performance and low-performance groups via bi-serial and point bi-serial correlation coefficients. The method of extreme groups can be applied to compute a very simple measure of the discriminating power of a test item. If a test is given to a large group of people, the discriminating power of an item can be measured by comparing the number of people with high test scores who answered that item correctly with the number of people with low scores who answered the same item correctly. If a particular item is doing a good job of discriminating between those who score high and those who score low, more people in the top-scoring group will have answered the item correctly (Matlock-Hetzel, 1997). In all three methods, the mean item discrimination was calculated as higher than 0,40. When the discrimination values of the items are 0,40 and higher, it can be said that the test can significantly distinguish the groups showing lower and higher performance as it is shown below in Table 3.15. (Crocker & Algina, 1986, p. 315). As an exception for this case, four items that have negative discrimination value are available as stated before.

Table 3.15 Explanation for the values of item discrimination

Item Discrimination	**Explanation**
$D \geq 0{,}40$	Item functioning quite satisfactorily
$0{,}30 \leq D \leq 0{,}39$	Little or no revision is required
$0{,}20 \leq D \leq 0{,}29$	Item is marginal and needs revision
$0{,}19 \leq D$	Item should be eliminated or completely revised

3.3.1.5.2. Reliability Studies of the Test

Within the scope of this study, the reliability of the adaptation to Turkish Language of TOMAGS was tested by using two distinct methods; Kuder-Richardson Formula 20 (KR-20) and Split-Half method. Kuder-Richardson Formula 20 (KR-20) which helps to obtain the internal consistency of tests (Kuder & Richardson, 1937) with items dichotomously scored (Crocker & Algina,1986) and Split-Half methods which examines the correlation among the results obtained by randomly dividing the test into two parts (Crocker & Algina,1986) were helpful in the determination of the internal consistency of the test.

More specifically, Kuder-Richardson Formula 20 (KR-20) is used as an indication of reliability in achievement tests and in other assessment instruments which are scored dichotomously, as true or false. In fact, it is a coefficient whose values can be changed from 0.00 to 1.00 and it is interpreted based on the consistency among the items in the measurement tool. As the value of KR-20 is become closer to the 1.00, it can be said that the scores that obtained from related instrument become more reliable. In this study, Coefficient of Kuder-Richardson (KR-20) was calculated as 0, 926 in accordance with the data obtained from the 47 items of the test. According to Cortina (1993), KR-20 values that are 0, 90 and the higher indicates that the items constructing the test are consistently measure the same psychological attributes. Moreover, this also reflects that there is statistically significant correlation among the items.

Split-half method is another method that makes the interpretation about the reliability of the adaptation of TOMAGs test. Although there are various methods to split the test in half, in this study, the items were randomly divided into two parts in order to prevent the bias in selection. Split-Half method is the correlation among the total-scores obtained from the two parts of the tests. Moreover, due to the fact that it is a correlation coefficient, it takes values ranging from -1,00 to 1,00. This obtained correlation reflects the one half of the test; hence, it needs to calculate Spearman-Brown correction so as to obtain the reliability coefficient of the whole test. For this study, the correlation coefficient (r) obtained from the two halves which was randomly constructed from 24 items and 23 items were found as 0, 774. When this correlation coefficient was corrected by using Spearman-Brown formula;

$$\text{Spearman Brown} = \frac{2*r}{1+r}$$

It was found that correlation coefficient for whole test is 0, 872. According to Peter (1979), values of 0,70 and higher which was obtained by the split half method from the instruments that was developed and used in social sciences could be seen as satisfactory. Hence, it can be argued that the reliability results obtained from the coefficients based on the Kuder-Richardson Formula-20 and split-half methods of the tests are satisfactory.

3.3.1.5.3. Validity Studies of the Test

Validity is the extent to which a test accurately measures what it is supposed to measure. In other words, validity refers to the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of tests (American Educational Research Association, AERA, 1999). That is, Validity of an assessment instrument refers to the degree of serving the purpose of the development of the instrument and evidences for this validity of the test were presented below.

Item-Total Test Score Correlations

Item-total correlation test is performed to check if any item in the set of tests is inconsistent with the measured behavior of the others, and thus can be discarded. The analysis is performed to purify the measure by eliminating unnecessary items prior to determining the factors that represent the construct (Churchill, 1979). Item-total correlation coefficients of the 47 items in the instrument which was adopted to Turkish language within the scope of this study were presented in Table 3.16 below.

Table 3.16 Item-total correlation coefficients of items

Item	Correlation Coefficient	Item	Correlation Coefficient	Item	Correlation Coefficient	Item	Correlation Coefficient
I1	.375*	**I13**	.519*	**I25**	.486*	**I37**	.514*
I2	.364*	**I14**	.606*	**I26**	.465*	**I38**	.569*
I3	.741*	**I15**	.610*	**I27**	.502*	**I39**	.557*
I4	.738*	**I16**	.437*	**I28**	.442*	**I40**	.662*
I5	.507*	**I17**	.588*	**I29**	.606*	**I41**	.318*
I6	.683*	**I18**	.447*	**I30**	.524*	**I42**	.470*
I7	.651*	**I19**	.484*	**I31**	.650*	**I43**	.517*
I8	.629*	**I20**	.501*	**I32**	.605*	**I44**	.429*
I9	.673*	**I21**	.641*	**I33**	.691*	**I45**	.481*
I10	.605*	**I22**	.535*	**I34**	.599*	**I46**	.476*
I11	.704*	**I23**	.385*	**I35**	.642*	**I47**	.446*
I12	.635*	**I24**	.394*	**I36**	.260*		

** Correlation coefficients are statistically significant at. 05 level (p<.05).*

As it was seen in the Table 3.16, all of 47 items have the statistically significant correlation with the total-test score. The correlation coefficients changes from the 0.260 to 0.741. Accordingly, all 47 items have statistically significant correlation with the total test scores; all items measure the same psychological attribute.

Percentages of Item-Based Correct Responses in Gifted and Other Students

It is expected that the items constructing the measurement instrument should discriminate the people having selected property from others, which is another of indicator of validity (Pierson, Kilmer, Rothlisberg, & McIntosh, 2012). In line with this, it was expected that correct responses of the gifted students identified as gifted should be more than others. After analysis for this case, findings presented in Table 3.17 was obtained to reflect the percentages of the students identified as gifted (n=95) and other students (n=467).

Table 3.17 Correct response rates of gifted students and others

Quest.	Others	Gifted	Quest.	Others	Gifted	Quest.	Others	Gifted
Q1	88,22%	97,89%	**Q19**	15,85%	33,68%	**Q37**	18,20%	48,42%
Q2	83,73%	95,79%	**Q20**	79,01%	90,53%	**Q38**	33,62%	65,26%
Q3	40,26%	81,05%	**Q21**	51,18%	74,74%	**Q39**	10,28%	35,79%
Q4	38,54%	77,89%	**Q22**	11,13%	41,05%	**Q40**	32,98%	71,58%
Q5	74,52%	92,63%	**Q23**	55,89%	81,05%	**Q41**	90,36%	89,47%
Q6	47,97%	89,47%	**Q24**	64,03%	82,11%	**Q42**	80,94%	88,42%
Q7	50,54%	90,53%	**Q25**	5,78%	23,16%	**Q43**	51,93%	61,05%
Q8	51,61%	90,53%	**Q26**	6,00%	22,11%	**Q44**	64,45%	77,89%
Q9	55,67%	86,32%	**Q27**	23,77%	58,95%	**Q45**	38,76%	64,21%
Q10	51,18%	80,00%	**Q28**	27,84%	63,16%	**Q46**	33,19%	65,26%
Q11	44,75%	81,05%	**Q29**	59,10%	84,21%	**Q47**	23,77%	43,16%
Q12	33,19%	73,68%	**Q30**	66,81%	84,21%			
Q13	33,62%	63,16%	**Q31**	58,46%	85,26%			
Q14	36,62%	67,37%	**Q32**	23,18%	48,42%			
Q15	38,54%	71,58%	**Q33**	20,99%	64,21%			
Q16	83,94%	94,74%	**Q34**	28,69%	62,11%			
Q17	55,46%	88,42%	**Q35**	28,48%	65,26%			
Q18	58,89%	81,05%	**Q36**	93,15%	87,37%			

As it was seen in Table 3.17, all the items apart from the items of thirty-sixth and forty-first was higher in the gifted students when compared to other students.

Correct response rates of the gifted students and others students in the thirty-sixth and forty first items were very closed to each other.

Means of Total Scores and Standard Deviation of Gifted Student vs Other Students

In a test that was developed for discriminating the gifted students, mean scores of students as identified as gifted are expected to be higher than the means scores of other students. Hence, the means and standard deviations of these two groups, obtained from measurement tool with 47 items, were presented in Figure 3. 4.

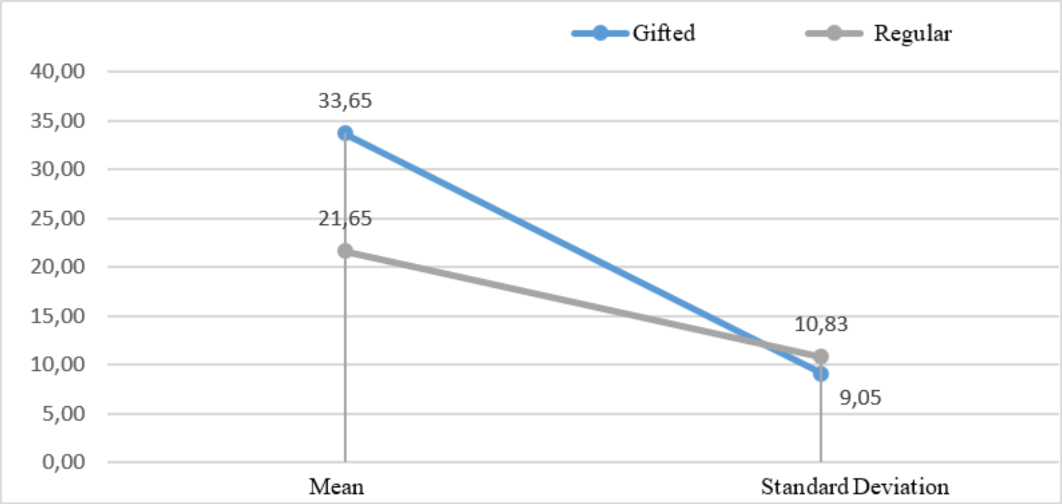


Figure 3.4 Means and standard deviations of gifted and regular students

As seen in Figure 4.2, the students identified as gifted by other institutions scored higher than the other students in terms their total scores obtained from measurement tool. Moreover, students identified as gifted show more homogenous distributions when compared to other students. Therefore, based on these findings, it could be said that measurement tool that was adopted to Turkish language was adequate in terms of its power for discriminating the students within the scope of correlation among the items and total scores. In conclusion, TOMAG is an internally consistent and valid scale, which is useful in the measurement of mathematical abilities of gifted students in Turkish culture.

3.3.2. Data Analysis Procedure Through Design Based Process

In this section, data analysis procedures conducted during all phases of this design based study were explained in detail. As in the nature of the qualitative research, data analysis of this design based study started with the pilot study, lasted throughout all data collection process and continued after the completion of data collection. That is, due to the fact that these data collection and analysis steps are interconnected with each other (Creswell, 2007; Glaser & Strauss, 1967), data collection and analysis were intertwined with each other and continuous analysis were conducted during the study (Miles & Huberman, 1994). This can also be seen in the time table of the data collection and analysis process in Table 3.18.

Table 3.18 Time schedule for the data collection and analysis of the study

Data	Data Collection and Analysis
2012-2014 period	Development of tasks-1stPrototype
2014-2015 Fall semester	Pilot study
2014-2015 Fall semester	Analysis of pilot study
February-March 2015	Development of 2ndprototype
April 2015	Expert Opinion
April 2015	Development of 3rdPrototype
April -May 2015	Try out with three teachers in 5 classrooms
April -May 2015	Continuous analysis (Formative analysis)
May-January 2015	Field test with one teacher in three classrooms
May-July 2015	Continuous analysis (Formative analysis)
August 2015-January 2016	Final analysis (Summative analysis)

Based on the exploratory nature of my aim, the points reflecting the practicality and effectiveness of differentiated tasks together with its problematic sides that need modification was tried to be described during the study. When the times huge amount of data made me overload and complicated, it helped me to return to my research questions tohighlightthe crucial points that I need to look for and examine (Miles & Huberman, 1994). Moreover, when the points need clarification, I asked directly to the participants not only during, but also after the data collection. During the analysis process of the study, both the students' and teachers' names were used with pseudonyms to obtain objectivity in the analysis. For example, teachers were labeled as “TS, TM, TN, TR” while gifted students were labeled as “S1, S2, S3,… etc.”. Furthermore, the codes weren’t defined prior to the analysis; they were obtained throughout the study because the data was context sensitive that we needed to see how they were shaped in the context (Miles & Huberman, 1994).

Initially, I aimed to obtain the most valid inferences from the data; hence, I reviewed the literature to have an idea about the analysis of design based research and how the similar data was implemented. In addition to this review, aims of the study were taken into consideration in the determination of my data analysisamongsix type of data analysis methods that Merriam offered for qualitative researchers (Meriam, 1998). Design based research is found similar to grounded theory in some aspects and constant comparative approach is one of the most frequently used form of analysis not only in the analysis of qualitative studies (Merriam, 1998) but also in the grounded theory and design based research. In line with this, constant comparative method was used to analyze the data obtained through the design based process. In this study, the steps defined by the Glaser and Strauss (1967), who is the developer of this method, were followed to describe the data in sufficient detail.

First of all, the students’ and teachers’ pre, intermediate and post interviews and classroom audiotapes were made in the text form by transcribing, which is a pre-requirement for the analysis of data (Cormack, 1991; Creswell, 2009). Although being time-consuming, transcribing is a crucial step for the organization of the data to obtain meaningful categories reflecting the main idea of the study (Masole, 2011). Moreover, data in the form of observation notes in logbook, students’ and teachers’ after sheet forms, students’ activity sheets and assessment forms were gathered with these transcribed data. These different data sources provided me to obtain more trustworthy and credible data by triangulation (Denzin, 1989). Before disintegration of the data into meaningful categories, the transcribed data was read several times to make sense of the complete structure of the data (Creswell, 2007). After this process, relevant data were determined by taking out irrelevant ones (Glaser & Straus, 1967). Then, the units of data from the first data set as interviews were obtained. These units of data were the incidences that served as the basis for the categories and they were compared through all the participants in the same data set. Beginning with these particular incidences, other incidents were looked for in the data to find the patterns. These last units of data were listed in a separate file and primary categories were constructed as the reduction of the data. Then, the other data sets from the observations and forms were examined by comparing with these units of data. Before altering them to the codes, similar units of data from various participants' data sets were gathered together (Creswell, 2007). After the completion of each new data set, the categories were extended or delaminated. By this way, availability of information gained from one source was checked from the other sources and this lead to more valid inferences from the data. As Miles and Huberman (1994) states, definition of codes is crucial for the wealth of the analysis process from the beginning to the interpretation. Therefore, while doing this, I wrote memos near the categories and codes to explain them in detail so as not to forget the actual meaning I assigned to them (Creswell, 2007; 2009). After determination of these tentative categories, they were compared with each other. Similarities and differences in these categories were determined and they were examined to obtain certain categories with lists under these categories. At some points, those tentative categories were deleted or changed in the dimension so as to reach finalspecific categories. That is, all the categories were again compared with each other to see the coinciding points or deficiencies in the content or in naming. Lastly, certain categories were namedbased on the researcher's experience with data (Glaser & Straus, 1967) and based on the literature by using the phrases that well describe the meaning of the categories (Creswell, 2007).

When all relevant units of data were placed into categories, it was seen that categories were saturated (Lincoln & Guba, 1985) as the product of constant comparative approach (Creswell, 2007). Hence, it was seen that no new products were emerging. After that, each category was examined and the ones having similar characteristics were separated from the others and these distinct groups were integrated as subcategories of the study. For example, benefits of the differentiated tasks for gifted students were divided into three interrelated subcategories as cognitive, emotional and social benefits. When needed, the categories could be grouped as sub-

sub categories (Creswell, 2007). Hence, sub categories relatedwith gifted students' emotional, cognitive or social benefits were also sub-grouped so as to better interpret the data.

To sum up, the data obtained through all design based process was examined in line with three research questions. Firstly; characteristics of differentiatedtasks that arouse as the final design principles, secondly; benefits of the differentiated tasks for mathematically gifted students and thirdly; benefits of the differentiated tasks for the teachers were gathered in three categories. Based on this specific focus, categories with their subcategories and sub-groups were outlined in the next chapter as the findings of the study. In the following part of this chapter, trustworthiness of the study was described.

3.4. Trustworthiness

Trustworthiness is used as the term that indicates validity and reliability in qualitative studies (Guba & Lincoln, 1981). Qualitative validity indicates the accuracy while qualitative reliability indicates the consistency of findings (Gibbs, 2007) and they are not discrete in the qualitative studies as in the quantitative studies (Creswell & Miller, 2000). Although they are used with different terms like, credibility for internal validity (Merriam, 1998), transferability for external validity and dependability for reliability (Shenton, 2004); validity and reliability are important for mentioning about trustworthiness of a study (Golafshani, 2003; Guba & Lincoln, 1981).

When it comes to trustworthiness of this study, Van den Akker and others (2006) advocated some guidelines to obtain credible, trustworthy and plausible findings for a design based study. Triangulation, member checking, explicit conceptual framework and full description are among those guidelines. First of all, in this study, during all phases, triangulation of data sources helped to enhance the reliability and internal validity of findings because weakness of each was compensated by the strength of another (Akker et al., 2006). That is, triangulation helped to increase reliability as well as internal validity of findings (Merriam 1998; Miles and Huberman

1994; Patton 1990). As Merriam (1998) advocated, examining the data in terms of data sources' perspective could enhance the internal validity of findings. Hence, the different data sources like students' pre, intermediate and post interviews, assessment and after sheet forms as well as teachers' pre, intermediate and post interviews and after sheet forms provided me to obtain more trustworthy and credible data by triangulation (Denzin, 1989). Lastly, triangulation is also known as one of the methods to ensure confirmability (Doğan, 2012), which is the objectivity in quantitative research (Shenton ,2004). Hence, confirmability of this study could be provided by means of triangulation process. Moreover, member-checking, as it was also explained in the prototyping part, was used to ensure the interpretation of the data during the process. In the informal talks, I wanted the students and teachers to agree or disagree what they said in the assessment or after sheet forms. Additionally, I wanted them to check the accuracy of the raw data obtained from the transcriptions in pre and pots interviews and this provided me to acquire more trustworthy findings from the participants. As Van den Akker and others (2006), stated, underlying rationale of the design based study comes from both formal activities and informal activities. Especially in this study, formal activities like literature review, discussions with critical people and in conferences in preliminary phases and expert appraisal provide explicit conceptual framework which enhance the validity and reliability of the study. Moreover, due to the fact that generalization of this study is limited, full description of the context and design decisions were provided so as to help for the transferability of this study to similar contexts and this was a method for the trustworthiness of a study (Merriam 1998; Miles and Huberman 1994). Lastly, prolong engagement is important to increase credibility of the study, hence, as the researcher, I was in the field during two mounts and spared most of my time with the teachers and students before and after the study process (Doğan, 2012).

As similar to these, from the Creswell (2009) perspective, the strategies explained up to here; triangulation, member checking, thick description of the detailed setting, spending prolonged time are the strategies to provide the validity in qualitative studies. In addition, clarifying the researchers' bias, which was explained at the end of this chapter, also helps to ensure the validity. Additionally, feedbacks from experts which were taken during the process also helped to improve validity of the findings and instruments (Clark, 2013). The tasks were developed in line with the curriculum requirements of 5th and 6th grade mathematics lessons and they were consulted to the expect appraisal in terms of both content and usability for students and teachers. Furthermore, the nature of the design based itself provides evidence of validity automatically. It provides concrete materials that can be used in real context by analyzing its usability in practical settings during the process (Van den Akker, 1999). Furthermore, some of the Gibbs' (2007) procedures for reliability was used in this study. For example, transcriptions were checked for obvious mistakes and the definitions of codes were clarified so as not to face changes in the meaning of the codes. Moreover, it is the fact that prior prototypes, which were tried out in three classrooms with three different teachers, helped to ensure reliability before field testing (Kennedy-Clark, 2013). Hence, as the main goal of design based research, the usable, practicable, feasible, reliable and valid products was designed and developed by evaluatingthem in classroom contexts (Square 2004).

3.5. Assumptions and Limitations of Study

In this part of the chapter, some assumptions and limitations that this study bring along was explained. First of all, it was assumed that the students as the participants of the study gave necessary attention to the activities and struggled themselves to solve these activities. Moreover, as the other participants of this study, the teacher shared their exact views in their interviews. Additionally, for the identification part of the study, Test of Mathematical Abilities for Gifted Students (TOMAGS) was used and the students were tested to assess their giftedness potential. In line with the scores obtained from these tests and teacher nomination, the students were assumed as mathematically gifted.

On the other hand, as it is known, mathematically gifted students are not so frequent in the population. Although classroom sizes and the number of classrooms were high in this study, I could obtain small number of sample in terms of mathematically gifted students. Moreover, it is the fact that the findings of this study are limited to these students as the participants of this study. Similarly, the findings from the teachers' perspectives are limited to the teachers that participated in this study. Additionally, although I tried to reach schools from diverse socio economic level, this effort was limited in Ankara and the data of the study is limited to the mathematics lessons approximately 1,5 or 2 months' period in one semester of the specific schools. Moreover, differentiated activities used through the process and the students' reactions to these activities were limited to the activities within the scope of this study.

3.6. Researcher Role and Bias

Researcher's role and bias are the critical factors for the qualitative studies due to its interpretive nature which depends on the researcher's experiences with participants and subjective deductions of the data (Creswell, 2009). Moreover, qualitative studies may be shaped in line with the researchers' background, beliefs or views that could lead to validity related problems (Doğan, 2012). At that point, reflexivity enables researchers to critically reflect their own beliefs and potential bias so as to control those biases through the study (Johnson, 1997). It is a threat for the trustworthiness of a study that the researcher, who is the key person for the qualitative process (Merriam, 1998) could record and interpret the findings as in the way that what she/he wants to find rather than what the findings really reflect (Doğan, 2012; Johnson,1997).

To overcome such threats, some strategies were used. At the beginning of the study, I clearly informed all my participants that the study was not obligatory; it is based on voluntariness of the participants. I made interviews with the teachers, school principals and families of the gifted students to brief about the purpose and details of the study. I mentioned my certainty about confidentiality of the giftedness of students as well as research findings. Most importantly, I paid much attention that gifted students never knew their giftedness and they were not tagged or behaved as privileged through the study. Moreover, as I mentioned before, I used pseudonyms during the data analysis so as to prevent biases. Furthermore, all the data were recorded in the researcher's log book or audiotaped. Moreover, for the data obtained from students' forms, probing questions were also asked in the informal talks.

Furthermore, for the sake of the data analysis and interpretation of the study, in the following part of this section, I briefly mentioned about my role in the study. As a researcher, during the try-outs and fied test, my role was participant observer. That is, while observing the students, I was enagaging in the activities in classrooms (Creswell, 2007). The students were informed about my presence for conducting a scientific study about their mathematics related task; however, they were not informed about giftedness dimension of the study. As mentioned above, I was in the classrooms through long period of time. This enabled me to conduct my observations with students' natural state because after three or four lessons, they got accustomed to me and I started to the actual progress of the activities and data collection. Ipartipated in the lessons while conducting my obervations by establishing an open and positive communication with all students in classroom. The students didn't recognize that I focused my attention to the gifted ones. Besides, we gave the forms to all of the students in classrooms so as not to remarkthe gifted ones and to see all students' reactions. As a researcher, I also paid attention being equadistant to both gifted and nongifted students and gave crucial importance to record my notes as occured in theclassroom so as not be bias.

CHAPTER 4

FINDINGS

The purposes of this study were three fold. First of all, it was aimed to design and develop differentiated tasks to satisy 5th and 6th grade mathematically gifted students' cognitive, emotional and social needs. Based on this, it was aimed to explore characteristics of these differentiated tasks suitable for satisfying gifted students' needs in classrooms. Moreover, as the other purposes of this study, the contributions of these tasks to teachers and to gifted students' needs in classrooms were also explored.

In this chapter, findings obtained from data analysis were summarized in three main sections. In the first section, findings obtained from the modifications for characteristics of differentiated tasks for 5th and 6th grade mathematically gifted students were examined. These characteristics constructed the final design principles of the study as an answer for the first research question regarding the characteristics of differentiated tasks. Hence, after mentioning about modificiations, these characteristics were addressed in three subsections; characteristics in terms of content, type and implementation method of the tasks. In the second section, benefits of differentiated tasks to teachers from the teachers' perspective were examined as an answer for the second research question about benefits of the differentiated tasks to the teachers. This section was also subdivided into three main subsections as benefits to teachers' awareness on giftedness and gifted education, self-adequacy and collaboration with other colleagues. Lastly, benefits of the differentiated tasks to the mathematically gifted students' needs were investigated in the third section as an answer for the third research question regarding the benefits of the differentiated tasks to the mathematically gifted students. Similar to the second section, this section was also subdivided into three main subsections as cognitive benefits, emotional benefits and social benefits of the tasks to students.

Before mentioning about these findings, in Table 4.1, data collection instruments and items leading to the related category of findings and research question were provided. As seen in this table, at the end of the data analysis, corresponding to the research question-1, three related category of findings as characteristics in terms of content, in terms of type and in terms of implementation method were obtained. Moreover, as an answer for the second research question, benefits of the intervention to teachers' awareness, self-adequacy and collaboration with other colleagues were acquired. Laslty, benefits of the intervention for students' cognitive, emotional and social needs were also obtained in reply to the last research question about the benefits of the intervention to the mathematically gifted students in terms of satisfying their cognitive, emotional and social needs. In addition to these, the table also offered some information about data collection instruments and items helped to obtain these findings. These instruments provided in appendices were mentioned with their abbreviations as explained in the upper part of the table and the number of questions were provided with the abbreviations. For example, for the first item indicating the related categories of findings for the first research question was showed as T-Pos-Int.11; in the meaning of the 11th question in teachers' post interview form.

To sum up, in the remaining part of this chapter, details about categories of findings with examples from different data sources were provided. First of all, findings obtained through design based process to form final design principles were explained with detail.

Table 4.1. Summary for the data collection instrument and items for related categories of findings

Data Collection Instrument and Item *(T-Pre-Int: Techer Pre Interview, S-A-Sheet: Student After Sheet, S-Pre-Int: Student Pre Interview S-Pos-Int: Student Post Interview, T-Pos-Int: Teacher Post Interview, S-As-Form: Student Assessment Form, T-A-Sheet: Teacher After Sheet)*	Related Categories of Findings	Research Question
T-Pos-Int.11, T-Pos-Int.14, T-Pos-Int.17, T-Pos-Int.18, T-Pos-Int.25, T-Pos-Int.29, S-Pre-Int.4, S-Pre-Int.5, S-Pre-Int.9, S-Pre-Int.10, S-Pos-Int.2, S-Pos-Int.3, S-Pos-Int.5, S-Pos-Int.7, S-Pos-Int.14, S-A-Sheet.2, S-A-Sheet.3, S-A-Sheet.5, S-A-Sheet.7, S-A-Sheet.8, S-A-Sheet.9, S-As-Form.3, S-As-Form.4, S-As-Form.5, T-A-Sheet.1, T-A-Sheet.2, T-A-Sheet.3	Characteristics in terms of content	
S-Pos-Int.1, S-Pos-Int.2, S-Pos-Int.14, S-As-Form.4, T-A-Sheet.1, T-A-Sheet.2, T-A-Sheet.3	Characteristics in terms of type	Research Question-1
T-Pos-Int.7, T-Pos-Int.8, T-Pos-Int.9, T-Pos-Int.27, T-Pos-Int.28, T-Pos-Int.30, S-Pre-Int.11, S-Pos-Int.12, S-Pos-Int.14, S-As-Form.10, T-A-Sheet.1, T-A-Sheet.2, T-A-Sheet.3	Characteristics in terms of application	
T-Pre-Int.1, T-Pre-Int.2, T-Pre-Int.3, T-Pre-Int.4, T-Pos-Int.1, T-Pos-Int.2, T-Pos-Int.3, T-Pos-Int.4, T-Pos-Int.34, T-Pos-Int.35, T-Pos-Int.39, T-Pos-Int.47	Benefits to teachers' awareness	
T-Pre-Int.5, T-Pre-Int.7, T-Pos-Int.33, T-Pos-Int.38, T-Pos-Int.39,	Benefits to teachers' self-adequacy	Research Question-2
T-Pos-Int.39, T-Pos-Int.40, T-Pos-Int.41, T-Pos-Int.42, T-Pos-Int.43, T-Pos-Int.45,	Benefits to teachers' collaboration	
T-Pre-Int.8, T-Pos-Int.15, T-Pos-Int.20, T-Pos-Int.26, S-Pre-Int.6, S-Pre-Int.7, S-Pos-Int.8, S-A-Sheet.3, S-A-Sheet.5, S-A-Sheet.4, S-As-Form.2, S-As-Form.6	Benefits for stds.' cognitive needs	
T-Pre-Int.6, T-Pos-Int.13, T-Pos-Int.15, T-Pos-Int.16, T-Pos-Int.19, T-Pos-Int.20, T-Pos-Int.23, T-Pos-Int.24, T-Pos-Int.26, S-Pre-Int.1, S-Pre-Int.2, S-Pre-Int.3, S-Pre-Int.7, S-Pre-Int.8, S-Pos-Int.4,S-Pos-Int.5, S-Pos-Int.6, S-Pos-Int.8, S-Pos-Int.9, S-Pos-Int.11, S-Pos-Int.13, S-A-Sheet.1, S-A-Sheet.6, S-A-Sheet.7, S-A-Sheet.9, S-As-Form.1, S-As-Form.6, S-As-Form.7, S-As-Form.9	Benefits for stds.' emotional needs	
T-Pre-Int.9, T-Pre-Int.10, T-Pos-Int.12, T-Pos-Int.15, T-Pos-Int.16, T-Pos-Int.20, T-Pos-Int.21, T-Pos-Int.22, T-Pos-Int.26, T-Pos-Int.31, T-Pos-Int.32, S-Po S-Pos-Int.10, S-A-Sheet.4, S-As-Form.6, S-As-Form.8	Benefits for students' social needs	Research Question-3
T-Pre-Int.11, T-Pre-Int.12, T-Pre-Int.13, T-Pre-Int.14, Int.5, T-Pos-Int.6, T-Pos-Int.10, T-Pos-Int.36, T-Pos-Int.37, T-Pos-Int.44, T-Pos-Int.46, T-Pos-Int.48, S-Pre-Int.12, S-Pos-Int.15, S-Pos-Int.15, S-A-Sheet.10, S-As-Form.11, S-As-Form.12, S-As-Form.13, T-A-Sheet.4, T-A-Sheet.5, T-A-Sheet.6, T-A-Sheet.7	Suggestions for usability in classes	Research Question-1

4.1. Modifications for the Characteristics of Differentiated Tasks for 5th and 6th Grade Mathematically Gifted Students: Final Design Principles

In this part of the study, findings reflecting the needed modifications for characteristics of the tasks to satisfy mathematically gifted students' needs through design based process of this study were examined. In order to better indicate developmental process of characteristics and activities, prototypes were explained orderly. Hence, in the first section, prototype-1 and modifications through the pilot study were explained. After that, modifications conducted with the experts' opinions and then, modifications conducted through try outs and prototype-4 were introduced. After this, modifications through the field testing was addressed and lastly, as the last version of design principles; characteristics of differentiated tasks for 5th and 6th grade mathematically gifted students were presented.

4.1.1. Prototype-1 and Modifications through Pilot Study

Preliminary research phase shed light on the framework for the suitable characteristics of differentiated tasks for 5th and 6th grade mathematically gifted students. Based on the data and inferences obtained from this phase, some list of the characteristics that could be used for differentiated tasks were determined. Summary of these characteristics was presented in Figure 4.1 and the details with explanations for these characteristics were provided in Chapter 3. All these characteristics were mentioned in the literature but the list was not clear and coexist. Moroever, all of these characteristics were provided as the suggestions from the researchers but they were not research based; experimented or approved by the scientific studies. Hence, these suggestions in the literature were gathered to construct draft design principles. In line with this, forty activities reflecting these characteristics were developed in order to satisfy cognitive, emotional and social needs of the 5th and 6th grade mathematically gifted students. For this aim, their relevance, consistency, practicality and effectiveness were formatively evaluated during the design based process of this study.

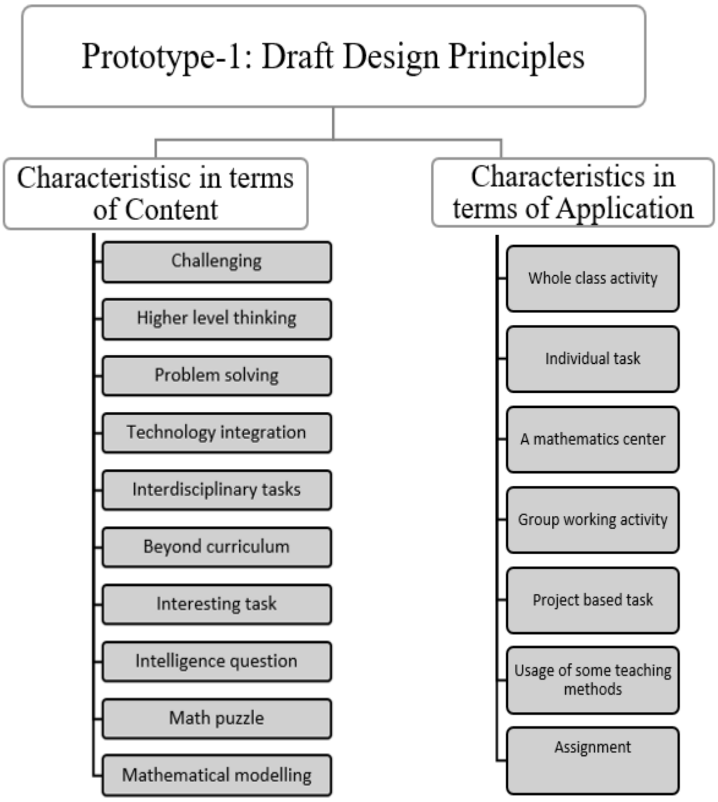


Figure 4.1 Summary for Draft Design Principles

Subsequent to the design of draft principles and activities, they were pilot tested in a private school by the researcher as mentioned in Chapter 3. Through this pilot study, modifications concentrated on the clearity and usability of the activities for 5^{th} and 6^{th} grade classrooms. The researcher faced some difficulties in implementing activities in classrooms. These were mostly related with the intelligibility and time management of the activity during the regular lesson. For instance, in the 9^{th} activity in Figure 4.2, the students had some difficulty in understanding the usage of numbers as only once. Thus, researcher modifed the activity by emphasizing the usage of numbers only once.

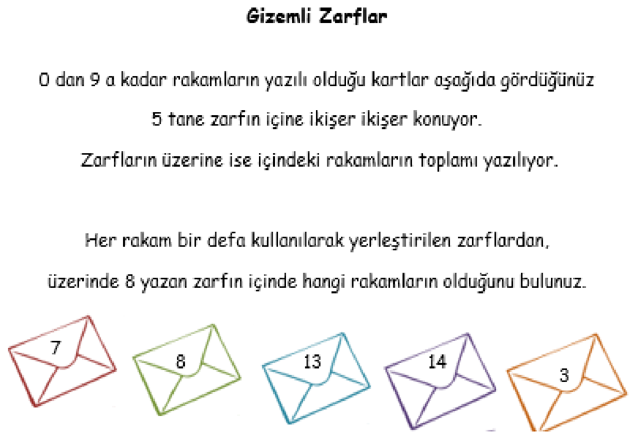


Figure 4.2 9th differentiated activity about envelopes

Similarly, in the 11th activity in Figure 4.3., the students had some concerns about the instructions of the activity. While diving the cake into parts, they focused on dividing into equal parts although they were not expected to do this. From their real life experiences, all of the students thought that the birthday cake should be divided into equal parts. Hence, it was needed to reorganize the instructions of the activity.

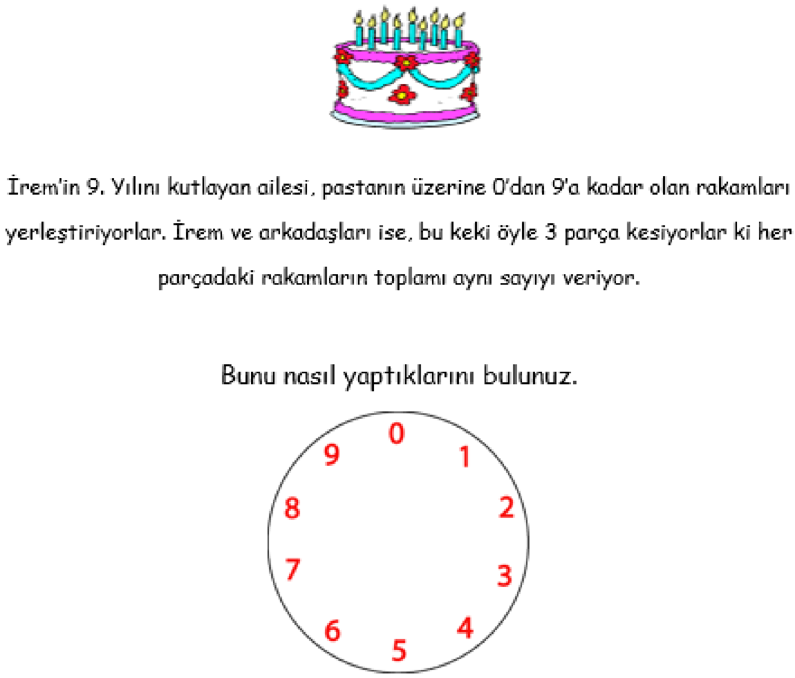


Figure 4.3 11thdifferentiated activity about birthday cake

Lastly, similar ambiquity problems aroused in the 21st and 28th activities. They were modified in order to make the instrutions clear; hence, the students could focus on the necessary dimensions of the activity. To sum up, all the activities were used in classrooms and the points needing corrections were reorganized and the related characteristics were approved. In this pilot study, design principles saved their form in Figure 4.1 and the characteristics of the activities were approved in the classroom implementations with the changes for their intelligibility. Moreover, in this process of design based study, as seen in Figure 4.4, prototype-1, which was designed in preliminary research phase, piloted in real classrooms and required revisions lead to construction of prototype 2 which was modified with experts' opinions as mentioned in the following section.

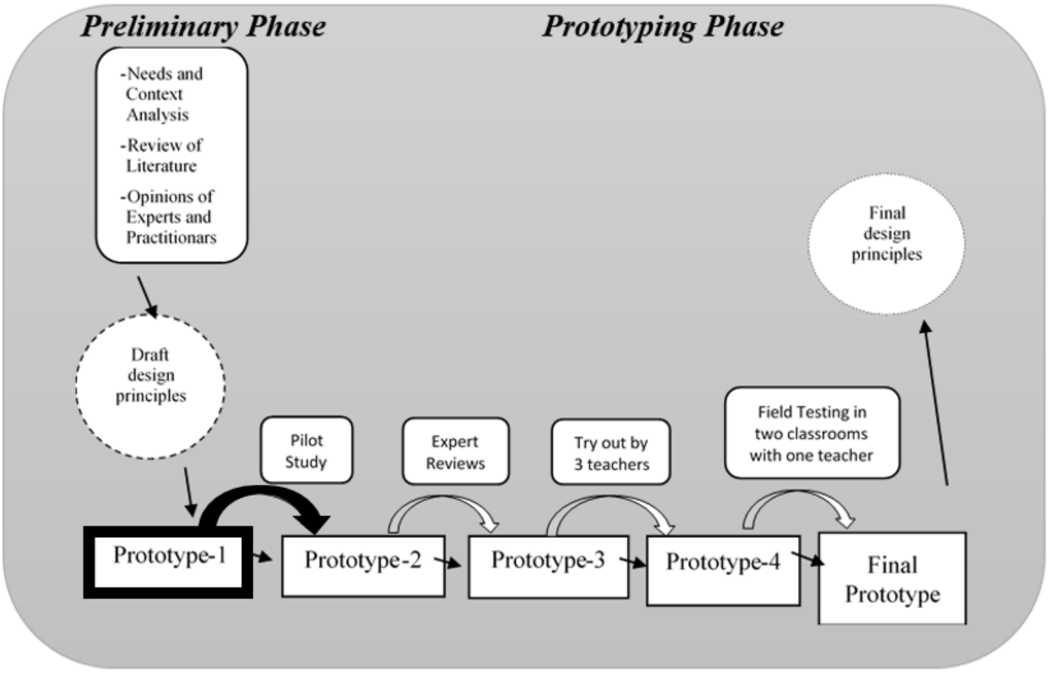


Figure 4.4 Design based schema: transition from Protype-1 to Prototype-2

4.1.2. Modifications to Prototype-2 Through Expert Opinions

Individual expert opinions helped to modify both design principles and activities so as to obtain more useful, clear and beneficial differentiated tasks for mathematically gifted students. After experts stated their opinions, these opinions were grouped as the opinions requiring modification to the activity and requiring modification to the design principles as presented in Table 4.2.

Table 4.2. A summary for experts' opinions

	Modification to the activity	Modification in terms of design principles
4th activity, 7th activity, 14th activity, 21st activity, 23rd activity, 24th activity, 27th activity, 29th activity, 33th activity	Ambiguity	
3rd activity, 28th activity	Correction	
2nd activity, 10th activity, 25th activity, 26th activity, 37th activity		More challenging
6th activity, 30th activity		More interesting
17th activity		Math puzzle form

For the opinions regarding modification to the activity, experts mostly stated their opinions to avoid ambiguity and make corrections on the activities. On the other hand, opinions regarding modification in terms of design principles aimed at well suiting the principles to the characteristics of the activity. For this aim, for example, some of the activities (2nd, 10th, 25th, 26th and 37th) were made more challenging in line with the developmental properties of gifted students. Characteristics of challenge was the most conspicuous one that experts dwelled on. To illustrate, most experts wanted to change the numbers in the 2nd and 25th activities as more challenging; needing comprehensive operations with more complex reasoning. As seen in Figure 4.5, the decimals in b and c options were added to the activity to make it more challenging.

Hesap makinene **sıfır tam binde üç yüz on iki** sayısını yaz.

Ardından hesap makinendeki sadece toplama çıkarma işlemlerini ve rakamları kullanarak aşağıda verilen sayıları elde edin ☺

a) 0,352 b) 0,612 c) 0, 317

Figure 4.5. 25th differentiated activity about calculators

Moreover, for the 10th activity, there were blanks that the students should place some numbers to obtain the total number in the right line and bottom column. Two of the experts wanted to diminish the written numbers to decrease the clues for the completion of the puzzle. Hence, the activity changed and become more challenging for the students. Similarly, the 6th and 30th activities formed as more interesting for the students at that grade and the 17th activity was reorganized as more suitable for the puzzle form, which is another suggested characteristics of the differentiated tasks. By this way, as seen in Figure 4.6, the activities in Prototype-2 were modified based on the opinions of experts and this new version of the activities with design principles formed Prototype-3, whose modifications were mentioned in the following section.

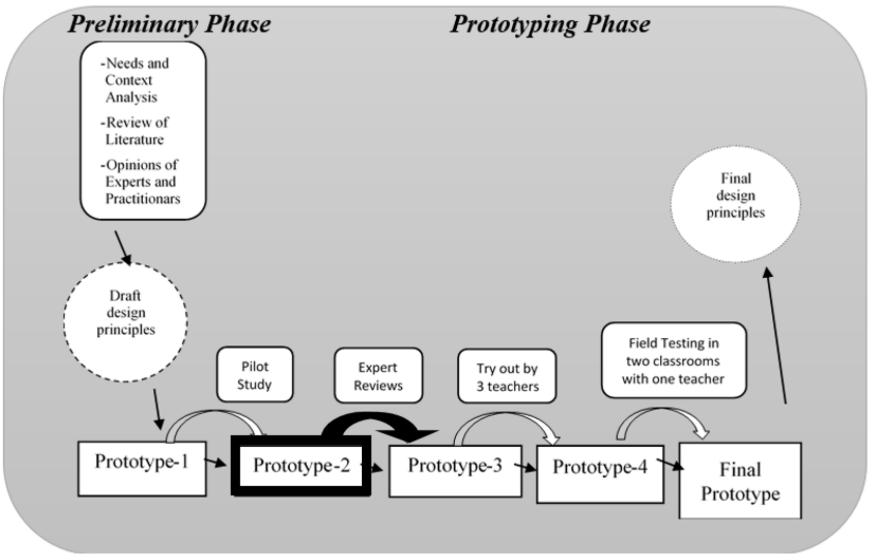


Figure 4.6 Design based schema: transition from Protype-2 to Prototype-3

4.1.3. Modifications Through Try-outsand Prototype 4

As stated before, activities in the 3rd prototype were used in four classrooms by three teachers and continuous evaluations were conducted during try outs. Teachers used these activities with their own timetables independently. Each of the activities except from the 29th and 36th activites were used by each teacher in try outs in different times as seen in Table 4.3. As seen, the 29th and 36th activities were used by only two teachers due to time limitation and curriculum requirements. Moreover, activities were used with various order but all of the activities, except from these two, were tried in classrooms with three teachers.

In each of their implementations, teachers and researcher made some changes immediately or the points were noted to make the changes later on. Based on these inferences, the tasks were continuously revised and revised versions were used by other teachers. By this way, each activity could be tried and revised by different teachers in different classrooms. At the end of these revisions, modified versions of activities were field tested as explained in the next section. In this section, some of these revisions to satisfy gifted students' needs were mentioned with their explanations and justifications from the experiences of teachers, students and researcher in try outs.

Table 4.3. Weekly program for the activity usage of teachers

	Activities used by teacher-1 (TS)	**Activities used by teacher—2 (TN)**	**Activities used by teacher-3 (TM)**
Week 1	3rd, 6th, 1st, 25th, 4th, 10th and 18th activities	27th, 1st, 15th, 13th, 6th and 12th activities	1st, 6th, 24th, 10th, 15th, 27th and 34th activities
Week2	7th, 17th, 11st, 39th,19th, 14th, 27th and 37thactivities	23rd, 22th, 5th, 19th, 11th, 18th, 25th and 37th activities	2nd, 3rd, 7th, 14th, 21st, 30th and 37th activities
Week 3	28th, 5th, 21st, 31st, 19th, 8th, 35th, 26th and 29th activities	23rd, 25th, 26th, 34th, 16th, 35th, 20th, 27th and 30th activities	11th, 4th, 26th, 18th, 35th, 8th and 16th activities
Week 4	16th, 9th, 40th, 15th, 38th, 22nd and 36th activities	9th, 21st, 7th activity, 14th,31st and 39th activities	28th, 23rd, 22nd, 25thand 36th activities

Table 4.3 (Continued)

Week 5	12^{th}, 20^{th}, 29^{th} and 34^{th} activities	10^{th}, 2^{nd}, 3^{rd}, 24^{th}, $28^{th}$and 38^{th} activities	12^{th}, 17^{th}, 5^{th}, 38^{th} and 39^{th} activities
Week 6	24^{th},13^{rd}, 23^{rd}, 30^{th}, 2^{nd}, 28^{th}, 32^{nd}, 33^{rd} and 40^{th} activities	4^{th}, 8^{th}, 32^{nd}, 17^{th}, 29^{th}, $33^{rd}$and 40^{th} activities	13^{th}, 9^{th}, 19^{th}, 31^{st}, 32^{nd}, 33^{rd}, $20^{th}$and 40^{th} activities

First of all, after conducting first implementations in week-1, the teachers wanted to have explanations for the tasks. Hence, as well as student activity sheets provided to teachers, a mini booklet including notes for the teachers was prepared and given to the teachers. In that mini-booklet, there were some explanations about how teachers should use activities and the points teachers should pay attention or emphasize were also included. Furthermore, all teachers wanted to have an answer key because sometimes they were not sure about their answers' correctness. Hence, in the second activity, the teachers' mini-booklet with the implementation clues and suggestions for activities as well as answer key was provided to all teachers. This need revealed the deficiency of the tasks in terms of teachers' perspective.

Moreover, when it comes to revisions for the activities, it was seen that there were some points that need clarification or correction for some activities. For instance, in the first task about *Gauss* in Figure 4.7., the students found the name but they couldn't understand what they found and what they should do. When they couldn't understand the need for searching about history of mathematics, it was observed by the teachers and researcher that design principle about interdisciplinary type of the task became a problem. Hence, the researcher and teachers determined that to better reflect the design principle as intersiciplinary task, an explanative sentence was added at the end of the activity and this entrance gave a clue that the name they found is a famous mathematician and they should search about it. Furthermore, additional spaces were allocated for their explanation as the answer of the question. With all these modifications, in the following implementations of the activity, as the teachers obtained positive feedbacks from the students, interdisciplinary activities were found useful and effective as design principles for differentiated tasks. For instance, one of the students mentioned his satisfaction for the interdisciplinary type of the task.

"I have never thought a mathematicians' life (Gauss) in that way. Learning about mathematics in history made me feel well. I wondered about the old mathematicians and now I have learnt one of them. I'm happy and knowledgable about something more than regular mathematics (laughing) (S6, informal talk in try out-Week-1)"

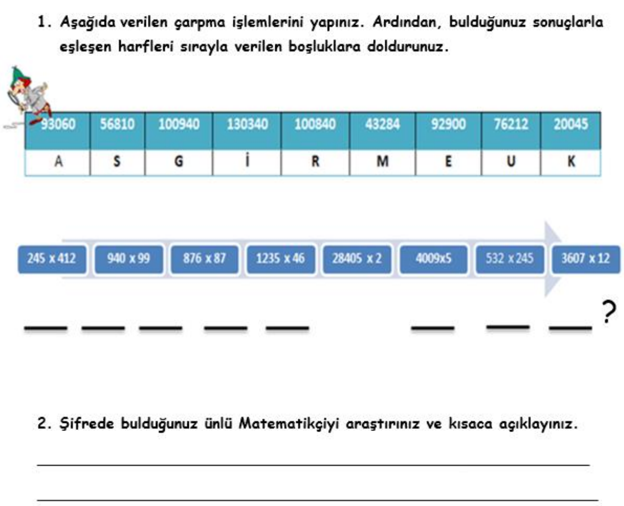


Figure 4.7. 1st differentiated task about Gauss

Another correction was related with the third activity named as *Cards* in Figure 4.8. In this activity, while two of the teachers (TS and TM) were using activities in the first week of the try outs, they supposed that symbols indicating the operation was missing. Another teacher (TN) was concerned about the appropriateness of the task due to its challenge to find the appropriate operation. Both teachers and researcher made a discussion about the activity and it was determined that to make the task more challenging for the gifted ones, the students should firstly determine which operation is appropriate for the task. Hence, an additional note was added to the question that the students were expected to determine the operation as addition, subtraction, multiplication or division and then solve the task. After this modification, in week-5, the teacher (TN) used new form of the activity in her classroom and shared her experiences about effectiveness of this challenge in fostering gifted students' cognitive abilities. Similarly, the students were content with this challenge in the activity and they were satisfied from the open ended structure of the activity. For instance, one of the students shared his opinions in after sheet form as, *"It is the first time that I have seen a regular operation question that I should determine. It was difficult for me to decide the operation and find the numbers. I mostly liked tricky point that two operations were the same. I enjoyed from this difficulty in determination (S2, After sheet form)."*

By this way, the teachers and researcher approved the appropriate challenge of the activity for the gifted students and as the design principle, challenge was again seen as an effective principle for differentiated tasks.

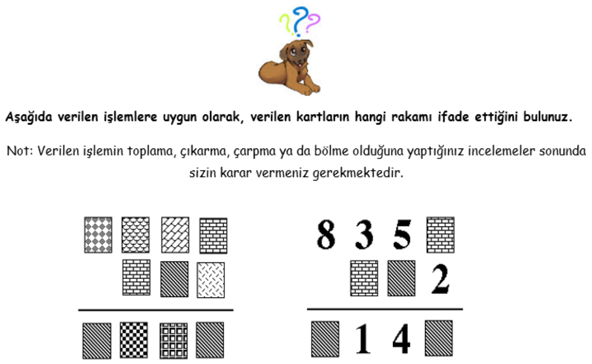


Figure 4.8. 2nd differentiated task about Cards

The 5th and 6th tasks were similar in their mathematical thinking. The 5th task about *Grandmother* in Figure 4.9 was modified to emphasize the words reflecting the clues of the problem. After implementation of the 5th activity by the teacher (TS) in week 3, due to the challenge level of the questions, it was determined to use 5th question firstly, and then the 6th task because the students would learn how to think this kind of questions and they can solve the 6th task, which is more challenging. By this way, the students facing with the 6th task could overcome the challenge and enjoyed from meeting with similar type of challenge.

Bir gün Efe babaannesinin yaşını merak eder ve sorar. Babaannesi ise:

- Annenin yaşını, senin yaşını, erkek kardeşinin ve diğer iki kız kardeşinin yaşlarını çarptığımız zaman 111111 buluruz.

Efe:

- Babaanne bu bilgiler senin yaşını bulmam için yeterli değil ki.

Babaanne:

- Pekala. Eğer annenin yaşına, siz dört kardeşin yaşlarını eklersen benim yaşımı bulabilirsin.

Efe biraz düşünür:

- A evet şimdi buldum. (Efe koşarak dışarı, top oynamaya çıkar ve bağırır). Babaanne sen gerçekten çok yaşlıymışsın.

Yukarıda verilen, Efe ve babaannesinin arasında geçen konuşmalar göre, sen de babaannenin yaşını bulabilir misin? Babaanne kaç yaşında?

Figure 4.9 5th task about *Grandmother*

For the 7th task, after implementation by all teachers, additional notes were added to the teachers' notes that the students should be informed that it is not obligatory to find all the numbers in the puzzle. Similarly, although it was written on the question, the rule that they should use each number only once was emphasized for the 8th task with the modifications in its instructions.

For the 10th task about *Math Puzzle* in Figure 4.10, because the teachers gave somehints to some of their regular students, who are not gifted, this instruction was added to the teacher's booklet to improve the utility of the task in mixed ability classroom by the teachers and researcher after completion of this activity in all classrooms. By this way, while challenging and interesting principles of this activity were seen as useful and beneficial for mathematically gifted students, they were made as useful for the rest of the classroom, too.

Aşağıdaki bulmacada her satır ve sütun sonlarınnda toplamları verilmiştir. Buna göre bulmacada eksik kalan bölümleri satır ve sütun sonlarındaki sonuçlara uygun olacak şekilde doldurunuz.

41	26	14	24	13		23		180
41	50	43	41	46		10	34	300
35		5	41	29	30	30	5	219
40	43	8	15		21	31	18	193
	18	26	3	42	32	28	44	224
11	5		36	35	29		18	202
45		28	29		34			223
	6	39		12	18	10	14	135
252	201	184	217	208	218	196	200	

Figure 4.10 10th differentiated task about *Math Puzzle*

While implementing the 12th task about *Ant* in Figure 4.11, all the students gave the answer as 'twenty' at first galance in all three classrooms. Hence, an additional note to the question that 'the answer is not twenty' was added to make the students focus on the important details of the question in a quick way as well as to make its usability easier for the teacher. Moreover, this note also provided to take gifted students' attention more. Before this additional note, all gifted students in two classrooms reflected the boredom and easiness of the activity because they thought the answer as twenty and they didn't want to think about it. However, after this additional note, the activity became more interesting and challenging for them, which gave evidence for the effectiveness of these principles. For instance, the student stated his satisfaction for the challenge and interesting principle of this activity in his informal talk as,

> *"The activity (about ants) seemed boring at first glance and I didn't want to try to solve it. But, when I read the additional note that the answer was not 20, I was really curious about the answer and tried to find the right one. I did it! It was difficult and interesting as I desire (S1, informal talks)"*

For the 13th task, because it caused a little problem that the students couldn't understand the question directly, a small scale example for the 10-page book was added to the question. For the 15th task, because the 5th grade students do not know the perimeter concept of the circle, after the first implementation of the activity in week-

1 by a teacher (TN), an implementation hint was added to the teachers' booklet that the teachers should give an example by showing the perimeter of the circle to reduce the ambiguity and to make the students focus on the exact meaning of the question.

Bir karınca 20 metrelik bir direğe tırmanmaya çalışıyor çünkü direğin tepesinde yiyeceği duruyor.

Birinci gün 4 metre çıkıyor ve günün sonunda 3 metre aşağı kayıyor. İkinci gün yine 4 metre çıkıyor ve günün sonunda 3 metre aşağı kayıyor.

Karınca her gün bu şekilde tırmanırsa kaç günde direğin tepesindeki yiyeceği alabilir?

Not: Cevap 20 değildir.

Figure 4.11 12th differentiated task about *Ant*

The tasks of the 21st and 22nd and their format was modified to make them more understandable and interesting. The reason for this revision was that after implementation of each activity in week-2 by two teachers, it was seen that the activities should be more interesting to attract gifted students' attention, as mentioned in the draft design principles (TN and TM). Hence, after these modifications, the teacher (TS) used 22th task in her classroom and observed with the researcher that mathematically gifted students in this classroom more engaged in the activity due to increasing level of interesting side of the activity. Additionally, the teacher also stated her ideas about other principles of the activity as,

> *"The activity was effective for students' thinking way of difficult fraction problems. As well as this, the activity was interesting and non-routine for them. I think the principle of non-rotine and interesting is very effective for satisfying gifted students' needs (TS, Week-4)."*

As another revision to design principles, after the last implementation of the 29th task about numbers (Figure 4.12) in week-6, the teachers and researcher noticed that the activity also suited well to the integration activities. That is, in the draft design principles, integration of mathematics and Turkish lessons were accepted as the sub-dimension of design principles. After implementation of the 29th task, it was determined that not only Turkish language but also English language could be integrated in math activities. Hence, this sub-dimension of design principle was changed as integration of math and language.

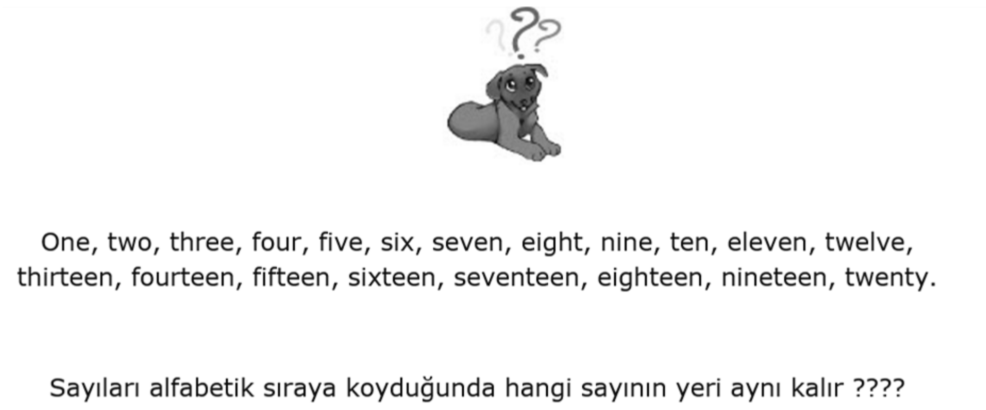


Figure 4.12 29th differentiated task about numbers

In the 23rd task in Week-2, during the first implementation in classroom-1, the teacher (TS) had difficulty that the students wrote the pizza with their words or sentences but not by using fractions. Hence, due to differences of the students' explanations in the try-outs, it was added to the instruction in the activity that the students are expected to write as in the form of fractions. Lastly, in week-6, the 32nd and 33rd tasks were organized by the teachers and researcher in a way that clues reflecting the logical error in the study were emphasized to make students focus on the correct parts of the paragraph.

In addition to these revisions for the activities, somechanges were also made to the structure of design principles. As mentioned, draft design principles were provided in two separate heading as: characteristics in terms of content and characteristics in terms of application as provided in Figure 4.1. Throughout the try outs, in discussions of the teachers and researcher, content part of the principles was found so general. For this reason, in the beginning of the 3rd week, the teachers and researcher discussed the isuee in their meeting and they had a common idea that some of the characteristics did not exactly reflect the characteristics in terms of content. Based on these discussions, it was determined that challenging, interesting and high level thinking was the adjective of the tasks that directly indicates the content of the activity. However, although other characteristics like problem solving, interdisciplinary, etc. were found more proper as the type of the tasks. Hence, it was determined that design principles as the characteristics in terms of content of the tasks were divided into two parts as the content and type. By this way, new version of the schema for design principles was obtained as in Figure 4.13.

Furthermore, at the end of the 4th week, long-running discussions were carried out with the researcher and the teachers about the relationship of design principles and activities. It was determined that the differentiated tasks should have at least one of three basic characteristics mentioned in Figure 4.13 as characteristics in terms of content, in terms of type and in terms of application. For example, the problem solving task should require higher level thinking. Moreover, to apply this differentiated task in classroom, the teacher should select one principle from the characteristics of application to better satisfy the cognitive, emotional and social needs of mathematically gifted students.

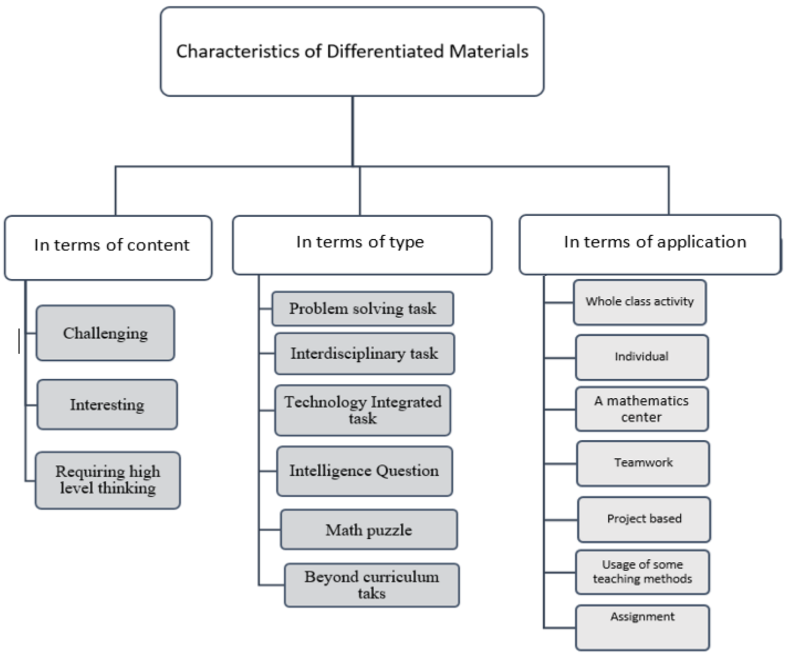


Figure 4.13 Summary for design principles in try outs

All these categorization and instructions for usage was added to teachers' booklets and lead to new form of design principles. To sum up, as mentioned above, during the try outs, revisions were multi-pronged; revisions to the explanations to design principles, to categorization of design principles, to content of the activities and to content of the teachers' booklets. Corresponding to these revisions, prototype-4 was developed by means of the feedbacks and data obtained from tryouts as showed in Figure 4.14. Due to the fact that involvement of prior prototypes ensures reliability before prototype tested in the field (Clark, 2013), more structured form of the intervention with well-articulated design principles was tested in another school with a different teacher. The process and the details of this field testing was explained in the following part of this chapter.

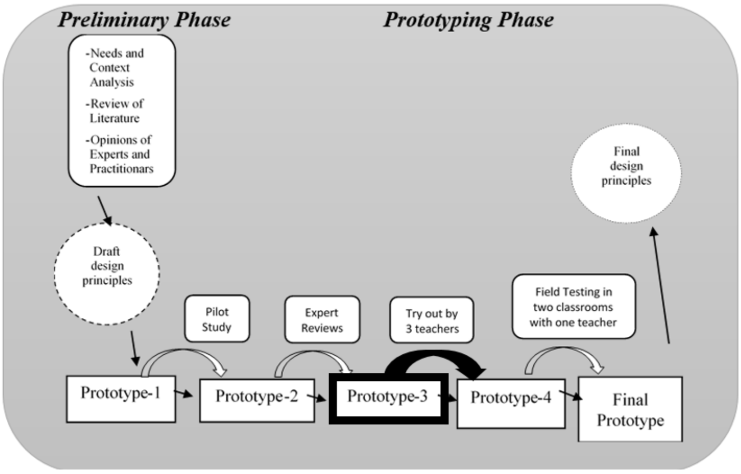


Figure 4.14. Design based schema: transition from Protype-3 to Prototype-4

4.1.4. Modifications through Field Testing

The fourth prototype was evaluated in the field test in terms of design principles, its practicality and effectiveness in classroom environments and whether it meets pre-determined specifications for the solution of the problems in the context (Clark, 2013; Plomp, 2013). That is, with the help of this field testing, prototype-4 formed its last version as final prototype. With the help of modifications carried out in pilot study, expert appraisal and try outs, the teacher in the field test faced little difficulties in terms of ambiguity, format or content of the activities. At some points, the teacher translated the activity so as to better fit to her own curriculum objective of the day. Like one of the teachers in try outs (TN), the teacher also used some of the activities in the math application lesson and advocated its proper usage in this lesson.

Hence, usage of the activities in selected lessons like math applications or mind games lessons was added as a new implementation method to the final design principles at the end of the discussion with the researcher and teacher in field test.

Additionally, instructions for the selection of the design principles in terms of content and type were clear at the end of the try outs. However, design principles in terms of application was not so clear both in the design principles and teachers' booklet. For this reason, its name was revised as characteristics in terms of implementation method as seen in Figure 4.15 and detailed explanations for each implementation method were added as mentioned in final design principles.

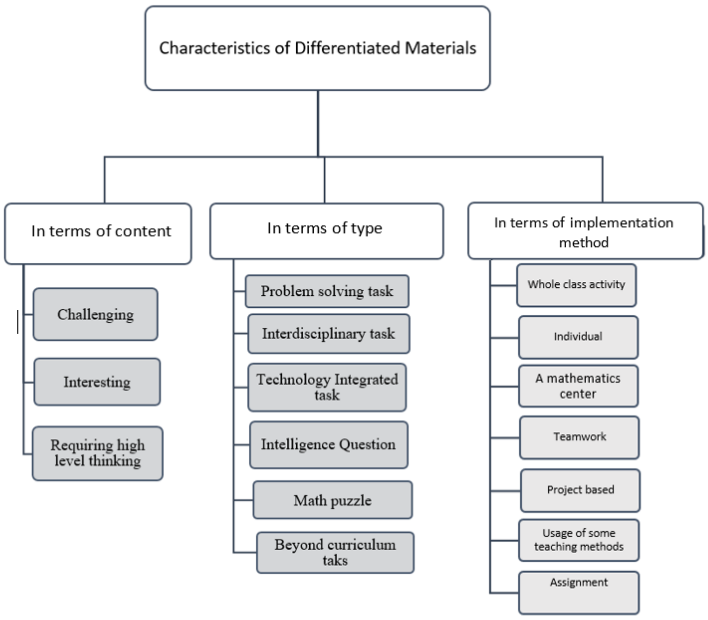


Figure 4.15 Summary for design principles in field test

Furthermore, during the field test, the teacher and researcher observed that selection of the appropriate implementation method for the activities lead to the easiness in the classroom management for the teacher. It was seen that using more than one of the implementation methods was also effective. For example, the teacher in week-2 started the activities with the whole classroom and continued with the students who are reluctant to continue and gave some routine exercises to the rest of the classroom. Hence, as another revision to Prototype-4, it was determined that instead of selecting only one method, the teachers can select at least one of the implementation methods while applying the activities in their classrooms. This flexibility was added in the teacher's booklet and emphasized in the final design principles that the teacher can begin with one method and then go to another one.

In addition to these, the teacher continuously stated that because the tasks were ready for them, it saved so many time and lead to easiness in usage. Additionally, she explained that interesting side of the activities engaged the students even the ones who are not interested in or good at mathematics. Hence, as well as important gains both for her own professional development and gifted students' needs, intervention prevented some classroom management problems and lead to decrease in the disruptive behaviors of some gifted students.

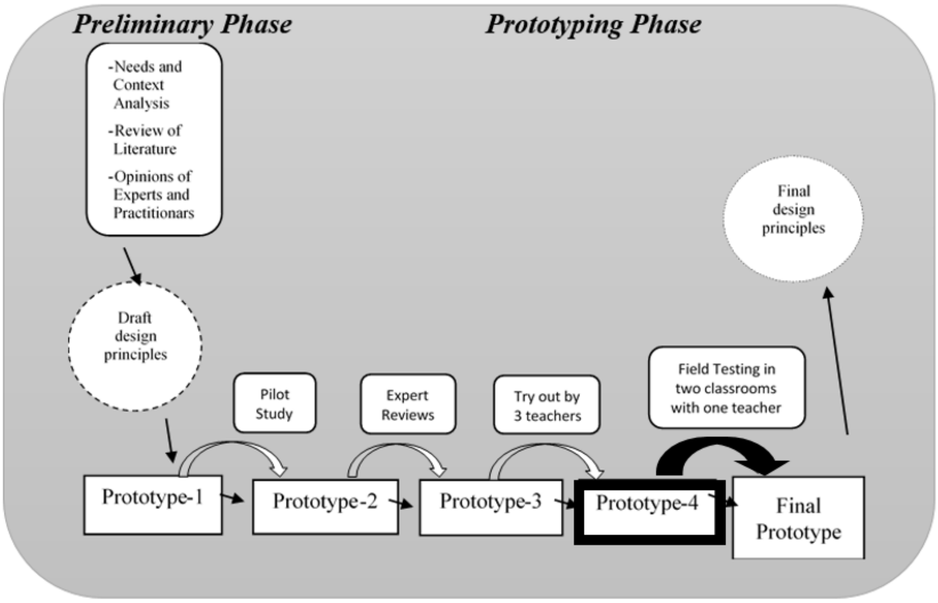


Figure 4.16 Design based schema: transition from Protype-4 to Final Prototype

Corresponding to these revisions and implementation notes from the field test, final version of differentiated tasks was developed to serve as beneficial tool for differentiating mathematical tasks in 5^{th} and 6^{th} grade regular mathematics lessons (Figure 4.16). Up to here, methodological specifications and development of the prototypes in the process were mentioned. By this way, how analysis and revisions of design principles were carried out through the process was stated as an answer for the first research question. In the following part, final design principles obtained at the end of these revisions were mentioned as the last point for the characteristics of differentiated tasks within the scope of this study.

4.1.5. Final Design Principles: Characteristics of Differentiated Tasks for 5th and 6th Grade Mathematically Gifted Students

All the data obtained from preliminary research phase and prototyping phase enabled to reform draft design principles which was mentioned in the methodology chapter. At the end of the continuous revisions in each of these steps, as final design principles with forty activities on the learning domain of numbers, three basic characteristics that should be selected for differentiated tasks were determined. These were the characteristics in terms of content, characteristics in terms of type and characteristics in terms of implementation method. For each of these three basic characteristics, some of the sub-characteristics were defined as seen in Figure 4.17.

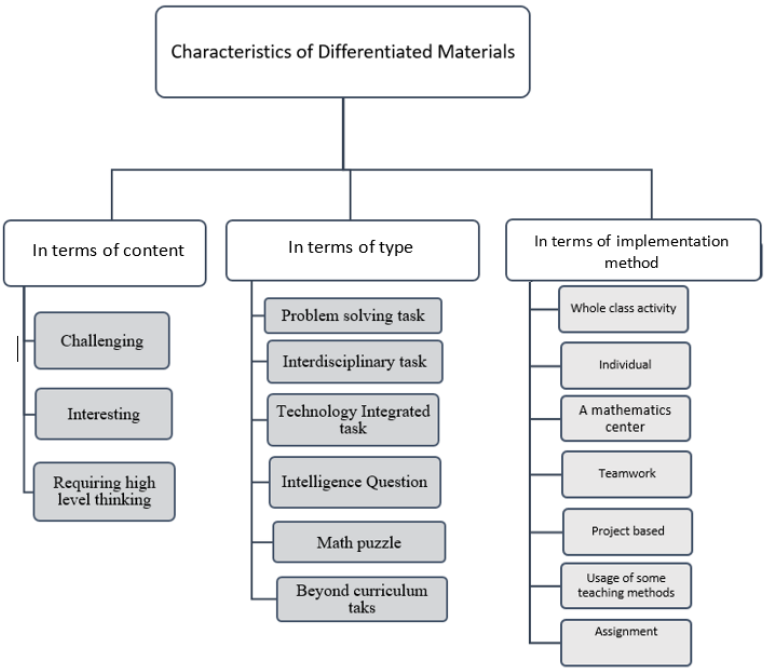


Figure 4.17 A Summary of Final Design Principles

For it to be a proper differentiated task for gifted students, as it was determined in try outs, the tasks should have at least one of each characteristic. That is, any differentiated task for 5th and 6th grade mathematically gifted students should have at least one content related characteristics while they are at least one type of task as determined by characteristics in terms of type of task and should be applied with at least one of these implementation methods. At the beginning of the study, these characteristics were stated in a list of two separate headings of content characteristics and application characteristics. However, during the implementation process in try-outs and field test, three main headings were found most appropriate to clearly define and state characteristics of differentiated tasks as mentioned in modifications. Hence, these content, type and implementation method were used as three general headings for these characteristics.

In addition to this, at the beginning of the try outs, these characteristics were disorderly listed and it was said that these characteristics are suitable for differentiated tasks. However, after each task, implementations with design principles were checked by the teachers and researcher. These implementations showed that these two main headings were not comprehensive to indicate necessary design guidelines for differentiated tasks. Thus, it was determined that the tasks should have characteristics from each of content, type or implementation methods to be an effective task for mathematically gifted students.

Findings from the student and teacher data reflected that, when a task has each of these three characteristics, it became effective, beneficial and attractive for mathematically gifted students. Hence, it was deduced that the task should have all three basic characteristics. In addition to this, it was determined that from each of these basic characteristics, at least one sub-characteristic should be selected. For example, a challenging and interesting (content) problem solving activity (type) could be applied as an individual task (implementation method) to the mathematically gifted student in mathematics classroom. Hence, those three basic characteristics as well as their sub-characteristics were formulated for guiding the design and development of differentiated tasks for the 5^{th} and 6^{th} grade mathematically gifted students. Findings gathered as these three basic characteristics with their sub-characteristics were presented as final design principles of this study in the following section. These principles as in the last form of characteristics, were summarized as the general framework for the design and development of differentiated tasks for satisfying mathematically gifted students' cognitive, emotional and social needs. For the explanation of these characteristics, some examples from the students and teachers in try-outs or field testing were also provided to better indicate the reasons for the evidences of related characteristics, some of which mentioned in try outs or field testing.

4.1.5.1. Characteristics in terms of Content

As the data obtained from preliminary research phase and prototyphing phase reflected, differentiated tasks for the 5th and 6th grade mathematically gifted students should have some content related characteristics. It was determined that the tasks should have at least one of those content characteristics that are challenging, interesting or requiring higher level thinking. Characteristics of each task were determined and approved with the expert opinions and classroom practices in try outs and field testing. Hence, final version of characteristics of each activity was determined by different data sources of students, teachers and experts, as presented in Table 4.4.

Table.4.4. Summary of findings about characteristics in terms of content

Characteristics in terms of Content	Task	Data Sources
Challenging	Act.2, Act.3, Act.5, Act.6, Act.8, Act.9, Act.10, Act.11, Act.12, Act.13, Act.14, Act.16, Act.18, Act.19, Act.20, Act.22, Act.23, Act.24, Act.25, Act.26, Act.28, Act.29, Act.30, Act.31, Act.32, Act.33, Act.34, Act.35, Act.36, Act.37, Act.38, Act.39, Act.40	S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12, S13, S14, T1, T2, T3, T4, E1, E2, E3, E4
Interesting	Act.1, Act.2, Act.4, Act.5, Act.6, Act.7, Act.8, Act.9, Act.10, Act.11, Act.12, Act.13, Act.14, Act.15, Act.16, Act.17, Act.18, Act.19, Act.20, Act.21, Act.22, Act.23, Act.24, Act.25, Act.26, Act.27, Act.28, Act.29, Act.30, Act.31, Act.32, Act.33, Act.34, Act.35, Act.36, Act.37, Act.38, Act.39, Act.40,	S1, S2, S3, S4, S5, S6, S7, S8, S9, S11, S12, S13, S14, T1, T2, T3, T4, E1, E2, E3, E4

Table 4.4 (Continued)

Requiring High Level Thinking	Analyzing	Act.2, Act.3, Act.5, Act.6, Act.8, Act.9, Act.10, Act.11, Act.12, Act.13, Act.15, Act.16, Act.17, Act.18, Act.19, Act.20, Act.22, Act.23, Act.24, Act.25, Act.26, Act.27, Act.28, Act.30, Act.31, Act.32, Act.33, Act.34	T1, T2, T3, T4, E1, E2, E3, E4
	Evaluating	Act.5, Act.6, Act.8, Act.9, Act.19, Act.25, Act.26, Act.30, Act.38, Act.39, Act.40	
	Creating	Act.35, Act.36, Act.37	

As stated before and seen in Table 4.3, all activities have at least one of the content related characteristics and these characteristics were determined by various data sources as shown with some pseudonyms and abbreviations in the table. For example, the teachers (T1, T2, T3…), students (S1, S2, S3…), the experts (E1, E2, E3…) were the data sources for the activities (Act.1, Act.2, Act.3…) having at least one of the content related characteristics. However, this doesn't mean that all these three characteristics should be found at the same time in a task. Each of the tasks in this study had at least one of those content characteristics, which were delivered in the preliminary research phase and approved with some modifications by the experts and practitioners in their prototyping phase. Hereinafter, the final version of these content characteristics, with some underlying reasons for their usage as differentiated tasks for mathematically gifted students were presented.

1. Challenging

Challenging activities, which were stated in Table 4.1 and Appendix A, were tried out and field tested in real classrooms with mathematically gifted students to satisfytheir cognitive, emotional and social needs. Data obtained from the teachers and students during try outs and field test indicated that these acitivites challenged the mathematically gifted students in an appropriate way and satisfied their cognitive needs as mentioned in the following category of findings as benefits to students. The students stated this case by using different statements during the implementation process. For instance, they mentioned that these activities were difficult and the activites compelled or challenged them. By mentioning about challenge, they also stated challenging their brains, mind or intelligence. For instance,

"The activity (10thActivity) challenged my brain (S3, After sheet form, Week1 in try out)."

"This challenging activity (23rd Activity) compeled me to think more about fractions (S7, After sheet form, Week3 in try out)."

The students shared their opinions that they were satisfied from being challenged in mathematics lessons by means of the activities labeled as having challenging characteristics. In a similar way, the teachers stated the challenge in the tasks that their children could struggle, which they do not face in their regular tasks. They found the activitie as challenging for the students' grade levels and developmental properties. Even, one of the teachers stated the changes in their ideas about challenging tasks as,

"When I first see this activitiy (22nd activity), I thought that my students can not do this task. I thought that this excessive challenge makes my gifted ones be alienated from this type of tasks. However, interestingly, this challenge took my students pleasure. They were really challenged to obtain the clues, but enjoyed from this difficulty. They could manage this challenge."

To sum up, in line with the data obtained from preliminary research phase, prototyping phase also supported the idea that challenge should be involved in gifted students' tasks so that their interests can be taken and maintained during the lesson by means of meaningful complexity of the tasks (Chamberlin, 2002; Deizmann & Watters, 2001, 2005; Gavin et al., 2007; Karaduman, 2010; Sriraman, 2003). Within the scope of this study, challenge means compelling the students with appropriate difficulty and the level of challenge may change with the level of the students. However, data from practitionars also advocated the idea that in order to be challenging, the student shouldn't see the answer directly; it needs some effort and thought provoking process as well as integration of all knowledge and experiences to obtain the solution. In this study, some of the activities as seen in Table 4.3 were designed to be challenging for 5^{th} and 6^{th} grade mathematically gifted students and this challenge was modified, used and approved in real classroom environments as the design principle for the content related characteristics of differentiated tasks.

2. Interesting

Some of the activities, as specified in Table 4.1 and Appendix A, were designed as interesting task for the context and developmental properties of the 5^{th} and 6^{th}grade mathematically gifted students. These tasks were designed as having interesting characteristics in the preliminary research phase and then developed through experts' opinions, try outs and field testing. In these classroom pratices, as the teachers' and students' data examined, the findings reflected that the activities took mathematically gifted students' interest and helped to attract their attention during the mathematics lessons. Moreover, it was also addressed that students paid more attention and had more enthusiasm for the tasks because they found these tasks very interesting and different when they compared them to their regular tasks in the classroom. As stated before, the students' ideas were taken in their after sheet forms and it was seen that the tasks specified as interesting tasks really excited gifted students' attention. Classroom observations supported this idea while students' own sentences in after sheets were like this;

> *"This activity (Activity, 16) was so interesting, I have never seen such a turtous mathematics activity (S9, After sheet form, Week-2 in field test)."*

> *"Interesting side of the activity (Activity, 30) made me keep my shoulder to the wheel (S1, After sheet form, Week-6 in try-out)."*

Similar to these, teachers' after sheet forms and interviews went along with the students' ideas. That is, teachers also specified these tasks as interesting for the classroom usage in the 5^{th} and 6^{th} grade mathematically gifted students' activities. One of the example among those statements was presented in below:

> *"I can definitely say that the activity (Activity 27) was interesting for my mathematically gifted students. Absorbing side was to find the right day by*

getting lost in the days of a week and they struggled to find the answer (TS, After sheet form, Week-2 in try outs)."

In brief, findings through the preliminary and prototyping phases reflected that interesting characteristics of the tasks should be involved in gifted students' tasks. As supported by some researchers (Johnson, 2000; Karaduman, 2010; Wilkins et al.,2006) and particpants of the study, gifted students need engaging tasks that catch their interests to get rid of boredom and lost in concentration since they may not always have intrinsic motivation. The interesting side of the activities means novelty that arouses student's attention. In this study, tasks that are non-routine, attractive, novel and oriented at student's interests were accepted as interesting and these interesting tasks were designed, developed and approved by classroom practices to satisfy mathematically gifted students' cognitive emotional and social needs.

3. Requiring Higher Level Thinking

Tasks requiring higher level thinking is the last characteristics in terms of content. As supported by the ideas from the preliminary research phase, to differentiate instruction satisfying gifted student's needs, they should be provided with tasks promoting higher level thinking (Chamberlin & Chamberlin, 2010; Freiman, 2006; Karaduman, 2010; Sriraman, 2003). This higher level thinking results in increased critical thinking of the students. Although gifted students are born with ability of critical thinking, they should be faced with the activities that teach them how they can think critically (Ktistis, 2014). Moreover, students of lesser ability should also be given opportunities to answer higher-order questions. Most of the teachers use questions that are in these categories, but for gifted students, greater emphasis should be placed on the higher-order skills.

In this study, some of the activities requiring higher order thinking were designed to promote the 5^{th} and 6^{th} grade mathematically gifted student's critical thinking skills. Bloom's taxonomy (Bloom, 1956) is particularly helpful in planning activities requiring higher level thinking. According to his revised taxonomy, tasks at the analysis, evaluating and creating levelserve this purpose and enable students to think in a higher level (Anderson et al., 2001). These levels were explained with more details as draft design principles in Chapter 3.

At the beginning of the prototypes and field tests, it was seen that the students were accustomed to think remember, understand or apply level in the Bloom's taxonomy. However, as they involved in the activities, their ability to think critically was enhanced by means of these tasks which are in the analysis, evaluating or creating level. Classroom observations reflected that the students even began to ask questions in these levels in their regular classrooms. Similarly, the teachers of the mathematically gifted students shared their experiences that their students in classrooms needed to think critically to complete these tasks. Moreover, they also mentioned about the benefits of these tasks to their gifted students' critical thinking ability. The activities specified as requiring higher level thinking was approved by the researcher and experts in the initial phases. After that, these activities were somewhat changed when needed and then approved by the teachers as needing higler level thinking task and they stated the need for such tasks in the tasks of mathematically gifted students. As an example from the teachers' statements,

> *"My gifted sudents had an ablity to think critically. This activity (Activity, 25) absolutely required thinking in higher order because it is not enough to know the decimals and their plcae value, they should determine which numbers and operations to be used to obtain the final numbers. It needs evaluation based on the principles of place value in decimals. I think, higher level thinking is really necessary for these students' tasks (TN, After sheet form)."*

As also seen from the teacher's statement, in this study, the tasks requiring higher level thinking was exist and it is important to meet mathematically gifted students with these kind of tasks in their regular mathematics lessons. Up to here, content characteristics of the differentiated tasks were examined. Hereinafter, characteristics in terms of type of the task were explained with detail.

4.1.5.2. Characteristics in terms Type of Task

At the end of the design based process, in addition to content characteristics, characteristics in terms of type were also specified for differentiated tasks of 5th and

6th grade mathematically gifted students. These are the problem solving task, interdisciplinary task, beyond curriculum task, technology integrated task, intelligence question and math puzzle. At the beginning of the study, draft design principles were consisted of two main headings and these type characteristics were included as the content characteristics. However, during the prototyping phase as mentioned before, these characteristics were determined as the type of the tasks. Thus, it was determined that in addition to content related characteristics, the tasks should also be categorized under one of these categories. These various tasks, which were gathered during the preliminary phase and approved as proper by the experts and practitioners in prototyping phase, were explained with detail in the following part of this sub-section.

1. Problem Solving Task

Based on the preliminary research phase, it was determined that problem solving tasks should be included in the education of gifted students so that students can solve realistic and attractive problems with mathematical ways (Freiman, 2006; Gavin et al., 2009; Greenes, 1997; Karaduman, 2010; Pierce, Cassady, Adams, Neumeister, Dixon, & Cross, 2011; Renzulli, 1986; Tieso, 2002). In line with this, in this study, problem solving tasks with other content related characteristics were designed and developed for the 5th and 6th grade mathematically gifted students. In this development process, experts' and teachers' opinions were taken and needed modification stated earlier in this chapter were conducted to obtain effective and clear problem solving tasks to mathematically gifted students.

Among those problem solving tasks, non-routine, real life or mathematical modelling problems were taken asthe sub-dimension and specified as proper for mathematically gifted students' problem solving tasks. More clear explanations for these three types of problems and new version of the sub dimensions were given below.

Non-Routine Problems: Non-routine problems are one of theoptions for problem solving tasks of mathematically gifted students. These are the problems which cannot be solved by using knowledge directly and they are not ordinary problems that could be solved with routine methods (Arslan & Altun, 2007). During the study, many activities as seen in Appendix A were non-routine problems that these activities satisfied mathematically gifted students' cognitive, social and emotional needs. For instance, one of the students in week-4 explained his feeling about the task as,

> *"The activity (9th task) was very different from the ones we usually do in our classroom. It was enjoyable and struggled me to find the correct numbers. In fact, addition is a simple job for me but this was an unusual problem which I prefer to do (S3, informal talk in try out)."*

Real Life Problems: Real life problems attract gifted students' attention because these are the problems that are related with real life and use realistic contexts. During the study, students could find many common points with problems in real life context and this reality aroused their attention. For example, one of the students addressed his satisfaction in his after sheet form after completion of a real life problem in field testing as,

> *"The activity (20th task) reminded me my marbles and I visualized the scenario. I had a good time while following each step in my problem. It was like a problem in my life. I enjoyed it although it struggled me (S9, After sheet form in field testing)."*

Thus, including these type of problem solving tasks is a choice for constructing differentiated task for mathematically gifted students.

Mathematical Modeling: Based on the preliminary research phase, mathematical modeling tasks were stated as one of the content related characteristics to satisfy mathematically gifted students' cognitive emotional and social needs. However, during the discussions with teachers in try outs and field testing, it was determined as a type of the problem solving task because mathematical modelling is a process that a problem in real life is formed as a mathematical problem whose solutions are again adapted to that real life problem (Berry, 2002; Blum, 2002). Solving mathematical modeling problems iscomplicated process that needs mathematical thinking in order to reach a goal by using conceptual tools and multiple interpretations (English; 2003; English

& Watters, 2005). More clearly, they require explaining, making sense and interpreting the case from the mathematical ways (Lesh & Doerr, 2003) and show the application of math in real life (Heymann, 2003). In classroom practices, it was seen that both students and teachers were satisfied from using mathematical modeling problems in mathematics classrooms. The teachers were content with these problems due to their role in making their students think various dimensions of the problem. The students were also content with the differentiated structure of mathematical modeling problems. For instance,

> *"I liked this different problem. We made great effort to reach our answers about employees. I feel like a real determinant of a company. It doesn't seem to the problems in our regular lesson, it was not boring and similar as those. I had a good time while using my brain. I want much more from these type of problems. Do you have any more? (S7, Informal talks in try out)."*

In line with the statements of this student, all the data from the teachers, students and observations reflected the idea that mathematical modeling seem different, unusual, more realistic and interesting to solve for the mathematically gifted students. Thus, this property of mathematical modeling made it as a good option for differentiated problem solving tasks for mathematically gifted students.

In general, mathematically gifted students in the try outs and field test showed great interest in problem solving activities that are non-routine, related with real life or include mathematical modelling. At the beginning of the try outs, it was seen that the students were accustomed to solve routine problems or exercises. Moreover, they could solve thesetype of problems quickly and also sometimes with boredom. It was observed that they did not take much time to think in depth about the problems. Even, when they were asked about problems in their pre-interviews, except for two students, they mentioned about problem solving tasks as routine, easy type of questions and they didn't mention any enthusisasm for problem solving. However, when they faced with those kind of problems, they came to realize that mathematical problems are not limited with those they could solve easily. The students spent much of their time with the problems without getting bored and stated their happiness and satisfaction with these different problem solving activities. Hence, at the end of the process, teachers and researcher decided for approval of problem solving tasks as a good option for differentiated tasks.

2. Interdisciplinary Task

As another option for type of differentiated tasks, it was concluded that interdisciplinary tasks which allow integrating more than one discipline into the teaching of any concepts (Beane, 1997) should be included in the gifted students' tasks because application of math in other fields leads to meaningful and engaging learning process as well as providing answers for related questions of gifted students (Berger, 1991; Freiman, 2006; Greenes, 1997; Karaduman, 2010; Renzulli, 1986; Sriraman, & Sondergaard, 2009).

In this study, some interdisciplinary tasks were included as the type of differentiated tasks so that gifted students could see mathematics in a more holistic way by interrelating the mathematics to other disciplines or lessons. During the design based process, enthusiasm of the mathematically gifted students for using mathematics in other disciplines was observed. Moreover, the students could interrelate their knowledge in any disciplines with each other and this enabled them to see that mathematics is in anywhere and they were satisfied from learning this by doing and searching.

Among those interrelationships with other lessons, mathematical history, mathematics and science lessons, mathematics and Turkish/English lessons are the ones that were used in these tasks and they were described as follows.

Mathematical History: Usage of mathematical history is a good option to form differentiated task for mathematically gifted students because gifted students have great curiosity about historical background of concepts and wonder about issues that happened in the past (Yevdokimov, 2007). Thus, as obtained from the preliminary phase, these tasks may be beneficial to meet gifted students needs of learning depth and background of the concepts (Aydemir & Çakıroğlu, 2013). The idea was supported from the participants through the process. For example, in the 1st task, when students find the results of complex operations, they obtain a famous mathematician and they should search about his life and contrubutions to mathematics. By this way, in classroom practices, as well as sudents' cognitive needs, their emotional needs were also satisfied that they were keen on learning something about mathematics in history.

Integration of Mathematics & Science Lesson: In this study, as anoth option, any concept from the science lesson was integrated or explained by means of mathematics as a differentiated task for mathematically gifted students. As obtained from the preliminary research phase, combining mathematics and environmental issues was a practical way to increase environmental awareness and to provide real life applications of math (Aydemir & Teksöz; 2014; Jianguo, 2004). Thus, 4th task was designed and developed through the phases of this sudy as an example of this option. In classroom practices, it was seen that the students were curious about real life effects of their own behaviors and they were satisfied to obtain their answers by using mathematics. Moreover, during the study, the students conducted long-running operations to obtain their answers for the activity and they compelled their ability in the problem solving and mathematical thinking. After this process, they made beneficial inferences about both the mathematical and science side of the case. Hence, it was determined that integration of mathematics and science lessons is an effective way to organize their comprehensive activities in different disciplines because these types of activities helped to satisfy their cognitive, emotional and social needs in classrooms.

Integration of Mathematics & Language Lessons: In the draft principles, this characteristic was taken only as mathematics and Turkish lessons, but through the discussion with teachers, it was determined that principles and issues in Englih language lesson should also be involved in the tasks. As mentioned in the modifications in try out, implementation of the 29th task in classrooms lead the teachers and researcher to think in that way. Hence, as the last suggestion for interdisciplinary tasks of mathematically gifted students, integration of the ideas in Turkish or English lessons in mathematics tasks was accepted as another option that may occupy gifted students' attention. Moreover, it was determined during the phases that students are taking Turkish, English and

Mathematics lessons almost in each grade level and they are continuously involved in studies regarding these three subjects. Hence, relating the tasks with these subjects made the students feel confident in solving mathematics and they enjoyed from using these disciplines together. For example, as stated in Appendix A, the 5th, 6th, 7th, 29th, 30th, 31st, 32ndactivities reflect integration of these three disciplines and students needed to use the main properties and objectives of these lesson to obtain the answers of the tasks by using their mathematical thinking, which resulted in the satisfaction in their differentiated needs.

3. Beyond Curriculum Task

As another choice for the type of tasks, they can be beyond the curriculum to fulfill gifted students' need in learning more (Johnson, 2000; Karaduman, 2010; Rotigel & Fello, 2004) because beyond curriculum activities aim to realize, discover, teach or use any mathematical concepts that are ahead of regular sub-learning domain in the curriculum. Hence, content of some tasks in this study were designed and developed as beyond the curriculum to meet mathematically gifted students' differentiated cognitive needs.

Based on the idea that mathematically gifted students have the potential to make sense of the concepts beyond grade level, 16th, 23rd and 28th activities were designed and developed to discover or use new concepts. While doing beyond curriculum tasks, students did not realize that they were learning a new mathematics concept. That is, they were expected to learn a new concept they didn't know before but they did not know that to complete the task, they needed to use a new concept that they hadn't learnt yet. By this way, they became open to discover the logic of new concept by interrelating it with their existing knowledge. In line with this, in the classroom tryouts and field test, mathematically gifted students engaged in the beyond curriculum tasks that they discovered or used the new mathematics concepts. Although they haven't learnt the concepts before, it was seen that they could interpret or make generalizations about the solution of the tasks.

Furthermore, mathematically gifted students enjoyed discovering and using new concepts and could enhance their cognitive potential. By this way, they weren't restricted only to grade level curriculum objectives; on the contrary, they could involve in the rich mathematics and showed great enthusiasm to discover new concepts. For instance, in the 23th task, as the activity went on, they needed to share the half or any part of the pizza with other people. That is, they needed to discover how to divide fractions to a number. Although they hadn't known to divide fractions, they could make reasoning and obtain the right way of thinking. Hence, they could make sense of the actual meaning of the division in fractions instead of memorizing the rules, which made mathematically gifted students task oriented and excited during the activity. By this way, it was approved that beyond curriculum task is an appropriate opportunity as a type of the differentiated task in order to satisfy mathematically gifted students' cognitive, emotional and social needs in mathematics classrooms.

4. Technology Integrated Task

As indicated in preliminary research phase, most of the gifted students are very abled, motivated and successful in technology usage and the role of the technology in their motivation could be used as another option to fulfill their needs (Johnson, 2000; Siegle, 2004). Moreover, it is the fact that technology allows the students to proceed at their own pace (Kaput, 1992; Özçakır, 2013). Hence, this made the gifted students meet their own differentiated needs by providing them an individualized pathway. Hence, technology integrated tasks were selected as one the characteristics in terms of type of differentiated tasks and these tasks were designed and developed.

In this study, the 2nd, 24th, 25th, 26th activities were designed in a way that needed some usage of technology for the 5th and 6th grade mathematically gifted students. While designing activities, it was determined that all technological tools and any related programs like office programs, geogebra etc. may serve this purpose. However, for this study, only calculator usage was preferred because calculators were determined as mostly available technological tools in classrooms in a limited timeline. Moreover, it was deduced from the student's and teacher's data that technology usage helped to involve gifted students in an effective learning. For example, in the 26th task, gifted students saw that they couldn't solve the activity with their existing knowledge.

Hence, they had to think from different points and scrutinized the knowledge of place value in decimals. Similarly, for these activities, the students made sense of the mathematical concepts while engaging in the technology integrated tasks with enjoyment because being allowed to use calculator in the lesson was very unordinary and interesting for them. Thus, during the long running discussions through prototyping phase, technology integrated tasks were seen as the proper type of differentiated tasks.

5. Intelligence Question

Providing intelligent question to gifted students is another opportunity that meet their needs to think more and motivate them to worry and struggle about the answer (Baykoç, 2011; Freiman, 2006; Johnson, 2000). During the activities, the 3rd, 4th, 5th, 31st, 32nd, 33rd and 34th tasks were used as in the type of intelligence questions. It was observed that they challenged the students to think the cases from variety of points and helped them to widen their viewpoints by querying from high level. Moreover, to obtain a proper and meaningful answer for an intelligence question, students needed to think in depth and cautiously. Moreover, they enjoyed analyzing all the points in these different questions in order to find the answer and expanded their mind to obtain the answer. For instance, one of the students mentioned his satisfaction in the 32th task as,

> *"This mind question annoyed me. I went crazy to find the answer. I had to think all the points and details in the study to find the answer. I liked all these feelings and efforts. I would like more questions like this (S4, informal talk, week-6).*

Furthermore, the teachers in the study stated that intelligence questions helped the gifted students to develop their ability to look from different perspectives. By this way, they could find opportunities with these intelligence questions to satisfy their cognitive and emotional needs. Hence, based on all these data, it was determined that tasks that are in the form of intelligence questions should be included as another type of differentiated tasks for mathematically gifted students.

6. Math Puzzle

As mentioned in the draft design principles, math puzzles are another crucial activities that may be provided to gifted students as the opportunity to differentiate their tasks (Freiman, 2006; Gavin et al., 2009) because a math puzzle is an activity that requires mathematics to solve with some specific rules that the solver must find a solution satisfying the given condition. Hence, math puzzles were taken as one of the type of differentiated tasks and the 1st, 3rd, 7th, 8th, 10th, 14th,17th, 30th activities were developed as math puzzle tasks in order to motivate and enable gifted students to analyze and synthesize their mathematical ideas with rules of the puzzles.

During the try outs and field test, students had to remember and use their mathematical knowledge while being actively involved in the activities. Moreover, some of them saw these tasks as enciphering and gained pleasure for looking for the clues or keys. The students were also satisfied from engaging such kind of tasks in their classrooms. For instance, one of the students' interesting expression for math puzzle tasks was in such way;

> *"In this math puzzle, I felt like playing a game in mathematics lesson. I can meet my game need by this way (S9, informal talks, Week-4).*

Besides, the teacher stated the effective usage of math puzzles to practice new or old mathematic concepts by keeping the student's interest. Based on these data, usage of math puzzle tasks which were developed in preliminary research phase was approved in try outs and field test through design based process of this study as an option for differentiated tasks to satsfy 5th and 6th grade mathematically gifted students' cognitive, emotional and social needs in mathematics classrooms.

4.1.5.3. Characteristics in terms of Implementation Method

In addition to characteristics in terms of content and type of the tasks, characteristics in terms of implementation method was also seen as crucial for proper application of differentiated tasks in 5th and 6th grade mathematics lessons. In this section, some implementation methods were presented as suggestions to teachers.

At the end of the preliminary research phase, these characteristics were addressed as characteristics in terms of application. However, as stated in the modification part in field testing, based on the discussions with teachers, these characteristisc were determined as characteristics in terms of implementation method for content and type related characteristics. Moreover, during classroom tryouts and field testing, these methodswere found more suitable for the implementation of these differentiated tasks in mathematics classrooms. Besides, as mentioned in the later of this section, the students could find opportunities to satisfy their cognitive, social and emotional needs by means of these methods. First of all, it was observed that due to the fact that gifted students have differentiated characteristics and requirements in social environment, the implementation methods enabled them to fulfill these social needs by not being as priveleged. The problems these gifted students faced in classrooms like loneliness, exclusion or overpermissiveness could be diminished that they could be active in their classroom discussions and implementations. Similarly, these implementation methods provided easiness in teacher's classroom management because the teachers could solve the problems that arouse earlier in classroom. For example, the teachers stated that they could overcome the problems because their gifted students had gotten bored in lessons but with the help of these implementation methods, gifted students who could discover, question or learn new concepts could be actively involved in the lesson and there was no opportunity for getting bored. Moreover, they also stated that grouping opportunities or whole class implementations decreased the gifted students' selfish beaviors. Additionally, students' emotional requirement like enjoyment, love, interest or excitement could also be satisfied. For instance, in a discovery implementation of 24th task, the students were active and curious about what they would found at the end of the process. Lastly, as their social and emotional needs were satisfied, they could be involved in all activity process which resulted in the satisfaction in their cognitive needs. For example, in Week-4 in try outs, when the teacher (TS) noticed that the student finished and get bored in the exercise type of decimal activities, she wanted the student to go to the mathematics center. At the end of the lesson, the student explained his cognitive satisfaction with this implementation as:

"Thank you teacher. I have just learnt the golden ratio in one of the journals in mathematics center. It is another decimal but not boring one. My thinking way about decimals was enlarged. (S5, Week-3 in try out)"

When it comes to the classroom usage of these impememtation methods, it was determined that the teachers could select at least one of these methods after determining the characteristic of content/s and type/s of the task. These methods were designed and selected in line with the needs of both gifted students and classroom atmosphere in preliminary phase and modified during the prototyping phase. Moreover, while determining in these implementation methods, it was given crucial importance to level the playing field; that is, it was important to be equidistant to all students; both gifted and regular ones. Moreover, it was also significant that the gifted students are developed while they were not behaved as privileged. That is, after determining the content and type of the task, the teachers should select at least one of the implementation methods by not attaching the students as gifted. After the try outs, researchers and teachers saw that using more than one implementation method is necessary and more useful at some points. Hence, it was determined that at least one of these methods could be selected as the implementation method of differentiated tasks in the classrooms. In the following subsections, these implementation methods were explained in detail.

1. Whole class implementation

Based on discussions with experts and teachers, whole class implementation was determined as a choice for the usage of differentiated tasks in classrooms. In this method, teachers can use differentiated tasks in their regular instructions that all students in classroom can benefit (Chamberlin & Chamberlin, 2010). In other words, these differentiated tasks could be used as a whole class activity as similar to their regular lessons. This way, in classroom practicess, all the students in classroom performed the activity and they found opportunity to develop their abilities as well as gifted students who are not behaved as privileged. Moreover, when the times gifted students completed and other students couldn't, the teachers gave some clues to the rest of the classroom or the students were allowed to make groups of two or three to find the solution. By this means, all students in classroom could benefit from the activity and gifted ones could satisfy their differentiated needs in their regular classroom with a regular implementation method.

During the try-outs and field test, the teachers mostly preferred to use this method. The teachers stated that usage of the tasks with this method simplify their works in classroom. Moreover, as stated before, at the points where the regular students had difficulty, the teachers provided directions or clues to the classroom. Hence, all the students in classroom could perform the activities with an interest and enthusiasm. Moreover, all the teachers stated that they found this method useful and practical for regular mathematics lessons and effective for mathematically gifted students. Furthemore, for all students, they could have a chance to meet with such differentiated tasksand struggled them to make their best. Bythis way, mathematically gifted ones engaged in the differentiated tasks without feeling as privileged and this enabled them to fulfill their social needs in classrooms while satisfying their emotional and cognitive needs. Besides, it was also observed that the students in whole class implementation were active and curious for the entire lesson. Hence, the teachers and researcher approved this implementation method as one of the easiest and effective way for differentiated tasks.

2. Individual task for gifted student

As stated in draft design principles, differentiated tasks can be provided separately as an extra individual work when gifted ones complete their tasks (Chamberlin & Chamberlin, 2010). Based on data obtained through try outs and field testing, the teachers stated that by means of the individual tasks, the problem of boredom in mathematics classroom for gifted students could be solved and their need for more details and challenge could be met. Moreover, the problems about misbehaving, disrupting or making others talk could be solved by occupying the gifted students.

In the study, this method was applied by all of the teachers during their regular lessons. All of them preferred to use this method while solving exercise type of questions in the classroom. They explained that other students needed much more practice after learning new concepts. However, because gifted ones could solve them in a quick and correct way, after a while, they got bored and sometimes disrupted others. Hence, the teachers used this method and provided differentiated tasks to gifted students both to overcome these behaviors and boredom problems. Furthermore, the teachers mentioned that this method not only prevented such classroom management problems but also helped them to provide differentiated tasks to their gifted students. For example, in one of the classrooms, while solving exercises about fractions, one of the gifted students (S7) began to get bored and talk with others after completion of her own exercises much earlier than other students. At that point, the teacher gave him the 20th task which she brang with her for such a case and wanted him to find the answer. By this way, the teacher could control the gifted students and the student stopped his disruptive behaviors. Furthermore, the student engaged in the activity because it was observed that he was pleased from the task that cognitively and emotionally satisfy his differentiated needs.

To sum up, individual task for gifted student was seen as a helpful way of fostering and controlling giftedness. However, at that point, preventing on labeling the gifted student is the delicate issue. That is, when the teacher gives this extra task only to gifted ones, this could attract other student's attention, which could result in undesirable consequences. Therefore, it was determined through the discussions in try outs nd added to the teachers' booklets that it is important to make it clear that these activities are for all students; not only gifted ones but also all the students in classroom could be given those extra individual task in the classroom. Hence, the teachers should clarify the idea that the ones who completed their do's or routine tasks in the regular order could take those tasks or they can take them at the end of the lesson to complete them in break or at home. To sum up, with these warnings in mind, this type of the implementation method was seen as the other proper principle for satisfying students' needs in regular mathematics classrooms.

3. Mathematics center

In draft design principles, as another option for an implementation method, the idea of constructing "A Mathematics Investigation Center" (Wilkins et al., 2006, p. 7) was determined for gifted students in mathematics classrooms. For this center, ateacher can bring some challenging or interesting tasks or students themselves can prepare and bring tasks or questions into the center (Diezmann & Watters, 2001; Hannah et al. 2011; Sriraman, & Sondergaard, 2009). Based on this idea, it was determined that differentiated tasks could be presented in such a centre. Hence, in each of the classrooms, a mathematics center was created and as implementation method, these differentiated tasks were placed in these mathematics centers. At that point, it was decided that the rules should be clear and there should be a system that the students should know when and how they can go to that center. Thus, they were informed about which days new tasks come to that center and what are the rules for usage of this center. By this way, the students could benefit from these tasks by going to that center.

In the study, two of the teachers in try outs and one teacher from the field test preferred to use this method actively. They constructed mathematics centers in the classrooms by involving the student in construction process. As well as the teacher, the students brought some story books, test books or magazines to the center. The researcher and teachers brought different magazines like 'Bilim Çocuk' 'Araştırmacı Çocuk', 'Dünyalı' or scientific books like in the TÜBITAK publications. Moreover, the teachers set a place for "Question for Brainstorming" and they putted some of these tasks in here. It was observed that all the students as well as gifted ones were interested in the books or tasks in that center. The teachers specified the rules in order to prevent management problems and this provided easiness in the usability and effectiveness of the method. The students using the center stated their satisfaction for reaching more advanced knowledge and their emotional well-being. For instance, the student in field test explained his emotional well-being when his teacher asked about his ideas for mathematics center in classroom.

> *"I feel like a scientist. It seems like a room for scientist. I can reach everything in this center and there are various challenging activities in here. I feel lucky to have this center (S9, Week-4 in field test).*

In addition to students' satisfaction, the teachers also stated that this method enabled them to attain all of their own goals because this center provided more time and opportunities for usage of these differentiated tasks without spending their time from regular lessons. Hence, presenting the tasks in mathematics center was approved as an implementation method for the differentiated tasks of mathematically gifted students.

4. Teamwork

In line with the idea that cooperative or group learning enable gifted students to work together and provide improvement both for gifted and regular students (Baykoç, 2011; Chamberlin & Chamberlin, 2010; Deizmann, & Watters, 2001), teamwork was approved as as an implementation method for differentiated tasks of mathematically gifted students. During the discussions in try outs, it was determined for teamwork implementation method that teachers can use both homogenous and heterogeneous groups based on their aim for the tasks. For example, some suggestions were provided for the application of differentiated tasks as group working activity. The teachers could form heterogeneous groups and provide different tasks to each group in line with the needs of the group. That is, the ones in the lower ability group can take tasks that explain the basic mathematical concepts related with the objective of the week. Then the ones in the intermediate group could have exercise type of tasks that help to reinforce what they learn, the ones who have higher abilities can have difficult questions and the group of gifted students can have those differentiated tasks both related with the objective or not. On the other hand, the teachers could form homogenous groups and distribute these activities to each group and want them to obtain the solution by collaborating with each other.

All these teamwork suggestions were used by two teachers; one teacher in try-outs and one teacher in a field test. The students enjoyed being together and the teachers mentioned the effectiveness and easiness in the usage of differentiated tasks in group working. Moreover, they also mentioned that gifted students who were shy and silent could have an opportunity to share their knowledge with other students in the classroom. Furthermore, they became natural leaders of the groups; used their management skills and helped others to complete the task. By this way, the teachers mentioned that this implementation method was usable and effective in providing some social benefits to gifted students. Moreover, students getting bored in regular implementations could find opportunity to reflect and share their own ideas in their teamwork. By means of these benefits, teamwork was approved as an implementation method for mathematically gifted students' differentiated tasks.

5. Project based

As another option, project based implementation was decided as a suggestion for an implementation method of differentiated tasks. In preliminary research phase, it was concluded that some researchers (Diffily, 2002; Stanley, 2012) advocate the project implementation as a good opportunity for gifted students. They stated that tasks could be given to gifted students as projects which they can complete individually or as a group in the specified timeline with specified requirements. Hence, it was deduced that the teachers could give one or some of the differentiated tasks, especially the ones more challenging or needing more time, as a project based task to the 5th and 6th grade mathematically gifted students to complete it individually or as a group.

From this point of view, teachers in try outs and field testingpreferred to use the 35th, 36th, 37th, 38th and 39th activities with these project based implementation method. When these activities were analyzed; it was seen that teachers mostly preferred to use mathematical modeling activities with project based implementation. They explained their reasons that modeling problems required a lot of time and students needed some process to comprehend its requirements. However, they do not have these required time in their regular lessons. Project based implementation provided opportunities for this requirements. That is, in project based implementations, the teachers could follow the student's procedures that they tried to complete in their leisure times with other students in the group. This way, they obtained more time to reason their knowledge and comprehend requirements of the question as well as receiving their teachers' feedback during the process. Besides, students stated their satisfaction for project based implementation due to its role in providing excessive time to search and learn about the tasks. For instance, the student conducting the 35th task as a project based implementation expressed his ideas as,

> *"This project study was so enjoyful and interesting. For this question, we had to think many cases and so we needed many time to work together. We were as busy as a bee, we become a good team. I'm sure the conclusion we obtain is*

the right way for the volleyball team. Project study was beneficial for us to reach our goals because if we had been in the classroom, we wouldn't find necessary time and energy for this (S7, Informal talks)."

To sum up, project based implementation as mentioned in the draft design principles was seen as an effective and beneficial way to satisfy gifted students' needs especially for some kind of differeantiated tasks.

6. Teaching Methods: Discussion, Discovery and Questioning

For the sixth implementation suggestion, some teaching methods were selected as being more appropriate for implementation of differentiated tasks for mathematically gifted students. These were discussion, questioning and discovery methods that they were seen as more coinciding with both gifted student's needs and proper usage of differentiated tasks in classroom environments.

As mentioned in draft design principles, discussion method helps to extend gifted students' knowledge and meet their need of elaborating more on concepts by communicating with others about new or already acquired knowledge of mathematical concepts in classroom (Johnsen & Ryser, 1996). Moreover, questioningmethod helps to probe students' thinking and satisfy their need for learning more involving why, how and what if questions (Johnson, 2000; Sriraman & Sondergaard, 2009). Lastly, because concepts with the help of abstract tasks may catch gifted students'interest, discovery method enables to fulfill their needs to learn the logic and rationality behind the concepts (Johnson, 2000; Van de Walle, et al., 2013; Wilkins et al. 2006).

Based on these ideas obtained in the preliminary research phase, during the study, teachers mostly preferred to use these teaching methods in order to best meet the differentiated needs of mathematically gifted students. It was observed that instead of getting bored, students were on the alert for the questions needing higher level thinking and this made them think in detail and relations of the concepts. Moreover, it took their interest more to discover the concepts or questions on their own, rather than providing knowledge directly to them. Especially for the beyond curriculum tasks, the teachers used discovery method to enable them making sense of the new concepts. Moreover, they continuously preferred questioning method while engaging in the tasks and especially when the students need help or clues. They guided their students' thinking by asking meaningful questions about the tasks and the students were also content with this method. For instance, at the end of the task in a lesson in week-5, one of the students stated to her teacher in the break times;

> *"Now, you ask thought provoking questions. I think them even in my home. I liked questions in classroom (S5, Informal talks in try out)."*

Additionally, the times that the students got stuck more, discussion method was preferred to elaborate on the tasks with students. As seen in observations, this method also engaged the gifted students in lesson because it was seen that they liked to share their opinions freely in classroom. Moreover, the teachers were also satisfied from active involvement of these gifted students' in classroom. Hence, these methods helped the gifted student's strong desire to reflect their own ideas because they could express and share their opinions. For these reasons, usage of these teaching methods was decided as another option for implementation of differentiated tasks to satisfy mathematically gifted students' cognitive emotional and social needs.

7. Task as assignment

As the last suggestion for implementation method of differentiated tasks, as stated in draft design principles, providing the tasks to gifted students as assignments may lead them to use their creativity and higher order thinking (Johnson, 2000). During the try outs and field testing, there were various usage of differentiated tasks as assignments. For example, while giving assignments to all classrooms, the teachers gave these differentiated tasks as assignment to only gifted students in the classroom. As another option, while giving homework, the teachers provided options to all class; that is, various types of homework could be given such as; 10 easy exercise type questions, three difficult questions and one differentiated tasks. After then, the teachers wanted their students to select one of them as an assignment, where gifted ones selected the differentiated ones while others prefered easier and routine ones. As another suggestion, teachers provided these as an extra assignment together with routine assignments of all students and they said that anyone could take this assignment and they were rewarded for their extra effort.

In detail, during the try-outs and field testing, the teachers used differentiated tasks in their assignmentswhen they didn't spare required time for the activities. That is, teachers mostly selected the tasks that need more time as assignments for students because they stated the lack of time for these tasks. Hence, assignment method was used especially for the long tasks. The teachers thought that the students should engage in the long-running tasks and should learn to focus on the everlasting tasks. Hence, because they didn't have a lot of time the in classrooms, they mostly preferred to use these tasks in student's assignments. Also, when the teachers gave these tasks as an extra assignment, they gave extra points for the ones that completed these in order to motivate them for other assignments. Moreover, one of the teachers in try-outs used the tasks as assignment by constructing different types of homework for each group of students. The gifted students were satisfied from struggling with these interesting assignments and they showed enthusiasm. Even, some of the students came to the teacher's room in the morning to say that they found the answer in the assignment. Hence, it was determined that the teachers could use this method practically and effectively and stated that it was crucial to organize the assignments in a way that motivate the students to complete at home.

4.1.4. Summary for Final Design Principles

The characteristics mentioned in this section of the study are final design principles that guided overall process of the study about designing and developing differentiated tasks for satisfying the 5th and 6th grade mathematically gifted students' cognitive, emotional and social needs. At the same time, these are the main outputs of the design based research; those well-prepared and tested design principles as characteristics of tasks were obtained at the end of the process. As it was stated in methodology chapter, those design principles went through a rough period by beginning as draft design principles and being shaped as the final design principles. In this process, comprehensive studies were conducted to complete two basic phases of the design based research. In these phases, while design principles took their final shapes, the usage of these differentiated tasks in mathematics classrooms were evaluated in their real context in respect to students and teacher's experiences, as well.

Hence, crucial characteristics required for developing differentiated tasks for 5th and 6th grade mathematically gifted students in classrooms were constituted with the help of design based process and how these tasks benefited to the students and teachers were examined during the data analysis. In the following section, findings about benefits of the intervention to the students were presented as an answer for the second research question.

4.2. Benefits of the intervention to teachers

As stated before, differentiated tasks, developed for satisfying 5th and 6th grade mathematically gifted students' cognitive, emotional and social needs, were used in mathematics classrooms by four different teachers in try-outs and field test. Due to the nature of the design based process, the teachers involved in every part of the design, development and evaluation of the study. Hence, the data reflecting their changes could be recorded during the study. Findings obtained from both classroom observations, teacher interviews and teacher forms reflected that the study had many benefits for teachers about gifted students when they were compared with their initial state. Those benefits, presented in the following headings, were gathered in three sub-categories as benefits to teacher's awareness on giftedness and gifted education, self-adequacy on giftedness and collaboration with other colleagues.

4.2.1. Teachers' awareness on giftedness and gifted education

In this subsection, findings reflecting how teacher's awareness about gifted students and gifted education changed through the design based process were presented. In the first part of this section, data obtained from teacher's pre-interviews were presented to examine the teacher's initial awareness about gifted students. In that case, findings showed that teachers were unaware of gifted students both in general term and in their classrooms. That is, teachers had a limited knowledge about gifted students like only knowing the existence of such students. For instance,

> *"I hear something about them, I heard the word gifted but I have no idea how those students are and how they behave (TS, pre-interview)."*

Furthermore, although two of the teachers were selected purposively for their effective teaching and master's degree, it was seen in the pre interviews that none of the teachers have adequate basic information about the characteristics of gifted students. Even, two of the teachers mentioned about their familiarity with gifted students as only an institution. That is;

"I know nothing about gifted students. I only heard about gifted students that they attend to an institution that you are working at (TR, pre-interview)."

At that point, it was seen that teachers thought gifted students as different students who attend different schools or institutions. They understood the term of giftedness as difference in the meaning of anomalous and thought that gifted students were educated at separate institutions. Furthermore, they said that they have never seen a gifted student before. Hence, they thought that they didn't have gifted students in their classrooms both in the past and now. That is, three of the four teachers stated that they do not have gifted students in their classrooms; they are the kind of students that attend special schools. To illustrate,

"They took my attention but I have never worked in such a school that gifted students attend (TS, pre-interview)."

Similarly, as well as their limited knowledge about these students, one of the teachers and even the administrator of the school was very bewildered about researcher's coming in to the school to teach gifted students. Following examples presented how they stated their despair to find such a gifted student in that school.

"I think you will waste your time in here. You should go to another school to find such a student. You can't find gifted student in our school. I think those students live in other countries like America. Anyway, the level of this school is very low, it is enough for us if we can make students come to the school, not to escape (ADM, pre-interview)."

"Here is only a public school that students' families have low socioeconomic status and students have low levels in academic success. So it is not possible to find such a student but you can try to find it (TS, pre-interview)."

As seen in their statements, both the teacher and the administrator didn't have any hope that they had a gifted student in their schools. On the other hand, it was another issue faced in the initial interviews that while mentioning about gifted students, it was seen that they sometimes used giftedness and hardworking interchangeably. To exemplify:

> *I have and had hardworking students but I do not know whether I can say them as gifted, what is the difference? Being more intelligent? But how can I differentiate it (TN, pre-interview)?"*

Due to the fact that teachers have not enough information about the difference between gifted and hardworking, they think that providing more exercises, solving more test questions could be beneficial and appropriate to fulfill their extra needs. For example, one of the teachers explained the case from his prior experiences.

> *"I worked as teacher in different private teaching institutions (dershane) very long time. There were so many gifted students there. I didn't do something special for them but we gave them more test questions, more difficult test questions (TM, pre-interview)."*

Similar to this, the other teacher mentioned about extra test questions as a solution for gifted student's extra needs and it was presented below,

> *"We may provide extra tests to those gifted ones related with only objectives of lesson (TR, Pre-interview)."*

As seen from the teacher's statements, they thought that more exercises or test questions could be provided to gifted students in order to fulfill their needs. That is, as well as their unawareness about giftedness and gifted students, they were unaware about what they can do for these students because their ideas are limited to solving more questions. Hence, as it can be easily seen from the words of participant teachers, they were unaware about gifted student's characteristics and needs. In line with this, the case was similar for teacher's prior awareness about Science and Art Centers (BİLSEM) where gifted students attend and educated after their school times. As stated before, these are the institutions on the authority of Ministry of National Education (MoNE) that students could attend those centers in reference to teacher's nomination and student's test scores. However, it was deduced from the interviews that the teachers were also not aware of these centers. In the first interview, one of the teachers said that he hadn't heard the word of BILSEM while three of them said that they knew

BİLSEM. Among those teachers who knew BİLSEM, it was seen that they had not adequated information about these centers. One example illustrating this case is provided below.

> "*Yes, I know BİLSEM. I had a student attending at BİLSEM. She was saying as 'I 'm going to BİLSEM' but I don't know anything, I mean details (TN, pre-interview)."*

In brief, findings frankly revealed that teachers were unaware about general and specific characteristics of gifted students as well as BİLSEMs. On the other hand, although no prior experience and knowledge, teachers of the study were keen on learning something about gifted students and gifted education. Therefore, it was the positive side of the study that all four teachers were willing to study. To illustrate,

> *"Although I do not do anything for them, I'm willing to do something because gifted students take my interest. This study serves my purpose for learning about them (TS, pre-interview)."*

As it is seen from the words of the participant teacher, they are willing to carry out some applications for gifted students in classroom. However, in spite of this willingness, they didn't know what to do for gifted students. In the following example, one of the teachers mentioned about his lack of knowledge in such a way:

> *"I cannot distinguish gifted students from other students. Even if I can distinguish, I have no idea about what we can do for them, if I knew, I haven't known how I can apply these (TM, pre-interview)."*

As seen from the teacher's statements, their unawareness was not only limited to characteristic of gifted students. Teachers were unaware about both the content and implementation method of the appropriate applications that could be provided to gifted students. Here is how one of the teachers mentioned about this problem,

> *"In fact, I agree with you in the idea that we should do something extra for them but I have no idea what we should do and whether we should do this in classroom or in a separate place. I think we can't do this in a classroom because other students will notice and this can result in trouble. If we do this*

in a separate place, again this will cause problems and the child will feel different, even her/his parents can feel special. So, even if I know what to do, management of this is another difficulty (TN, Pre-interview)."

To sum up, analysis of pre-interviews clearly elicited the reality that teachers blind to the gifted students and unaware of their needs in these classrooms. On the other hand, analysis of the post interviews conducted at the end of the design based process revealed the changes in their awareness about gifted students. In other words, at the beginning of the study, teachers didn't have enough awareness about gifted students. Even they had some hearsay, they didn't know what to do for these students in classrooms. Nonetheless, it was seen in the post-interviews that teachers become more equipped with the properties, developmental and educational needs of gifted students in their classrooms. Contributions in terms of knowledge and increase in the teacher's awareness were clearly seen in their sentences. For instance, two of the teachers gave proper explanations about gifted students and their educational needs when they were asked about what they now know about gifted students.

"Gifted students think differently, learn easily and quickly, like to discovery learning and have strong reasoning abilities. Sometimes, they are ambitious for success and stubborn. However, some of the gifted students are hidden; they are very shy and silent (TS, post interview)."

"I know about gifted students that they achieve the solution very quickly in a creative way. They think in a way different from the others. They do not limit themselves using in one way, they try to verify their solutions (TR, post-interview)."

As it is seen, teachers learnt about gifted students and this showed us the difference in their knowledge. In the beginning of the study, they had no idea or they thought that being hardworking could be an indication of giftedness. However, as clearly seen in their sentences, now they had a clear and more comprehensive understanding about the characteristics of gifted students. Hence, these are the benefits of the study in terms of increase in the awareness of teachers. In line with this, teachers also mentioned about these benefits with their own words. Here are the three teacher's sentences reflecting their variation clearly:

> *"This study increased my awareness: Before anything else, I learned the existence of gifted students even in my classrooms. (TN, post-interview)."*

> *"Frankly, lots of contributions for me: I know the level of the students; I know the gifted students. I learnt many things, I did something for my gifted students. I was oblivious of my gifted students (TR, post-interview)."*

> *"I personally have lots of benefits: I realized that I should do something for my gifted students. I learnt who is the possible gifted, I learnt how to behave, I learnt that we should provide different applications for them. (TM, post interview)."*

As seen in the teacher's words, they felt their improvement on their knowledge about the gifted students and they clearly stated the contributions of the study. Moreover, together with this awareness in the properties of gifted students, teachers become more equipped about the necessity of doing something for these students. Moreover, they had knowledge about what they can do for gifted students in their classrooms. For example:

> *"I have partial knowledge but I know they need special education, as teachers we should spend time for them because they need special interest to fulfill their potentials (TN, post interview)"*

As well as this awareness of teachers about gifted students in classrooms, they mentioned that they were more equipped about tasks, applications and approaches for students. To illustrate,

> *"Now, I know what they like or don't. I can prepare proper tasks for them. Moreover, I have an itinerary to follow the right way (TR, post-interview)."*

Furthermore, one of the teachers reflected his comprehensive knowledge about guidance of gifted students as follows:

"I know that meeting with the parents and explaining the case is a crucial point. Also, we can lead our students to another institution, to a psychologist or BİLSEM. BİLSEMs are our rescuer. We can make collaboration with them (TM, post-interview)."

As seen from his sentences, although he even didn't know the BILSEM at the beginning of the study, now he was knowledgeable about the rings of this chain. Similarly, one of the teacher's long explanation summed up the last point that she reached. At the end of the process, she was able to observe the gifted student and realized the differences in his behaviors. That is,

"I noticed that when we spend long time for explanation of the content, the gifted child begins to get bored and draw something on his notebook. Before this study, I hadn't notice this, but now I noticed and tried to get him involved in the lesson. At least now, I know what I should do and what I shouldn't do. When I try to do something for him, we become closer to each other. Furthermore, doing something for my student who I mostly neglected up to this time felt me happy (TS, post-interview)."

This verbatim revealed the important gains of the study in terms of increase in her awareness about gifted students and approaches to them. Besides, another crucial gains in terms of increase in their awareness was the issue of daily life. Almost all of the teachers mentioned about their changes in their lives. First of all, they mentioned that they began to relate something they hear or see to their gifted students. For instance, in the following sentences, one of the teachers talked about the awareness issue in her daily life.

"Even in irrelevant places, for example, when I saw a question in a competition in the TV, or a puzzle or a riddle, I say that 'Hımm I can use it in my classrooms, it takes the gifted one's interest' (TR, post interview)."

Teachers also mentioned that the increase in their awareness affected their social interactions. They mentioned that they share this knowledge with their family and with their friends in their coffee or tea talks because they wanted to increase other people's awareness. Moreover, one of the teachers also emphasized how the study made an effect on her awareness in the daily life:

> *"I speak to teachers in my entourage and explain gifted students as much as possible. I make observations on their children. Once, I observed my friend's child and mentioned the possibility of this case. They went to a psychologist and they made WISC-R test and now she is diagnosed as gifted. I think it benefit's both me and my entourage. It is my awareness even in daily life (TN, post-interview)."*

The teacher's anecdote not only revealed the benefits of the study on the teacher's awareness in her life, but also the reality that equipping the teacher's about gifted students could help to discover other gifted potentials. Similar to this anecdote, another teacher shared his experience with his own child that this study had a critical role even in the awareness for his immediate family. His words explaining the issue were stated below,

> *"I absolutely think that this study had many benefits for my life. For instance, the times that you come here and we went to hospital for our child are concurrent. You mentioned to me about possibility of giftedness for my own child. Although other people said this to me, before I thought my child as normal not gifted. Even if he is gifted, I thought that there was nothing to do. But now, I know that he is gifted and I aware of his difference. Moreover, I absolutely know that his difference should be developed and followed. I even think about using those tasks or the similar ones in his earlier age (TN, post-interview)."*

In addition to this effect of the teacher's awareness on his own family, the teachers also mentioned how they changed their awareness in their future decisions. In the following example, the teacher mentioned that she made two important decisions for her life after participating to this study.

> *"I have many gains for my professional development. Even I applied to one of the congress. I'm planning to take part in the 3. Intelligence and Ability Congress. I think I need more information and I need to develop myself more.*

I'm planning to design new tasks like yours. Even, I'm searching about BİLSEM because now, working at BİLSEM takes my interest (TS, post-interview)."

In her sentences, working at BILSEM and participating to relevant congress will give her variation in her awareness that the study had provided to teachers. As it was seen both in observations and student's statements, the study provided many contributions to the teachers in terms of the awareness in their actions of the life. Hence, this awareness made them see the events even in their daily life from different perspectives.

To conclude, the benefits of the study in terms of increase in the teacher's awareness regarding gifted students; their properties, needs and suitable opportunities, were investigated in this section. Identification of the gifted students in their own classroom made them aware of the issue because they didn't think that they have a gifted child in their own classroom. Although they were unaware and not knowledgeable about gifted students and proper tasks that suit the needs of these students, they were aware of the issue with details at the end of the process. With the help of the design based study, the teachers involved in all process of the study as participant, as developer and evaluator of the tasks. Hence, this involvement made them acquainted with gifted students; created and increased their awareness. In parallel with this, the benefits of the study regarding self-adequacy of teachers were investigated in the following section.

4.2.2. Teachers' self-adequacy about giftedness

Findings reflected that the study had benefits to teacher's self-adequacy of gifted students, as well. That is, teachers mostly mentioned about the contributions of the intervention with respect to increase in their self-adequacy of mathematically gifted students. Hence, in this section, benefits of the study to the teacher's self-adequacy was examined. Similar to the first section, the statements were addressed in two parts as pre interviews and post interviews in order to infer the changes in teacher's sentences with regard to self-adequacy.

Analysis of the pre interviews reflected that at the beginning of the study, all the teachers felt insufficient on using strategies to reveal their gifted student's full potential. They also regarded themselves as inadequate for providing proper educational opportunities to these students. Their answers were very obvious that they felt insufficient for gifted students and the examples of this case from all the teacher's answers are presented below.

"I want to do something for gifted students but I don't feel equipped myself so as to make something for them (TS, pre-interview)"

"I don't feel qualified in terms of providing proper opportunities to my gifted students (TN, pre-interview)."

"For the present, I have never feel adequate about this issue (TM, pre-interview)."

"I feel myself incompetent (TR-pre-interview)."

As seen from their statements, all of the teachers participated in the study lacked in the self-efficacy about gifted students. On the other hand, analysis obtained from post interview data revealed the changes in teacher's self-efficacy related opinions. That is to say, in post -interviews, all of these teachers spoke their mind that their self-efficacy was increased with the help of this study because they feel more qualified and equipped about gifted students and gifted education. Here are the obvious examples from two teachers mentioning the incompetence in the pre-interviews and explaining this change directly:

"I understood gifted students and how I can study with them. I can say that I feel confident about gifted students (TS, post-interview)."

"I feel good because I can say some words about this issue at the moment. My lack of knowledge prevented me to be interested in gifted education, but now, this study, whose process has many details, changed my perception that I can deal with the gifted students and gifted education. Now, I feel more qualified (TR, post-interview)."

In these examples, although they were not asked for directly, the teachers stated the changes in their self-efficacy related emotions. During the interviews, they continuously mentioned that they were more qualified about gifted education and feel more confident to meet educational needs of mathematically gifted students. Hence, the teachers gained self-confidence by means of this study. In those post interviews, three teachers stated this confidently and indicated that they could do many things for gifted students now. In these statements, the increase in their self-adequacy could be clearly seen, too. To illustrate,

> *"I don't say I'm an expert but I feel more comfortable. That is, I see myself one step ahead. At the beginning of the study, I thought that I could do nothing without you. Even with you, I worry about myself whether I can apply properly or whether I am suitable for this study. But now, I can do something without you (TN, post-interview)."*

Similarly, two of them stated the gains in their self-efficacy by explaining how they can go ahead of the tasks provided them. That is,

> *"By means of these tasks, I find myself more adequate and equipped, I will apply these in my classrooms since then. I will make more search about what we can do in classrooms and I will add some extra questions in line with yours (TM, post-interview)."*
> *"I know the gifted students and their levels. Even if I cannot identify these levels, I can provide some activities you gave us or the similar ones for the students from whom I suspect in terms of giftedness. I can organize them or I can adopt them in accordance with the needs of my own classroom. In a sense, I can take care of myself, don't worry about me [laughing] (TR, post-interview)."*

From the last teachers' reaction and words, her relief could be seen even though she had full of concerns about her adequacy at the beginning of the study. As a last example from the teacher's statements, one of the teachers explained that she felt qualified and this made her good. That is, *"I felt myself more satisfactory. When I do something for gifted ones, I had a clean conscience about doing something for gifted students. I felt to be sufficient for them to some extent and I saw this from their reactions, too (TN-post interview)."*

From the analysis, it was examined that the teachers had serious problems about gifted students and their education at the beginning of the study. They neglected the gifted students because they were not aware of them and could not realize their difference. As consequent of this, they had many concerns about their qualification and adequacy about gifted students. However, as they carried out the crucial steps of the study, they not only spent more time with gifted students but also learnt the properties and educational techniques for their gifted students. Hence, this made the teachers progress about gifted education and naturally, resulted in gains based on their self-adequacy about the issue. As a support of these classroom observations, teachers in the post interviews and informal talks also revealed this change as contributions for themselves and they were provided in this section. In addition to these benefits to teacher's self-adequacy of giftedness, benefits of the intervention to teacher's collaboration were also deduced in the data analysis and they were examined in the following section.

4.2.3. Teachers' collaboration with other colleagues

In this section, teacher's data was investigated based on the benefits of intervention to the teacher's collaboration with other colleagues. In researcher's observations, it was seen that all teachers in the study set up a social network about usability, organization, content and practicality for using differentiated tasks in accordance with the needs of both gifted and regular students in their classrooms. During the study, teachers in the try-outs communicated with each other about the details of implementation and programming as well as reactions of students in their own classrooms. When needed, they changed their methods, programs or implementations or they accommodated their own methods with reference to the best implementations of other teachers. In addition to this group working, they communicated with other teachers not in the study and they shared their experiences about gifted students and their reactions for these implementations. These observations also found a place in the interview transcripts that this study made a difference in collaboration of participant teachers with the other teachers both in the school and outside the school.

First of all, data obtained from post interviews showed that teachers in the same branches who do not need to communicate in the regular curriculum process needed to communicate with each other. These teachers continuously collaborated with each other for proper usage of differentiate tasks in their own classrooms. Here are how two of the teachers emphasized this collaboration with their own words:

> *"Frankly, everybody follows in line with their own speed and way; hence, we do not talk about our routine mathematics curriculum. However, for this study, the case was not like that. The curriculum was not routine and each student was very different from the other gifted ones. For this activity, it was very good that we strongly needed for the experiences and opinions of each other. At the beginning of the process, we made a meeting with all teachers participating in this study. We talked about the students; which students, in which classrooms diagnosed as gifted. After that, while we were in the implementation process, we got each other's opinions and talked about: 'How I applied for this activity', 'How did you plan?', 'How we can develop this part?', 'I faced a problem in the classroom' (TN, post-interview)."*

> *"When I talked to other teachers about this study, they all had a great interest for the study and we got into a group working, even though we applied them individually, it was a process and nobody had any idea. Hence, we always needed to consult and learn from each other. Normally, we are together in 5th and 6th grades classrooms but we do not speak about the students apart from the times of general exams. But this was so different, everybody had to help and learn together (TS, post-interview)."*

Similarly, it was observed that the participant teacher in the field test study shared all of her tasks and experience with other teachers and established informative dialogues both in their school and other schools. To illustrate this case from her own words, *"In the school, I was the only teacher conducting this study. However, other teachers wanted to learn about something about gifted and I gave my tasks to others. I tried to explain the program and organization of the material. They examined the questions with great eagerness and wanted to apply them in the Maths applications elective lesson (TR, post-interview)."*

In addition to increase in the collaboration among the same branches, the teacher's interactions with other branches in the school were also formed. That is to say, with the help of this study process, teachers communicated with other teachers and tried to inform them about gifted students in classrooms. They also mentioned about their speech with the teachers in other branches about how they should behave to gifted students. Moreover, as the teachers carried out new and different activities, the other teachers realized the case also from the student's reactions in the classrooms. Hence, as they saw this excitement and organization both in the mathematics teachers and students, they asked and wanted to know about the details. Besides, due to the novelty of the gifted concept, the teachers wondered about the students and applications. Accordingly, these interactions were observed in the teacher's lounge during the study. An example of this interaction, from the post interview of the teacher in the field test study was presented.

"During this study, I always shared my observation and process with other teachers. They followed the process with great interest and this built our bridges. I continuously informed the classroom teachers of gifted students; one of them is an English language teacher and the other is a science teacher. They were surprised about gifted students in their classrooms and wanted me to share the steps with them (TR, post-interview)."

On top of teachers in different branches, all participant teachers communicated and collaborated with the school counselor in the matter of gifted students in the school and tasks that would be used in classrooms. For instance:

"We talked with guidance service. Especially about students, who are the gifted, how we should approach to them. We organized a working plan with them (TN, post-interview)."

Lastly, in terms of benefits for the collaboration of teachers in the school, all the teachers mentioned about their meeting with the school principal due to the nature of conducting a research study about gifted students. Here is one example that the teacher stated her interaction with the school principal about gifted students and gifted program in the school.

> *"The school principal made a contact meeting with us. It was very beneficial that we talked about diagnosing and providing proper tasks for gifted students. During the process, we informed him about the gifted students, our steps and benefits of the study. Sometimes, we appealed for help about difficulties or problems that we faced in the procedure (TN, post-interview)."*

As seen from the teacher's statements, the intervention had benefits to their collaboration not only with the teachers in the school but also with the school principle. As they stated in their pre-interviews, they didn't need to collaborate with each other in their regular program. However, as it was also seen from the observations, during the try-outs or field test, the teachers, guidance service and school administration, worked in a systematic discipline by collaborating with each other. One of the teachers mentioned about this as "working as a cog in the machine *(TS, post-interview)."* Besides, during the study, the teachers involved in each process not only in the implementation but also in the evaluation. After application or examination of tasks, they were also asked for their ideas and adaptations about the study. Hence, it couldn't be far away from the effects on their real life. Among those effects, benefits were outstanding conclusions that their interaction both in the school and outside school was affected from the study. They communicated more with the other people; hence, they made more collaboration with them. Therefore, the benefits of the study to teacher's collaboration with others were investigated in this section. Up to this point, benefits of the intervention to the teachers were investigated that the study had some contributions to the teacher's awareness, self-adequacy and collaboration. After all these benefits, following section was organized to examine the benefits of the study to mathematically gifted students as the last category of findings.

4.3. Benefits of the intervention designed to satisfy mathematically gifted students' needs

As for the teachers, the study had valuable benefits to mathematically gifted students in terms of satisfying their needs in classrooms. In this section, these benefits were investigated as an answer for the last research question 'how the 5th and 6th grade mathematically gifted students benefitted from the differentiated tasks designed for satisfying mathematically gifted students' cognitive, social and emotional needs?'. As it is known, mathematically gifted students are different from regular students in classrooms and they have unique mathematical potential. So as to reveal and not to lose this potential, mathematics classrooms provided opportunities for their cognitive, emotional and social needs. Moreover, the student's reactions and opinions were gathered during the study as the data reflecting their experiences in using differentiated tasks in mathematics classrooms. All the data, obtained from pre and post interviews, student's after sheet forms and student's assessment forms as well as researcher's log-book reflected the benefits of the study to satisfy mathematically gifted students' needs and those benefits were handled in three different sub-categories. Hence, the benefits of the study in terms of satisfying mathematically gifted student's cognitive needs, emotional needs and social needs were investigated in the following three subsections.

4.3.1. Satisfying students' cognitive needs

In this part of the section, analysis reflecting the cognitive benefits of the intervention to the mathematically gifted students were examined. It was seen in the analysis that intervention provided cognitive gains to these students who lack more cognitive supports in their regular classrooms. These benefits were mentioned not only by the teachers but also by the students. Hence, in this section, findings will be presented firstly from the teacher's perspective and then from the student's perspective.

As interview transcripts reflected, all teachers believed that tasks provided general cognitive benefits to the mathematically gifted students like development of thinking, reasoning, mathematical thinking and problem solving as well as challenging the students. These were the most frequently stated skills that the teachers formed various sentences reflecting the role of the intervention in development of these skills. When the teachers were asked about their opinions about differentiated tasks, all of them directly mentioned about those cognitive benefits. Herein after, each teacher's view about those cognitive benefits to their gifted students was given separately to exemplify the case with their own words:

> *"The activities were not routine that we cannot find in books. I think using these tasks developed lots of abilities of gifted students such as problem solving abilities, power of thinking and mathematical thinking… They are the questions that needs comprehension in variety of ways. Hence it developed students' cognitive skills (TN, post-interview)."*

> *"They are the kind of questions needing attention, focus and logic, not memorization. They were joyful and really made a sensation for gifted students… They puzzled and surprised the students…I think they were very beneficial because students needed to reason and get in touch with their all mathematical knowledge to solve the questions. Students also needed to question the relationship of mathematics with other disciplines. Hence this study developed gifted student's mathematical thinking. (TS, post-interview)."*

> *"As I said, the gifted student would never solve such questions. At least now, she tries to think about such kind of thought provoking and everlasting questions. (TM, post-interview)."*

> *"They were not like the routine questions, students needed to spend long time. There are valuable benefits for students because routine classroom questions were inadequate for them. We showed them further and make them to think differently. Already, students said 'a teacher, was it the answer? I never think in that way'. It develops student's point of view and help to range up (TR, post-interview)."*

As seen from the teacher's words, they mentioned various skills that students need to use in those questions and those skills were developed by means of the activities in the study. The teachers found the tasks as non-routine and different from the ones in books. Moreover, they emphasized the benefits to the student's thinking process. Along with those general cognitive benefits, issue of being challenged, was the other matter about cognitive benefits that was explored most often both in teacher's data and student's data. In a general sense, it was reflected in the teachers and student's pre-interviews that gifted students need to be challenged in an appropriate difficulty level. In the interviews, they mentioned about their satisfaction because they thought that these differentiated activities provided enough difficulty to their gifted students. They explained that they didn't know that their students can go further if they compelled them. With the help of this study, they challenged their students in an appropriate level and all the teachers participated in the study explained their thoughts about providing challenge and its positive conclusions. For example, in the following example the teacher shared his experience that he could observe the big change in his gifted student who saw everything as boring:

> *"Questions challenged the students. Sometimes they could bring the answers at the end of the 40 minutes or in break times. They struggled in the break times; it was great for one of my gifted student because I have never seen him struggling at something. I was shocked when he came in the break time. He usually finds everything easy and boring; and says no need to struggle. Most of the questions in irregular classrooms do not take his attention. Yes, he had a great change, but why? I learnt and noticed that we provided him what he needed indeed: a challenge (post-interview, TR)."*

Those sentences clarified that usage of these tasks had excessive benefits to involve and struggle the gifted students in the lesson. Like this teacher, other participant teachers also mentioned about positive effects of challenging the gifted students, yet two of them mentioned about this by describing their gifted students whose characteristics is different from the previous one. These students were different in the personality that they were trying to do everything as requirement of the lesson, unlike other students. However, the teacher drew the attention at the point that although they are best in the classroom, being challenged is an opportunity for them to improve their abilities.

> *"I realized that in regular classrooms, we do not challenge them and we do not develop their full potential. They are hardworking and successful but we only*

use their small potential. But they have a great potential and we cannot see and use them without compelling. This study exactly made this (Post interview, TM)."

As the teacher stated, in the past, although they thought that being successful is enough for gifted students, now they know that gifted student can go ahead by compelling them. Besides, similar but more clear explanation comes from the other teacher as following:

"We do not compel the gifted students because he was already best in classroom; he was solving all questions although he thought that math was boring due to easiness. However, by means of this activity, they were compelled and challenged to reach one step further; they needed to spend a lot of time to solve questions; they needed to think further. (post-interview, TN)."

Findings about those cognitive benefits were also supported by the student's data obtained from both students after sheets and assessment forms. To reveal these findings, following part of this subsection mostly concentrated on student's data to show how student's advocated the cognitive benefits to themselves by using idiocratical words. In the first instance, in order to describe the cognitive benefits of the tasks, students mentioned about development of their brains or intelligence by using their own distinctive words. For instance, students explained their feeling as liking, yet providing his reasoning as development in his brain or intelligence. Here are several examples from student's own words in the forms:

"I liked the activities because it improves my brain (S2, After sheet form)"

"I like the activities because I become mentally alert (S3, Assessment form)"

As it can be deduced from student's sentences, they emphasized that they liked it because these activities make their brain or mind improve. At that point, when these student's pre-interview data were compared, it was seen that the activities provided them an opportunity to meet their need for development. Here is the one of those student's sentences from the pre-interview that coincides this conclusion:

"I like the lesson but we always do the same things, the easiest ones; my brain can't develop with them (S2, pre-interview)."

The student's consistency could be seen in his sentences that at the beginning of the study, he complained about the lack of cognitive development in lessons. At the end of the study, he shared his feelings as liked the activities because they satisfied his need of cognitive development. In line with this idea, the students shared their satisfaction that they used their brain more and effectively by means of the activities. Hence, they thought that the activities had benefits for them as using their brains. For instance, the student explained his desire for doing more activities as related with his need.

"I want to do more exercises of this kind. They relieve me and I can use my brain more effectively (S7, Assessment form)."

As seen in student's answer, she is satisfied from struggling and using her mind and desired to do more such kind of activities. Similar to this, two of the students, one is in the post interview and other is in the student assessment forms, mentioned about activities as doing exercises for their brain. One of them is presented in below:

"I think they are very beneficial for me because it is like a mind exercise (S10, Assessment form)."

As seen, the student saw the activities as brain exercise for him as they use their brain more. Furthermore, students not only thought this usage as in exercising level, but also they thought that these activities made them compel their mind. Hence, this compelling resulted in some contributions as development of his cognitive needs. Here is one example for this case from the sentences of the student,

"I think the activities are mind developing. I like them because they develop my intelligence (S2, Assessment form)."

The student was satisfied from struggling his intelligence because he thought that this develops his intelligence. This was also seen in the observations that the students were satisfied from fulfilling their cognitive needs and this was seen in their reactions during the activities in classrooms. That is, all of the gifted students participated in the study thought that the tasks had cognitive benefits for their development. As well as those benefits mentioned up to here as related with their thinking, intelligence, brain or mind, some other benefits were also mentioned. Exemplary, five of the participant students mentioned about quickness in their thinking as contributions of using these tasks. With regard to this case, an example from the students' own words are presented below.

> *"It benefits to my thinking. It works my brain and mind; this result in quick thinking. I think my speed of thinking increased…. I solve the questions quicker (S6, post-interview)."*

Along similar lines but in a different manner, one of the students, whose sentences were provided below thought that differentiated activities benefited him on making quick decisions.

> *"The activities are beneficial for me because while I'm thinking, now I can come to the solution quickly (S4, Assessment form)."*

In addition to this, three of the students mentioned about attention. They addressed the issue that they needed to focus their attention so as to come up with the solution and they see the activities as taking, focusing and increasing their attention. One illustration from the student's own words in his assessment form are given below:

> *"The activities are beneficial for me. They develop our intelligence and attention. They focus and draw my attention (S14, Assessment form)."*

Student's sentences clearly emphasized the effect on attention. Similar to this, one of the students mentioned about the changes in terms of contributions like using the brain more effectively and doing mathematical operations more carefully.

> *"These activities have some benefits for me. For example, I use my brain more effectively and I can do mathematical operations more carefully (S10, Assessment form)."*

Together with these, as cognitive benefits, two of the students shared his ideas about the effect of the questions in the differentiated activities on their reading ability.

While one of them stated that they had improvements in her reading comprehension, the other one addressed in his gains in the interpretation on his reading. One of these student's sentences were presented below.

"I noticed that I learnt to interpret the writings with the help of these activities (S12, Assessment form)"

In line with these contributions, three of the students emphasized the gains for the logic and reasoning. To exemplify the issue from the interview transcript:

"It has provided logical benefits. I liked solving problems by making reasoning (S1, post-interview)."

In a similar way, another example from the student assessment form was given below that the student found the activities as beneficial because he needs to make reasoning to solve the questions.

"I think these activities are beneficial for me because there are questions that we needed to make reasoning (S14, Assessment form)."

On the other hand, while one of the students agreed with the benefits of these tasks, he emphasized these contributions in such a way that he directly said these activities developed his mathematical thinking. Her sentences are presented below:

"I think they are beneficial for me because they develop my mathematical thinking (S9, Assessment form)"

Moreover, another student mentioned about the benefits to her mathematical thinking as providing to think in different ways as:

"These activities were beneficial to me. I think they made me look from different perspectives and they taught me how to think in different ways in mathematics (S6, post-test)."

In terms of direct contributions for mathematics, another explanation came from two students. Sometimes, while trying to solve the questions, it was seen in the observations that students needed to study and repeat the older concepts. Usage of these tasks in classrooms made the gifted students realize their deficiencies in prior mathematical contents like forgetting prior concepts. Besides, as another general cognitive benefits of solving differentiated activities, two of the students realized his brain as functioning like a calculator. They realized this after an activity related with calculators and they deduced the idea after finding the correct answer. Here is how one of them is stated in the interview.

> *“I thought that in fact, my brain is working like a calculator (S1, post-interview).”*

In brief, all the data clearly demonstrated that both teachers and students believed in the cognitive benefits of the study for mathematically gifted students in the classrooms. Moreover, the students stated their satisfaction for these benefits and provided detailed answers to explain their cognitive gains like increase in their problem solving abilities, mathematical thinking, reasoning and development in their mind. In line with this, during the design based process, student’s data obtained from observations, students after sheets, assessment forms and student’s interviews, all showed the benefits of differentiated tasks to student’s need to be challenged. That is, it was a critical issue that gifted students mostly mentioned about deficiency of this challenge in their pre-interviews. Hence, analysis of data obtained from those pre-interviews showed that all participant gifted students had a great need to be challenged in an appropriate level because all of them said they found their regular mathematics classrooms so easy. Even, some of them stated that due to inadequate challenge, they saw mathematics as meaningless and boring. For instance,

> *“I like math but it is mostly boring because there is nothing to challenge me in our mathematics lesson. I like to be challenged but problems are very easy…For example we learnt tenths, our teacher can ask us to find thousandths (S2, pre-interview).”*

As it can be deduced from this student’s sentences, they were keen on more thought-provoking concepts or questions and wanted to see or try to find what is further in the concept they learned. Likewise, another student stated his way of searching about difficulty:

"I do not like to solve easy questions. I'm looking for the most difficult ones in my test books. I feel happy when I was challenged (S4, pre-interview)."

S4 clearly presented their need for difficulty even in their own test books. In a general sense, students were bored due to easiness in classrooms and they needed some challenge. After all these pre-interviews, as it was also mentioned by their teachers, students stated the benefits of these tasks with regard to their need for challenge what they needed in pre-interviews. As a first inference, when they were asked about the activities, all of the students find the activities as challenging. Hence, challenging is the most frequent word in the student's data obtained both in process and at the end of the process of the study. From these, it could be deduced that the activities satisfied the student's need to be challenged because they clearly stated their satisfaction as liking the activity by relating to the difficulty or challenge. Therefore, they were satisfied and interested when they were challenged. Similarly, gifted students had a great demand for difficulty and they found mathematics classrooms as boring when the times they faced easiness in the activities. That is to say, analysis showed that positive ideas were correlated with the difficulty while negative ideas were correlated with the easiness. For instance, only three students saw the activities as boring in their after sheets. It was seen that all of these students explained their reasons as relevant to easiness or lack of difficulty. Below, one of those sentences was demonstrated:

"The activity was boring because it was very easy. But the other activity was interesting because it was challenging (S9, After sheet form)."

As one can see, the student explicitly associated his reasoning for seeing the task as boring to easiness of the activity. These examples openly revealed that most of the gifted students in the study assessed the quality of the activities in terms of its easiness or difficulty. An example for this, the student's sentences in the interviews were provided:

"You and our teacher asked us very very difficult questions, but I'm not angry with you. On the contrary, I'm thankful to you, difficult questions keep my attention (S14, post-interview)."

To make it clear, the student was thankful for providing him such difficult questions. This was seen from most of the student's statements in the assessment forms and post interviews that the students were grateful for facing these activities in their mathematics classrooms. As they stated, their need to be challenged was satisfied by means of this intervention. Even, although some of the students were satisfied from this difficulty, they shared their desire having more challenging activities which develop them cognitively. That is, the more the challenge included in the tasks of gifted students, the more they liked and gave their interest. Hence, it could be deduced that the activities satisfied the student's need to be challenged.

To sum up, both the teacher's and student's data reflected that usage of tasks had great contributions to mathematically gifted students. That is, it was stated that the tasks had some benefits to the mathematically gifted students as challenging them in an appropriate level while enhancing their skills like mathematical thinking, reasoning and problem solving. Furthermore, these benefits coincided with their cognitive needs and the students satisfied from having these tasks in their mathematics classrooms. After these benefits of the intervention to student's cognitive needs, analysis regarding the emotional benefits of the intervention was investigated in the next section.

4.3.2. Students' emotional needs

Findings from the analysis revealed that this intervention had some affective benefits for gifted students, too. Therefore, as the second subcategory of the benefits, emotional benefits of these tasks to mathematically gifted students were presented in this section. Researchers defined emotions in variety of ways and they used different categories for emotion. For instance, Carlson and Hatfield (1992) stated the emotions as feeling related with the components of physiological, cognitive and behavioral. Moreover, Ekman (2003) mentioned about sixteen enjoyable emotions different from each other. Furthermore, according to Spielger (2004) embarrassment, happiness, love, anger, sadness and anxiety, all reflect emotions. Although there is not a clear cut expression for emotion, in the studies, love (Spielger, 2004), motivation (Lang, Bradley and Cuthbert, 1998), happiness (Ekman, 2003; Spielger, 2004), fun and satisfaction (Ekman, 2003), were handled as one of the constructs of emotion. Besides, in Özdemir's (2012) study, fun, love, surprise and motivation was taken as the constructs of the theme of "emotions". Starting from this point of view, in this section, student's emotions like excitement, love, being interested, motivated all taken as the benefits to satisfying emotional needs of students.

Through the study, the teachers continuously stated the emotional reactions of mathematically gifted students while engaging in the tasks and these reactions were also observed by the researcher. Furthermore, students explained their emotions while describing the activities and their opinions. In those emotions, they not only mentioned about their feelings about tasks, they also mentioned about their disposition towards mathematics and how these dispositions changed through the process. Hence, in this category, emotions in the data were examined in two separate headings; benefits of the intervention to satisfy student's emotional needs and benefits to student's disposition towards mathematics. That is, emotions were related with how the intervention satisfied mathematically gifted student's emotional needs and benefitted to their emotions regarding mathematically gifted student's disposition towards math. For this reason, in order to present those emotions more clearly and detailed, they were divided into two parts as presented in the next two subsections.

4.3.2.1. Satisfying students' emotional needs

In this subsection, students and teacher's opinions reflecting how the intervention satisfied their emotional needs were presented. In general terms, students and teacher's opinions demonstrated that usage of differentiated tasks in mathematics classrooms brought positive conclusions towards gifted students. In the first part of this subsection, the case was addressed from the teacher's perspective. That is, teacher's opinions about emotional benefits of tasks to students were provided initially.

Teachers thought that they could feel and see the benefits of the study to their gifted students. They mostly mentioned about this benefit as taking the keeping student's attention or interest. However, before going on with these benefits, teacher's opinions regarding student's emotions in pre-interviews should be examined to see the difference. In those pre-interviews, teachers complained about gifted student's boredom or lack of interest in the lesson and how difficult to take their interest during the tasks. Even, some of them mentioned about its negative conclusions like disruptive behaviors of gifted students. For instance,

> *"He is so energetic; he can be hyperactive. He easily gets bored from everything and complains about boredom in classroom. He talks to others while I'm trying to explain the lesson, so he disrupts others (TM, informal talks)."*

It could be deduced from the teacher's words that he had some classroom management problems due to negative emotions of the gifted student. Most of the teachers mentioned those kinds of problems in their classroom. They emphasized boredom and lack of interest in conducting the tasks in the lessons or homework. On the other hand, during the study, it was observed that the gifted students enjoyed from the activities and tried to solve all questions excitedly. This idea was found in the teacher's sentences from the post-interviews, too. When their pre and post-interviews were compared, the benefits of the study on their emotions was seen clearly. That is, the statements of teacher in the previous example exemplified the case clearly.

> *"My gifted student feels quickly suffocated. There are some long-running subjects in our curriculum. While teaching this, my gifted student shares his boredom. He says 'teacher let's move on to the new concept'. When he learnt or when he did the problem, he immediately gets bored. However, these activities enigmatically awaken his interest. (TM, post-interview)."*

Similarly, all the teachers mentioned about interesting side of the activities and how these activities draw their gifted students interest and attention. What is more, excitement was the other emotion that students felt during these activities. It was both observed in the student's reactions and faced in the teacher interviews that teachers mentioned about their student's excitement towards the activities. Here is one of the statements exemplifying this case:

> *"The questions caught attention. They were waiting excitedly and wondering what is the next question. The points were hanging on the wall, they were looking their points excitedly (TN, post-interview)."*

In addition to this excitement, student's willingness and eagerness was the other emotions that the teacher observed in their students and stated in their interviews. Although they had emotional and behavioral problems with their gifted students, teachers noticed that these students were waiting for the activities and they were keen on solving the problems during the intervention. For example, following the teacher, stated the effect of these activities by touching on the emotional benefits:

> *"I felt this study made some positive effects on my students. The activities drew the gifted students' attention and changed the atmosphere. All the students were competing in a positive way. How can I say? They became eager, they waited the questions keenly. (TN, post-interview)."*

As seen, the teacher also mentioned about the changes in competitive atmosphere as being full of interesting and exciting activities. Following script provides a similar explanation:

> *"I think these tasks were so beneficial. The activities were of interest to gifted students. They were keen on solving questions… They covetously struggled in order to obtain the solution and to satisfy their curiosity (TS, post-interview)."*

Additionally, teachers thought that this study had some effect on student's motivation and they related this to other emotional factors such as being interested. For instance,

> *"The activities were very good and interesting and they aroused the gifted student's interest. They were already good at mathematics but these activities were different and helped them to enjoy with the mathematics. For this reason, their motivation was dramatically increased (TR, post-interview)."*

In addition to all these benefits, two of the teachers mentioned about changes in the student's self-confidence. These teachers stated that they realized the changes in their student's reactions and behaviors. These changes lead them to think that their students become more self-confident by means of this study. The next two scripts presented the case from the teacher's own words.

"The problems in the regular lesson was seem routine for them. This study enhanced their love of mathematics. It increased their self-confidence because normally, when I ask them a problem in the lesson, almost all of the classroom solves the question. But this time, he realized that these were more difficult questions and he can solve in the right and quick way." (TS, post-interview)

As similar to this teacher, another teacher also mentioned about this gains about the self-confidence in the next example:

"The points were hanging on the wall and they were increasing in each week. At first, they supposed that everybody can do completely but they saw there are the ones who cannot and they are the highest one. They gained self-confidence and they excitedly waited each week. Even, one of the students; I mentioned about him before. He was from the low level classroom. Because the level of the classroom was low, I was explaining the lesson from the low level and this student was probably bored. I was surprised that he was solving all these questions and although he never speaks to me, once, he came to teacher's room and asked me whether I can give him more questions. After this, he started to speak more with me and with other students as well. I think this study made great gains for his self-confidence (TM, post-interview)."

In a brief, the teacher's ideas reflected that intervention had many emotional benefits for gifted students in mathematics classrooms. Students were satisfied from usage of tasks in classrooms that they were interested and excited. Therefore, their motivation for mathematics lessons as well as their self-confidence had some gains by means of the intervention. When it was looked from the student's own point of view, similar findings were obtained. When they were asked about their opinions, feelings and ideas about the intervention, all of the gifted students in the study used positive emotions in order to explain their ideas. In the remaining part of this subsection, findings about the emotional benefits of the study to students were presented by providing examples from the student's own statements.

Before reflecting how the study benefited to the student's emotional needs, it was important to analyze what the students needed from their mathematics lessons in terms of their emotional needs. Data in the pre-interviews mostly revealed that mathematically gifted students have some emotional problems with the lesson. In other words, the students complained about uninteresting, boring, not suspensive and uninspiring activities in their mathematics lessons. Moreover, they mention about lack of enjoyment and fun in their lessons and how they need such kind of emotions while engaging in the mathematical tasks. Among fifteen students, eleven of them touched on this subject that following example summarizing the key points could be representative of the student's ideas. That is,

> *"I love numbers, geometry and mathematics but I don't like mathematics lesson. It is boring, I want to make something interesting and excited in lessons. My teacher says we have to do these exercises but I don't enjoy these. I need different and attractive things in mathematics, if they them involve in lesson, I would be happy (S13, pre-interview)."*

As the students clearly indicated, gifted student's emotional needs were not completely satisfied in their regular mathematics lessons. On the other hand, during the intervention, the students who complained about insufficiency in their emotional needs was observed while enjoying with the activities. That is, data analysis indicated that students loved the activities and they found them as interesting, suspensive and enjoyable. That is, it was revealed in their explanations that student's emotional needs were satisfied by means of these activities. First of all, students mostly mentioned about having fun with the activities. Following statements demonstrated two student's similar explanations about loving the task due to entertainment.

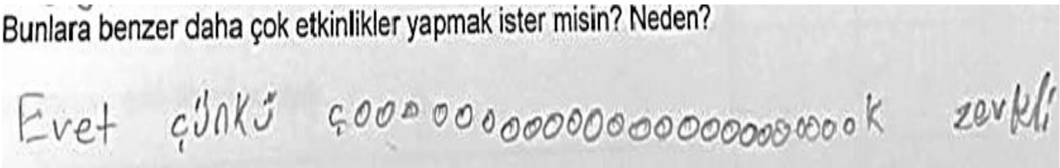
> *"I liked the activity because it was very enjoyable (S11, after sheet form).*

> *"I love the activity due to its entertainment. (S1, After sheet form)"*

Likewise, from the gifted students, who mentioned about lack of entrainment in the pre-interviews, four of them stated that these activities made their routine lessons entertaining in their assessment forms or post-interviews. To illustrate this, one of these student's statements were presented below:

> *"The activities made the lessons enjoyable (S10, Assessment form)"*

As seen the student directly stated the role of activities as making the lesson enjoyable. Data analysis revealed that the students could find the enjoyment that they looked for in pre-interviews. It was also seen that while mentioning about enjoyment, they used different words; like fun or amusement. Although these words changed among the students, they desired to continue doing such activities because they were satisfied from the enjoyment. To illustrate this, one of the student's scripts was presented in Figure 4.18.


Bunlara benzer daha çok etkinlikler yapmak ister misin? Neden?

Evet çünkü çoooooooooooooooooooooooook zevkli

Figure 4.18. Explanation of S7 about differentiated tasks in classroom

As seen in the figure, the student tried to explain his willingness to do more activities by mentioning the amusement of the activities. Furthermore, the student tried to emphasize the extent of this amusement by writing one letter of word 'much' twenty-four times. In addition, the students used various expressions to define emotional benefits of the study and these emotions provided permanent interest to the lesson. For example, 'mystery' was one of these expressions that gifted students in the study used to define how they felt good while struggling with the problems. Hence, it was deduced that the students who complained about lack of exciting or interesting tasks in mathematics lessons could satisfied these needs and they were pleased to be in such an atmosphere. For example, two of the students in the assessment forms, one of the students in the after sheets and one of the students in the post interviews mentioned that the activities were interesting because they were mysterious. Likewise, three of the students mentioned about feeling deciphering, mysterious or hidden code. Following example was remarkable because the student stated himself in the pre-interviews as deprived from interesting activities in mathematics lesson. However, his sentences in the student's assessment data revealed how his need to be interested was satisfied.

“The activities are not boring. While doing the activities, I feel like solving a secret code (S2, Assessment form).

As seen, the student shared his satisfaction from feeling like deciphering a secret code. As well, this idea was also found a place in one of the student’s informal talks:

“It made me feel as if there was something hidden, and I had to walk in a mysterious walk to find the hidden object. (S13, post-interview).”

As seen from their sentences, intervention aroused different feelings for mathematically gifted students. These new and different feelings made them focus on the lesson as well as increasing their motivation. Therefore, most of the student’s emotional needs were met by way of these feelings as it was understood from their statements. The activities and all process provided an environment to the students where they can feel positive emotions that vary in the types and intensity like excitement, interest, entertainment, mystery and love. Furthermore, sometimes, the students used some conspicuous explanations or words to define their emotions about the activities like writing only ‘super’ or writing ‘I love these activities” with capital letters. From those, an example from the student’s script was provided in Figure 4.19 as follows:

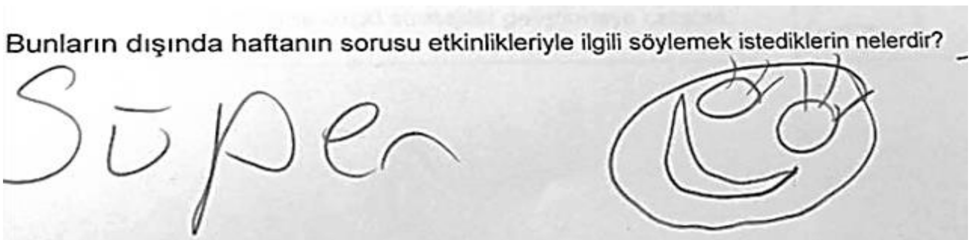


Figure 4.19. Explanation of S11 about differentiated tasks in classroom

All these examples and whole structure of both students and teacher’s data revealed that usage of differentiated tasks in mathematics lessons had many positive emotional gains for gifted students in the study. In addition, when the students focused on their own feelings during the intervention, they provided various answer for how they felt while solving the task. ‘Happiness’ was the word that students mostly used to define their feeling during each activity. That is, gifted students mostly felt happy while solving the activities. The most frequent word used to express their feelings toward the activity was “excitement” that gifted students felt excited while solving the activities. Along with those most frequent feelings, findings revealed that although some feelings differed from each other, each activity made them feel good; such as feeling like a million bucks, keenly, pleasure, amusement or proud.

In sum, the student’s opinions reflected their positive emotions about the tasks. Among those emotions, excitement, interested, enjoyment, happiness, liking and amusement were most frequently used ones. I could say that, although it was difficult to keep gifted student’s interest and increase their motivation in the lesson, the students felt positive emotions while involving in the process and they continued the study with high motivation. Hence, their emotional needs could be satisfied by means of the intervention. Following this satisfaction that was investigated in this section, the data about student’s emotions was also related with the mathematically gifted student’s disposition towards mathematics. Hence, benefits of the intervention to student’s disposition were examined in the subsequent sub-section.

4.3.2.2. Students’ disposition towards math

In this subsection, benefits of the intervention to student’s disposition towards mathematics were addressed. As an emotional aspect, disposition was addressed in this study because disposition towards mathematics played a crucial role both in the teacher’s and student’s emotional statements during the intervention process. In this study, mathematical disposition was used in the meaning that "a tendency to think and act in positive ways" (National Council of Teachers of Mathematics, 1989, p. 233). Moreover, disposition was seen an important factor that affect mathematically gifted student’s motivation and approach to the lesson. Both students and teacher’s data reflected the idea that integration of differentiated materialstasks on gifted student’s mathematic lesson resulted in some positive changes in their disposition towards mathematics. These changes could be clearly seen in the student’s own sentences in the assessment forms and could be partially seen in the teacher’s words. In the initial part of this subsection, teacher’s ideas about the issue would be addressed. In the post interviews, teachers mostly mentioned about the effect of the study on student’s views about regular mathematics lessons. They stated their observations about gifted students and how their disposition was changed in accordance with this study. For instance,

> *"This study helped to change the student's perception towards mathematics. That is, they saw that mathematics classrooms become more amusing and enjoyable. Students could see the different sides of the mathematics and different areas of usage. For example, they saw that mathematics does not only mean numbers, it is in real life, related with logic, mind questions and thinking. (TR, post-interview)."*

As seen from the words of the teacher, the teacher thought that their student's perception towards mathematics changed in a positive way. Moreover, teachers were satisfied showing the students a different side of mathematics and obtaining student's constructive reactions. In addition, they could make comparison of their own student's prior and later behaviors; hence, they can see the changes in the dispositions. For example, one of the teachers explained his comparison as follows:

> *"I think it has another benefit for my gifted student. His attitude towards mathematics was changed. Although he is not keen on mathematics lesson, now he is waiting for the lessons excitedly. Activities bought heat to the lesson [laughing] (TM, post-interview)."*

As could be deduced from his example, the teacher thought that the study had an effect on the attitude of the students towards mathematics. As well as teacher's ideas based on their observations, the student's own data supported these ideas. Findings laid bare that more than half of the gifted students in the study were happy with the positive alteration in their views about mathematics. Students gave lots of information about the changes in their disposition towards mathematics. They mentioned about not only the changes in their liking but also changes in their tunnel vision about mathematics and the positive conclusions of this case. Hereupon, examples from student's own sentences was provided to demonstrate the dimensions in the student's disposition. For instance, the student explained the change in her opinions about mathematics.

"My interest in mathematics has been increased when compared to last year. Now, I love mathematics more. (S9, Assessment form)."

As it is seen, the student frankly expressed her changes that now she liked mathematics more and his interest in mathematics was increased with the intervention. More similarly, another student stated the change in his love with the change in his perspective.

Let's go to the past. I didn't love mathematics. These activities changed my perspective towards mathematics. I like mathematics. (S7, Assessment form)."

As seen, the student compared his past and now. In his comparison, he deduced that although he didn't like mathematics, now these activities had changed his perspective towards mathematics. Similar to these, four of the students in the study mentioned about boringness while expressing their change. They said that although they saw mathematics as boring, they changed their disposition. For instance, the student below explained his thought about the changes.

"Mathematics was a boring lesson but now it very good and entertaining (S1, Assessment form)."

As seen, the student explained his change that although mathematics was a boring lesson, now it is very good for him. As stated before, gifted students complained about boringness or lack of entertainment in mathematics. Under favor of this study, students moved away from this idea that mathematics was boring. On the contrary, they altered their disposition so that they found their mathematics lesson as entertaining. An example from the student's own sentences was presented as follows:

"These activities had an effect on my perspective. I say that 'Is mathematics this?' Now, mathematics entertains me (S3, Assessment form)."

As seen, the student found mathematics as unjoyful and this resulted in questioning his own opinions about mathematics because it didn't coincide with his prior ideas about what the mathematics was. What is more, the student in the following example frankly stated changes in his opinions about entertainment of mathematics.

"This activity taught me that mathematics could be more amusing (S8, Assessment form)."

As the student clearly emphasized, the study changed his opinions because it made him learn the fact that mathematics can be amusing. From that point, findings showed that students noticed different properties of the mathematics lesson and this resulted in the change in their disposition towards mathematics. To be more precise, as well changes in student's feelings, they expressed the changes in their realizations about mathematics. The study helped the students to discover various points in mathematics. That is, students realized that in fact, mathematics is not only doing calculations or it is not discrete from real life. They could see that operations are not ends they are the means to obtain the solution and data analysis revealed that intervention helped to change student's ideas. They noticed that mathematics does not consist of numbers or operations. They stated this realization in their scripts. For instance, some of the students mentioned that at the past, they thought mathematics as consisting of operations like multiplication, addition, and subtraction only. However, they realized that mathematics does not mean operations, it needs logic and other cognitive process. Examples of this case from two student's own sentences are provided below:

"I thought that mathematics only consists of operations. But now, I saw that it is more than operations (S9, Assessment form)."

"I learnt by means of these activities that in mathematics, everything is not operations, in fact, mathematics is logic (S2, Assessment form)"

As seen from the student's words, they could see the mathematics in a holistic way that their ideas about mathematics has changed or expanded. As stated before, the study had also many gains to show the relationship of mathematics and real life. Students stated that their ideas were changed because they saw that mathematics was in real-life. Many students cited about this change in their assessment forms and after sheets. Two of the examples of those sheets are presented as follows:

"This activity changed my opinions. We use mathematics in our daily life; even while slicing a cake (S13, After sheet form)."

"I learnt by means of this activity that lots of things in real life is related with mathematics (S10, After sheet form)"

As seen in the figure, while one of the students mentioned about his realization that they use mathematics even while slicing a cake, the other student directly shared his idea that his thoughts about mathematics was changed because many things in real life was related with mathematics. That is to say, it was an important gain for this study that the student's opinions were changed in a way that mathematics is in real life, it is not separated and it is not only a lesson. Hence, this idea made them become closer to mathematics and resulted in positive disposition towards mathematics. As a last example for this case, one of the students shared her opinions about the role of these activities in changing disposition towards mathematics below.

"I think these activities could make the students like mathematics (S9, Assessment form)."

The student thought that the students who don't like mathematics could like it. To sum up, intervention had significant emotional benefits for mathematically gifted students to change their disposition towards mathematics. As stated before, these students tend to think mathematics as boring, easy, lack of entertainment and relationship with other disciplines as well as real life. Nonetheless, these differentiated tasks argued against this and gained favors for their disposition towards mathematics. Hence, in this section these emotional benefits to student's disposition were addressed. Together with the other subsection about benefits of the intervention to satisfying student's emotional needs, the section about emotional benefits of the intervention was completed. In the following section, benefits of the intervention to mathematically gifted student's social needs were examined as the last section of the last research question.

4.3.3. Satisfying students' social needs

Up to here, benefits of the intervention to mathematically gifted students regarding their cognitive and emotional needs were examined. At that point, benefits of the intervention to satisfying student's social needs were investigated in this section. As mentioned before, gifted students have serious problems related with their social needs. To be more precise, it was stated by the teachers in pre-interviews that most of the gifted students in classrooms had some issues in their communication with other students in classrooms and with their teachers. Moreover, gifted students had deficiency of conducting or searching different activities in their social lives. When the data obtained from both teachers and students were analyzed, it was seen that this intervention provided benefits to mathematically gifted student's social needs, too.

Data about social characteristics of the mathematically gifted students was gathered from these student's mathematics teachers and classroom teachers. Also, opinions of their families were gotten when needed. During these interviews, they mentioned about some social problems that these gifted students face in their classrooms. In accordance with this data, the gifted students in the study were separated into two groups in terms of social needs in line with their social problems. All gifted students in those two groups have some troubles in their social relations with other students in classroom. While the first group of the students were the ones having problems in the relationships or communication with others, the other group consisted of the students who had problems about honoring by others in classroom. Hence, the analysis was investigated based on the benefits to these two group of students.

First of all, the study had benefits for the ones who have difficulty to contact with other students in classroom. Two of the students were in this group and their teachers mentioned about the changes in their communication with other students. Following example was given to present the issue from the teacher's own perspective.

> *"He was an antisocial student, he hung out with himself. He solves all the questions by himself in regular lessons. But these activities were difficult that he needed to receive help from other gifted students. This student also formed an interaction when he was the first person solving the question. He tried to explain the curial points of the questions or gave clues to his friends. The study was beneficial for him to solve this problem (TM, post-interview)."*

The teacher's statements clearly revealed the fact that usage of differentiated tasks in mathematics classroom provided this student an opportunity to reveal his abilities and contact with other students. In a similar vein, in the following example, the teacher shared her incident about the change in her silent student.

> *"Once, he had searched and found a mind question at home and although he is very shy and silent, he wanted to go to the blackboard and asked a mind question to other students in the classroom. This behavior made me surprised because I have heard his voice few and far between. (TM, post-interview)."*

The surprising behavior from this student, who was very shy and silent, demonstrated the effects of the study on student's expression of themselves. By asking for going to blackboard and wanting his friends to solve the mind question, he directly revealed the social benefits of the study. At that point, as also seen from the classroom observations, those students came out of their shell by means of the intervention. As they saw their success and potential in these activities, they became more self-confident and overcame the problem of public speaking.

In addition to the examples regarding withdrawn students, the similar issue, another two of the students had, is about the difficulty about honoring. Those students were being alienated from the others in classroom although they were not as shy as the students in previous examples. These groups of students were alone in the classroom because other students didn't prefer them as friend due to their highest grades or studying hard. Moreover, one of these students was seen as the wonk of the classroom and other students didn't like his different interests. Therefore, those students had problems with their friends and this affected their social needs negatively. However, during the study process, after a while, these students were observed while socializing with other students. As the study progressed, other regular students could see that these activities were different and needed different abilities except from memorizing or studying hard. As they observed the gifted ones while interpreting the questions reasonably, gifted students increased in value in their eyes. This observation was also placed in their teacher's post interviews. For instance,

> *"The study had great benefits in terms of honoring of gifted students in the classroom because they didn't include this student in their own group, but by*

means of this study they socialized with the gifted student. They talked and appealed for help from the gifted one (TN, post-interview)."

As seen from the teacher's words, the regular students not only communicated and interacted with the gifted student, but also asked for help from him. In addition to this example from the teacher's own observation, the student's own statement revealed this issue was presented in the next example.

"I became popular in the classroom. Beforehand, I didn't know that I'm so good at mathematics. Now, I became popular [laughing] (S8, post-interview)."

As seen from the examples, the study had benefits for the students having difficulty in being sociable. On the other hand, the gifted ones had to contact with other gifted students and sometimes they become natural leader of the group. This prevented the gifted students being tagged. Moreover, they were able to use their leadership ability without bothering others. Hence, the students were smoothed ruffled feathers in the natural process and as the important social benefits of the study, gifted student's leadership ability could be discovered and developed. An example of this case from the teacher's sentences,

"The other students naturally selected them as leader. Other regular students were showing their own answer to the gifted student before showing it me or they were asking whether they are in the right way. I do not like the type of the student who thinks and says that he can do everything. At that point, the students can become selfish. In the initial times of the study, I was afraid of facing that situation but in the study I observed that this process was progressed naturally. Also, he was impatient. While waiting for others, they were the first person to complete the questions but with this study he learnt to be patient and wait for others (TS, post-interview)."

In addition to such individual gains for gifted students with other regular students, communication between gifted students were also increased. It was seen during the process and it was also deduced from both the student's and teacher's data that gifted students were in touch with other gifted students. Here is how this case was voiced from one of the teachers:

"The gifted students realized that they had a short hand with each other. They helped each other continuously. I saw them while they were trying to explain something about the points in the problem of the week. Even, they realized that they have other common points and they began to talk about astrology, they brought their journals and discussed them. (TR, post-interview)."

Likewise, the idea was also found a place in the student's own words. That is, when they were asked about whether they have some changes in their friend relationship, one of the students mentioned about his familiarizing with another gifted student in classroom.

"Yes, I and M.A. get closer. Before, I didn't know that he was like me; he likes challenges the same as me (S13, post-interview)."

Up to this point, direct benefits to the gifted student's interaction with other students in the classroom were examined. On top of this, student's interaction with each other was also altered in a competing way. That is, by means of the study, a competitive environment was created in the classroom. This environment provided an opportunity for gifted students who need competing to do their best in their social life. Besides, the students who couldn't perform to their full potential due to lack of a competitive environment in their regular classrooms struggled themselves to obtain the solution both in a true and quick way. All the students began to compete with each other to solve and obtain the prize of the question like top points, three stars, two stars or being the first. Regardless of the prize, the students lived in such an atmosphere that they should do the best to be better than others. Namely, they tried to do the best of their own; hence they tried to use their full potential. Moreover, this also showed them what they can do if they struggle. An example about how the study made an effect to the classroom environment that satisfies their social need was presented with the following sentences from the teacher:

"The students ran against each other. They were in a rat race while making jokes with each other. Such an atmosphere made them compete by entertaining, which helped them create an environment satisfying their social needs (TN, post-interview)."

As seen from her statement, not only a competitive environment but also a joyful environment was established under favor of differentiated tasks and the students interacted with each other in this environment. Likewise, another instance from the other teacher's statements presented this case as a change in the student:

> *"They competed with each other to score the points or stars. Normally they do not compete with each other. But this time, everybody tried to do their best and they socialized while doing this (TR, post-interview)."*

Besides, following statements also exemplified the case from the student's own scripts. In those scripts, students addressed their satisfaction with the competition that the study brings to the classroom.

> *"It was very joyful that I competed with my friend (S9, after sheet form)."*

> *"The activities are very amusing. They create an atmosphere like we are in have a small competition. This cheers the classroom up (S1, Assessment form)."*

As seen, the first student explained that the activity provided competition with his friend and he found this interesting. Likewise, the other student mentioned about entertainment and the effect of competition as cheering the classroom up.

As well as benefits on the interaction of the gifted students with other students in classroom, creation of such an environment had also benefits on the increase in the interaction between gifted students and the mathematics teacher. In other words, these students communicated more openly with their mathematics teachers by means of this study. It was the most frequent answer for what they noticed about their teachers during this process was realization of their teachers. That is, gifted students thought that their teacher had a real and great effort for them and this made their relations stronger. For instance,

> *"Thanks to our teacher. She prepared all these joyful activities. She tries to enjoy and challenge us. We realized that she studies for us so we should study more for her. (S1, post-interview)."*

This idea was also stated by the teachers that they could be closer to each other and they could better understand their gifted student. To illustrate,

> *"We had stronger communication. We came close to each other. This study provided to have better relationships with me and the gifted student and all other students. I had felt satisfactory because I said yes, I did something for them. I had a clean conscience about my gifted students. I saw this happiness from their reactions, too "(TR, post-interview)."*

In a similar manner, another teacher mentioned about the changes in her relationship with the gifted student in her classroom and how the study benefited on this relationship. His sentences were as follows:

> *"I shared what I learnt during this activity to my gifted students. I suggested some other books and activities that they can do at home. In the past, we had never talked in break times with gifted students. They could already learn and they were already good at math. In the break times I was trying to teach the concepts to other students who have difficulty in leaning or I was doing some reinforcements for them. But during this process, we shared many things even in break times. He came and asked me many things (TM, post-interview)."*

Up to that point, the benefits of the study to the interaction of the gifted students with the other students and teachers were discussed. In the analysis, it was also seen that during this study, a few of the students and teachers also stated the benefits to the increase in the interaction between gifted students and their families. Teachers indicated that although families thought their children as normal or even as naughty, when they learn their children's giftedness, their point of view to their own child was changed. This led to positive interactions between each other. Families also showed interest to the question of the week or activities carried out in the classroom. Even, some of the students mentioned about solving similar questions at home with their family. For instance, first example from the teacher's words is as follows:

> *"I have reactions about the families also. Some students said that 'teacher, I'm asking these questions to my family. Even, one of the students said that 'On*

Tuesdays, we spared time for these at home and sometimes my father finds similar questions, he began to ask to me, too (TR, post-interview)."

In this example, the teacher shared the influence of the study on the relationships at home. As the teacher mentioned, students had changes not only in their schools but also at home and this was an indication of the benefits of the study on their social life. Similarly, another teacher stated his realization about the change in the father of the gifted student with these sentences:

"I know that one of my gifted students wanted from his family these kinds of activities. This case was aroused my interest because as far as I knew, he was not a caring father. But after our meeting, his father bought puzzles and they tried to solve the puzzles together at home. (TM, post-interview)."

As well as the changes that the teacher mentioned in the post interviews, two of the students also stated the issue in their assessment forms. They mentioned about their family when they were asked about the changes in their daily life. For instance,

"The activities changed my daily life. I'm ask my father these questions; this entertains me (S12, Assessment form)"

As one can deduct from the words of the student, he directly mentioned about his father and his entertainment from asking the question to his father. Therefore, as seen from both teacher's and student's statements, the study had benefits on the interactions both in classroom and outside the classroom. Thus far, the effect of the study on the interactions was handled as social benefits of the intervention. What is more, the data also revealed other benefits apart from these interactions. For example, findings reflected that gifted students experienced some changes in their daily lives, too. They started to look from different perspectives in their daily lives. During the study, it was observed that all gifted students tried to do something in their daily lives. Some of them were struggling with similar mathematics problems or mind questions, some of them tried to obtain those kind of sources from books or the internet. Even, one of the students wrote a question on his own and brought it to his teacher. That is to say, the study helped them to integrate mathematics into their social lives. To exemplify this integration, the student's statements in pre and post interviews and the differences in those interviews were emphasized below. First of all, the student's statements in his pre interview about homework or doing something related with mathematics at home was presented.

"I do not want to do anything related with mathematics. I hate doing my mathematics homework. They are all easy ad boring exercises. I have already learnt them. Why do I have to do the same things at home? (S9, pre-interview)."

But the same student was observed that he brought various sources from his home, including questions like in the study. He mentioned about finding these questions from different sources by searching. What is more, his teacher also stated this issue in her post-interview as follows:

"He bought a book and said me: 'teacher, shall we ask this question to other students in class?' Showing him as eager for something astonished me (TR, post-interview)."

As the change in this student's regular practices revealed, other students were also gained a different practice that they could change their social life by involving in mathematics. As stated before, although none of the gifted students stated to do anything at home related with mathematics, their teachers expressed the change in that behavior. For instance,

"In the last week, some of those gifted students came to school with books about mind questions or puzzle books (TS, post-interview)."

As seen, the intervention benefited to the student's daily life that they could satisfy their social needs. In a similar vein, one of the students reflected the changes in his social behaviors that he made the effort about searching and doing similar activities. Examples from the student's script about the effects of his daily life were presented.

"I found a book involving similar questions. Every day, I 'm studying this book (S6, Assessment form)."

"The activities resulted in the changes in my daily life. I prepare the questions similar to these activities and I gave them to my teacher (S1, Assessment form)."

In the first script, the student mentioned about finding a book that have similar questions in the study and he explained that he studied that book every day to be more successful. At that point, the students who did not consider the studying mathematics as necessary at the beginning of the study, revealed his change in her habits. Subsequent to this, another student explained his changes in his daily life as preparing and giving similar questions to his teacher. Hence, all these data clearly demonstrated the influence of the intervention on the student's social life.

As the last dimension of the benefits of the intervention to the student's social needs, the data revealed that the students made progress in their self-expression. The teacher stated that these students tried to interpret their own, different solution when appropriate. It was also observed that, even the times that their teachers made some errors, they could explain the missing points in their thoughts. As an example of this case was given from one of the student's post interview data as follow,

"This study provided me to express myself well, while talking to the classroom or with my friends (S8, post-interview)."

As both the specific examples and whole data indicated, students had changes in their social life and this affected their social relationships in a positive way. Hence, I could say that, mathematically gifted students could find opportunities to meet their social needs while using the differentiated tasks designed and developed for their needs. Furthermore, while engaging in this process, they interacted with their friends, teachers and families. Moreover, they found environments that they could reveal and develop their potentials and became more active in their social life. Therefore, these social benefits of the intervention to mathematically gifted students were investigated in this section.

4.4. Summary of Findings

Based on the main purpose of the study, the aims of this study were three-fold. That is, as the general purpose, it was aimed to design and develop the differentiated tasks for 5th and 6th grade mathematically gifted students. Within the scope of this objective, three main aims were addressed in the study. Examining the characteristics of differentiated tasks for 5th and 6th grade mathematically gifted students was the first aim. Moreover, benefits of the intervention to the teachers and to the mathematically gifted students were the other aims of the study. In line with these aims, the findings of the study gathered in three main categories as summarized in Table 4.5.

Table 4.5 Summary of main findings

Characteristics of tasks	**Benefits of tasks to teachers**	**Benefits of tasks to students**
Content	Enhancıng teachers' awareness on giftedness and gifted education	Satisfying students' cognitive needs
Task	Increasing teachers' self-adequacy about giftedness	Satisfying students' emotional needs
Implementation method	Increasing teachers' collaboration with other colleagues	Satisfying students' social needs

As the final design principles of the study, the first category consisted of characteristics of the differentiated tasks for mathematically gifted students. These characteristics were addressed in three sub-categories as characteristics in terms of content, task and implementation method. It was determined that the tasks should have at least one characteristics from these sub-characteristics. Hence, characteristics of differentiated tasks appropriate for regular mathematics classrooms of 5th and 6th grade mathematically gifted students were specified.

In addition to the findings for designing and developing process, findings reflecting the evaluation process were also addressed from both the teacher's and student's perspective. Hence, benefits of the intervention to the teachers were investigated in three sub-categories. Firstly, it was seen that the intervention benefited to teacher's awareness on giftedness and gifted education. That is, while the teachers were unaware about the gifted students and how to educate these students, the student's awareness about the issue was dramatically increased. In the second category, it was concluded that the intervention had some benefits to the teacher's self-adequacy about giftedness. When their self-adequacy related opinions in the pre-interviews were compared with their last opinions, the contributions could be clearly deduced. Moreover, the benefits of intervention to teacher's collaboration with other colleagues were addressed in the last sub-category of the findings. The teachers collaborated with other teachers both in the school and outside school as the other contributions of the study.

When it comes to last category of findings regarding the benefits of the intervention to the mathematically gifted students, it was seen that the study provided important benefits to satisfying their cognitive needs, emotional needs and social needs. That is, at the beginning of the study, the students complained that the tasks in mathematics classrooms couldn't satisfy their cognitive, emotional and social needs. However, it was explored during the study that the intervention served this purpose and provided lots of opportunities for their cognitive, emotional and social needs. To conclude, this chapter included the findings gathered for the aim of designing, developing and evaluating the differentiated tasks for 5th and 6th grade mathematically gifted students in three main categories with their significant sub-categories.

CHAPTER 5

DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

The first motivation for this study is to design and develop differentiated tasks for satisfying the 5th and 6th grade mathematically gifted students' cognitive, emotional and social needs. Based on this, characteristics of these tasks were explored. Moreover, it was also aimed to assess the benefits of these differentiated tasks to mathematically gifted students and teachers. The first chapter of this study consists of the introduction section in which the significance of the problem statement, purposes and related research questions are presented. Subsequently, the second chapter focuses on the review of the literature about mathematical giftedness, gifted education, cognitive, emotional and social needs of gifted students as a well as the importance of the teachers' awareness of the issue. In accordance with the related literature, the methodology that was used during the study is presented in the third chapter. Finally, while the fourth chapter presents the results of the study, the final chapter discusses the findings and suggests implications for educational practices and recommendations for future studies.

5.1. Discussion of Findings

In this section, findings are discussed under three main sections based on the research questions of the study. That is, findings regarding the characteristics of 5th and 6th grade differentiated tasks for mathematicallygifted students, benefits derived from the intervention to teachers and the mathematically gifted students are discussed below.

5.1.1. Characteristics of 5th and 6th Grade Differentiated Tasks for Mathematically Gifted Students

As regards the answer for the first research question -what the characteristics of 5th and 6th grade tasks for mathematically gifted students are - the design based process enabled the researcher to produce the characteristics that these tasks should have to meet the diverse needs of gifted students in mathematics classrooms. It is not an easy task to develop or differentiate an educational program or tasks in line with the needs of mathematically gifted students (Hertberg-Davis, 2009; Kanevsky, 2011; Karaduman, 2010; Reger, 2006); however, the design based process of this study helped to proceed in a structured way in accordance with the purpose of the study. That is, characteristics in terms of content, in terms of task and in terms of implementation method were obtained with the help of preliminary and prototyping-evaluation phases. This coincided with the idea that design principles include both substantive and procedural specifications in order to conclude with practical and effective interventions (Herrington, McKenney, Reeves, & Oliver, 2007; Plomp, 2013) as Mafumiko (2006) obtained his supportive curriculum materials with content, format and procedural specifications. That is, findings of this study provided both content specifications in the form of scientific knowledge needed for constructing differentiated tasks and procedural specifications in the form of implementation knowledge for these differentiated tasks. Besides, due to its nature, the design based study produces a theory based practical product (Kennedy-Clark, 2013; Masole, 2011; McKenney, 2001; McKenney & Van den Akker, 2005; Plomp & Nieveen, 2013; Van den Akker et al., 2006). The aim of design principles is not to formulate the tasks; rather, they provide opportunities for others to gain benefit for their own settings by selecting the substantively and procedurally most appropriate tasks (McKenney, Nieveen, & Van den Akker, 2006). Hence, characteristics whose validity was satisfied by means of key points in literature reviews, expert opinions and researchers' experiences with gifted students and whose practicability and effectiveness were ensured during the prototyping-evaluation phase were obtained as the main output of this study. In addition, four quality criteria; relevance, consistency, practicality and effectiveness (Nieveen, 2013) were satisfied by means of the formative evaluations in the study. All these helped to fine-tune the tentative design principles so as to better address the problem (Herrington, McKenney, Reeves & Olives, 2007; Plomp, 2013).

In addition to the explanations that the design based nature of the study provided concerning content and procedural specifications for tasks, some other reasons of this issue could also be discussed. Another underlying reason why these basic principles were gathered under three main headings as characteristics of content, task and implementation methods is that principles come from both the theory and practice. First of all, it was seen from the implementations that the content of the gifted students' tasks is important in that it affects their cognitive, emotional and social well-being. For instance, findings showed that when the tasks lacked challenge and novelty, gifted students found them uninteresting and didn't struggle with the mathematics tasks. In fact, some of the students' disposition towards mathematics was negative due to the boring and repetitive tasks carried out in classrooms. Hence, accommodating the content so as to meet their needs was the first issue that needed attention. As previously stated, challenging, interesting and requiring higher level thinking were three content related characteristics that tasks developed for mathematically gifted students should have. As supported in the findings obtained from teachers and students' experiences, these characteristics also coincide with the ideas of some researchers in the literature review. First of all, in a study by Freiman (2006), it is argued that gifted students are inclined to struggle with more challenging tasks, and thus challenge was seen as an important dimension for mathematically gifted students' education (Chamberlin, 2002; Deizmann & Watters, 2001; Gavin et al., 2007; Hammer, 2002; Karaduman, 2010; Leikin, 2010; Sriraman, 2003). Secondly, in her study, Sheffield (1994) suggests that interesting activities help gifted students to improve their skills by engaging them in the lesson and this idea was also supported by other researchers (Johnson, 2000; Karaduman, 2010; Leikin, 2010; Wilkins et al.,2006). Due to the fact that gifted students have various interests (VanTassel-Baska, 1998), designing interesting activities to arouse their interest was regarded to be essential. As a last concern of content related characteristics, higher level thinking was found to be required to improve mathematically gifted students' critical thinking (Chamberlin & Chamberlin, 2010; Freiman, 2006; Leikin, 2010; McComas, 2011; Karaduman, 2010; Sriraman, 2003) because critical thinking was related to the higher level thinking in many studies

(Black, 2005; Halpern, 1998; Miri, David, & Uri, 2007; Page & Mukherjee 2007). Thus, in order to obtain tasks that promote students' higher level thinking, the upper levels of Bloom's (1956) revised taxonomy (Anderson et al., 2001) was used in the development of the differentiated tasks.

In addition to characteristics in terms of content, some types of the tasks were found to be more effective and beneficial for mathematically gifted students both in the literature and classroom implementations. Therefore, how the content was presented to these students is another significant dimension; in addition, task type and method of implementation were given necessary importance as the other two main headings. Findings showed that tasks that are challenging, interesting and requiring higher level thinking should be presented to gifted students in the form of non-routine and integrated tasks like problem solving, interdisciplinary tasks, intelligence questions, etc. Moreover, when the content was integrated with these tasks, it effectively met their need of elaborating issues with details in a systematic way. That is, these students could solve the challenging or unusual problems that their peers could experience some difficulty in while trying to solving them. Encouraging the students to solve these problems was also supported by several other researchers (Freiman, 2006; Karaduman, 2010). Hence, problem-solving tasks that are non-routine, that reflect real life or are based on mathematical modelling were addressed as the tasks designed for mathematically gifted students (Freiman, 2006; Gavin, 2009; Greenes, 1997; Karaduman, 2010; Pierce et al., 2011; Renzulli, 1986; Tieso, 2002). Moreover, gifted students have an inner ability to make connections (VanTassel-Baska, 1998) and they can transfer the mathematical concepts to other disciplines (Karaduman, 2010). Hence interdisciplinary tasks were regarded to be appropriate to improve this ability and this was also stated by different scholars (Berger, 1991; Freiman, 2006; Greenes, 1997; Karaduman, 2010; Renzulli, 1986; Sriraman, & Sondergaard, 2009). Furthermore, due to the fact that they have an inner ability to do and learn more than their age levels would permit (Johnson, 1994), more complex tasks that are beyond the curriculum were considered to be other effective tasks (Rotigel & Fello, 2004; Johnson, 2000; Karaduman, 2010). In addition, math puzzles (Freiman, 2006; Gavin, Casa, Adelson, Carroll, & Sheffield, 2009), technology integrated tasks (Johnson, 2000; Siegle, 2004) and intelligence questions (Baykoç, 2011; Johnson, 2000;

Freiman, 2006) are other tasks that could be developed to enhance mathematically gifted students' potential. To sum up, these activities help students to scaffold their learning by interrelating the new knowledge with their existing knowledge and motivate them towards their mathematics lessons.

Subsequent to the characteristics of the content and task type, findings concentrated on the implementation of these tasks. Proper attention should also be devoted to how differentiated tasks should be implemented in the classroom so as to actively involve gifted students in the process by avoiding differentiating them from the others and providing them with privileges. Some implementation methods were found to be more practicable and effective for the application of these tasks. I could say that, during the study, these methods also helped the teachers to guide their implementation because they didn't have any idea about proper applications that help the mathematically gifted students to perform their full potential by actively engaging them into the lesson. Whole class task which the teachers in this study mostly preferred for their own classrooms enabled the students, both gifted and regular ones, to compel their own limits. In this method, all the students in the classroom could perform the activities (Chamberlin & Chamberlin, 2010) and the teachers provided clues or used any other method to enhance students' skills to obtain the solutions (Chamberlin & Chamberlin, 2010). Moreover, providing the task as an individual task to gifted students (Chamberlin & Chamberlin, 2010) and task in mathematics center **(**Wilkins et al., 2006, Diezmann & Watters, 2001; Hannah et al. 2011; Sriraman, & Sondergaard, 2009) were other options that both the teachers and students felt satisfied in using. While applying these two methods, the teachers emphasized that all students could take these extra tasks when they completed their to do's or tasks. In this way, none of the students were treated as privileged and this enabled the teacher to implement the tasks without harming any of the students. Moreover, teamwork tasks (Baykoç, 2011; Chamberlin & Chamberlin, 2010; Deizmann, & Watters, 2001) were another implementation method that the students engaged in by collaborating with each other both in homogenous and heterogeneous groups. Additionally, implementation of project based tasks (Diffily, 2002; Stanley, 2012) or providing students with these types of assignments (Johnson, 2000) were other methods that could be used properly for mathematically gifted students. Lastly, some teaching methods, holding discussions (Johnsen & Ryser, 1996), tasks that required questioning (Johnson, 2000; Sriraman & Sondergaard, 2009) and discovering (Johnson, 2000; Wilkins et al. 2006; Van de Walle et al., 2013) were also specified to best meet the needs of mathematically gifted students. VanTassel-Baska (1998) argues that discussion, questioning and social interactions should be employed in gifted students' classrooms, and this coincides with the key components of constructivism in that these methods help scaffold the students to perform their full potential (Reger, 2006). Besides, discussion is known as the most commonly used method for promoting critical thinking (Hammer, 2002), while discovery has the potential to enrich mathematical lives of gifted students (Johnson, 1994).

To conclude, as the characteristics were validated by theoretical arguments and well-articulated by means of the evidence obtained through try outs and field tests, the value of knowledge was strengthened. That is, the design based study enabled that these characteristics obtained from the literature could be developed in line with the evidence derived from the teachers' and students' experiences and reactions. Initially, when the tasks and principles were designed, they were in a draft form independent of each other and real life. However, during the process, these characteristics correlated with each other and they were experienced with the teachers' usage and students' reactions, which could shape the last version of principles. I could say that the reason why both teachers and students perceived these tasks as practical and effective is due to this well-articulated background coming from both the theory and practice in different classrooms of different teachers. Following the discussion on these characteristics, following section discusses findings related to the benefits of the intervention in teachers.

5.1.2. Benefits of the intervention to teachers

As well as the design and development, the evaluation of these tasks was another issue investigated in this study. First of all, the intervention was evaluated in terms of the benefits it provided to the teachers. The findings revealed that it produced important benefits in terms of the teachers' awareness of giftedness and gifted education, teachers' self-adequacy regarding giftedness and teachers' collaboration with other colleagues. As previously stated, teachers have a vital role in gifted education (Baykoç, 2011; Freehill, 1981; Rotigel & Fello, 2004) because as Lekin (2010) states, gifted education requires teacher sensitivity. That is, they should differentiate and modify their classrooms in accordance with the various needs of gifted students (Hammer, 2002), and they should help mathematically gifted students to appreciate the value of mathematics (Karaduman, 2010). The possible reason why benefits to teachers fell into these categories might be that teachers are unaware of gifted students (Baykoç, 2011; Freehill, 1981; Rotigel & Fello, 2004) and do not have the required knowledge, equipment and adequacy to properly modify their classrooms to fulfill the unmet needs of gifted students (Hertberg-Davis, 2009; Kanevsky, 2011; Newman, 2008). With the help of the intervention, teachers learnt the cognitive characteristics and behavioral properties of mathematically gifted students. While at the beginning of the study, they did not even think that they could have a mathematically gifted student in their own classrooms, at the end of the intervention they could differentiate the students with potential giftedness. This conclusion coincides with the findings of Gavin, Casa, Adelson, Carroll, Sheffield (2009)'s study that the advanced units that they developed by means of Project M^3 provided the teachers to become aware of the characteristics of mathematically promising students as well as important issues regarding their education.

As the teachers became involved in the process, they could make sense of the knowledge on mathematically gifted students as well as their educational and psychological needs. In this way, great contributions to their self-adequacy regarding these students and their educational opportunities were obtained. When the teachers were initially asked about their willingness or voluntariness to participate in the study, all the teachers showed their willingness; however, all of them shared their concerns regarding their inadequacy for gifted students. They questioned their knowledge of mathematics, pedagogical content knowledge and knowledge of gifted students. After a while, thanks to the nature of the design based research, they became involved in the entire process of the design and the development of the activities. They acquired the key points and strategies about gifted education and they could test these strategies in their own classrooms. Moreover, they could ask for help when needed and obtained immediate feedback from the researcher. All these resulted in professional development for teachers and this development led to an increase in their self-adequacy regarding gifted students. Due to the fact that self-adequacy is an important concern for teachers (Fuller, Parsons, & Watkins 1974) as it influences their effective teaching in classroom (Adams & Martray, 1981; Fuller et al., 1974), revealing this concern helps to solve teachers' self-adequacy related problems (Paulsen, Anderson, & Tweeten, 2015). Therefore, it might be inferred that this study revealed the teachers' self-adequacy related concerns regarding gifted students and their education in classrooms. Subsequently, during the study they were not only informed about the gifted students but also provided with well prepared, ready tasks. Teachers continuously stated that these tasks made them feel good since these ready and reliable tasks facilitated their work. While using these tasks, they could examine the tasks, test them in their own classroom, and observe and differentiate the reactions of their gifted students. In this way, they could overcome their self-adequacy related concerns in that at the end of the study, all teachers stated that they could then feel adequate to better address the needs of their gifted students. In fact, some of the teachers mentioned that the following year, they would use these tasks on their own even by modifying and adding some similar activities to them.

This study not only provided these benefits regarding teachers' awareness and self-adequacy, but also made many contributions to the teachers' collaboration with other colleagues. Little (1982) argues that to what extent teachers in a school collaborate to shape their tasks or practices demonstrates success of the school, which is the key point for distinguishing successful schools from unsuccessful ones. That is, teachers' collaboration is not only necessary and beneficial for teachers themselves but also for the improvement of the school. Hence, it is important to devote sufficient time to teachers' collaboration (Raywid, 1993). Findings of the present study explicitly revealed that there wasn't any collaboration among the teachers at the beginning of the study. All the teachers were experienced in their teaching elementary grade level students and they didn't feel the need to ask for help, discuss or produce new tasks for students. They were only communicating with each other about their personal life or general issues of the school. Nonetheless, a spontaneous collaborative environment was established by means of this study. The reason of this collaborative environment could be based on three main issues. First of all, the nature of the design based research requires collaboration among practitioners; hence, the teachers collaborated with each other to better design and develop the tasks. They worked heartily, collaborated and discussed the issues significant to their gifted students and their education. Secondly, the work item was different, unknown and challenging for the teachers. That is, gifted students and their education is not a well-known subject for the teachers in Turkey (Tütüncü, 2013). Hence, teachers needed to collaborate with their colleagues both to learn and improve educational opportunities of their gifted students. Furthermore, gifted education was a conspicuous issue for the other teachers who were not in the study and the students' positive reactions and high motivation towards the applications were also remarkable for them. Hence, during the study, all teachers both in school and outside the school became curious and wanted to be informed about key issues of gifted education. That's why, they collaborated with each other to obtain a more effective environment for the gifted students in their schools. Last but not least, gifted education itself is a holistic issue which needs collaboration among school services (Baykoç, 2014; Green, 2013, Landrum, 2001). That is, as in the present study, classroom teachers, branch teachers, guidance services and even the school administrator collaborated to better understand and address the needs of gifted students.

To sum up, I could say that the study made a major contribution to teachers' professional and individual development concerning the issue of mathematical giftedness. Hence, these contributions made a positive effect on their knowledge, pedagogical content knowledge as well as their self-adequacy and collaboration with other colleagues. In addition to these benefits for teachers, the intervention has also produced benefits to mathematically gifted students, which are discussed in the following section

5.1.3. Benefits of the Intervention to Mathematically Gifted Students

To develop students' giftedness, providing a supportive environment is crucial (Monks & Ypenburg, 2002). To better assess the gifted students' needs or programs that are prepared for them should include observations, interviews, students' documents and interviews as well as teacher and parent interviews (Karaduman, 2010). In line with this, based on the data obtained from various data sources in the present study, findings revealed that the study was beneficial for gifted students and these benefits were investigated under three main headings. Hence, this part discusses the benefits of the intervention in terms of satisfying mathematically gifted students' cognitive needs, emotional needs and social needs.

First of all, parallel to Reger's (2006) idea that gifted students necessitate special tasks to stimulate and improve their thinking skills, the intervention provided benefits in terms of satisfying mathematically gifted students' cognitive needs. Besides, findings highlighted that differentiated tasks made great contributions to students' cognitive skills, such as mathematical thinking, problem solving, reasoning and critical thinking. These findings also coincide with the idea that the main concern of gifted programs should be to enhance students' thinking skills especially critical thinking (Newman, 2008; VanTassel-Baska, 2010). Although in their nature most gifted students have the ability to think critically (Hammer, 2002), critical thinking can be developed further; hence, gifted students should be taught how to think critically (Elder & Paul 2007; McCollister & Sayler, 2010). This, in turn, suggests that the tasks especially the ones requiring high level thinking seem to be very likely in helping them to learn critical thinking because tasks requiring analysis, evaluation and creativity require and cultivate critical thinking (Ktistis, 2014). Moreover, the reason why the findings revealed a sense of satisfaction in gifted students' cognitive needs is that these students need to learn the content in depth with complex, detailed and difficult tasks to meet their cognitive needs (Karaduman, 2010; Gavin, Casa, Adelson, Carroll, & Sheffield, 2009) and this intervention served this purpose by challenging them during its well-structured phases.

In addition to being challenged cognitively, gifted students' affective and social development is also crucial (Baykoç, 2014; Colangelo & Davis, 2003). As well as these cognitive benefits, findings also revealed emotional benefits of the intervention to mathematically gifted students. These benefits were two fold; that this, the intervention satisfied students' emotional needs, while changing their disposition towards mathematics in a positive way. There is always a risk that if children are exposed to similar, low level tasks, a loss in their high ability could be experienced (Waxman, Robinson, & Mukhopadhyay, 1996) and they could get bored due to routine and similar tasks (Johnsen, 2004). That is, it is known that gifted potentials may lead to failures due to lack of motivation, constancy and self-confidence (Stenberg, 1986). Findings revealed that the students enjoyed the intervention and they shared positive emotions regarding the tasks. To illustrate, entertainment, like, enjoyment, amusement, increase in their motivation and even mystery were the words that they used to define their positive emotions regarding the tasks. Both the teachers and students shared these reactions and this helped to create a fun and interesting environment. By means of this environment, the students could be actively involved in the activities and they struggled through engaging tasks. This conclusion supported the idea of Trna and Trnova (2014) that having motivation like being interested in the tasks plays a crucial role for cognitive development of gifted students. Hence, all these reflect that their emotional needs could be satisfied because as stated by Leikin (2011), a fun learning environment is a necessity for mathematically gifted students. Furthermore, in terms of being successful in mathematics, Fennema and Sherman (1976) mentioned the importance of such attitudes as enthusiasm, perseverance, belief in oneself and usefulness of mathematics as well as the desire for challenging mathematics. Due to the fact that these attitudes were continuously mentioned by the students and teachers, it could be argued that these emotional benefits can lead to more success for the students in the present study.

The findings also highlighted the benefits of the intervention to students' disposition towards mathematics. Some of the students shared their opinions that although they didn't like mathematics, with the help of the present study they liked the activities because they noticed that mathematics is not a boring lesson; it includes many joyful, interesting, challenging, interactive and relational dimensions in real life. That is, the students frankly mentioned that these activities changed their disposition towards mathematics. In line with this conclusion, as Maxwell (2001) states, enjoyment is related with positive disposition in that enjoyable, motivating and beneficial tasks help students elicit their positive dispositions toward mathematics. Furthermore, the findings are also supported by Anku's (1996) statements that creating an environment which shows to students the interrelation of mathematics with real life and enables the students' to communicate with each other fosters students' disposition towards mathematics. Similarly, as argued by some researchers, connecting mathematics to real life or other disciplines (Nunes, Schliemann and Carraher,1993) or using problem solving tasks (Lester et al., 1994) arouses students' interests and confidence in doing mathematics. In line with this idea, it could be said that such characteristics of the tasks as interdisciplinary, problem solving, interesting, etc. served this purpose, which, in turn, could create a positive impact on the students' disposition. Besides, it is a fact that tedious operations are one of the reasons for disliking or forming a negative disposition towards mathematics (Park & Park, 2006). In this study, mathematically gifted students who were exposed to routine, similar and easy exercises in their regular classrooms could engage in different activities that are interesting, challenging and require higher level thinking. Hence it is very likely that the students' disposition was affected by these tasks. This was an important finding of the study in that tasks based on constructivism foster positive dispositions in mathematics (Maxwell, 2001), and students' disposition helped them to struggle with the challenging tasks and enabled them to develop mathematical habits like undertaking their own responsibility (Lappan, 1999).

As the last benefit to the students, findings revealed that the intervention satisfied mathematically gifted students' social needs, too. While dealing with the tasks, the students formed an interaction with both their teachers and other students, which is in line with the idea that social interactions should be integrated into gifted students' educational process (VanTassel-Baska, 1998). Teachers mentioned some social and behavioral problems of their gifted students. It is known that gifted students are the ones who need more attention, interest and strategies to manage them in classroom environments. Hence, as one of the vital outcomes of this study, the teachers could overcome these problems. The most likely reason of this is that the students could form a heathy communication with the people around them and they could express themselves.

It is a real damage that gifted students could hide their giftedness in order not be perceived as nerds (Galbraith & Delisle, 1996). This study might provide great benefits in terms of this risk. That is, the teachers introduced some of the gifted students as lonely and silent. Besides they mentioned that these students had problems and difficulties in building friendship with their classmates because regular students saw them as nerds due to their high grades and differentiated interests. However, the intervention made important contributions in that these students formed interaction with gifted students, sometimes asked for help, and discussed the issues; hence, they could find an opportunity to know each other. In classrooms, teachers sometimes formed homogenous and heterogeneous groups. These implementation methods might also have affected their relations positively. In heterogeneous groups, all the students collaborated with each other, and the students gave priority to the gifted students' ideas. These gifted ones, who have social problems, helped other students and became a natural leader of the group. It is a fact that heterogonous grouping helps students to adapt to real life since students will live in such environments and these groupings provide a model for them (Esposito, 1973; George, 2005). In addition, this grouping provided some benefits for the regular students, too. That is, they could take advantage of the gifted ones and learn the target points they needed to learn, which coincides with the idea that heterogeneous groups enable the students with lesser ability to learn from the high ability ones (Esposito, 1973; Fiedler, Lange, & Winebrenner, 1993). As for homogenous grouping, on the other hand, it also provided various benefits in satisfying gifted students' social needs. For instance, during the study, it helped to form an interaction among gifted students. They could see that other gifted students could solve the questions as they do and they have similar interests with each other. Moreover, they could have the opportunity to think and discuss beyond their curriculum levels and they learnt that they should learn more about the concepts.

To sum up, to obtain a holistic picture of the appropriate opportunities of mathematically gifted students and a deeper insight into the tasks, students' and teachers' opinions were taken. It is another fact that the nature of the design based study contributed to these findings and its role in these findings could be discussed, too. That is, this methodology enabled the teachers to take part in each process of development and evaluation. In this way, the teachers learnt the crucial points of gifted education by hands-on experience. They continuously interacted and got feedback from the researcher and students' reactions. They were also informed about the expert opinions and theoretical perspectives in relation to this issue. Most importantly, the design based study enabled them to change their methods, behaviors or implementations when needed. Frankly, different from all other methodologies, flexibility in the design based study enabled the teachers to intervene in the issues immediately. When they saw that the task or their implementation didn't work, they could change or modify it to better address the needs of gifted students and the class. In this way, they could experience the key issues regarding gifted education which cause positive conclusions to their awareness, self-adequacy and collaboration. Automatically, from the students' perspectives, such a structured intervention provided them with an effective environment where they were cognitively, emotionally and socially satisfied because when the teachers and the researcher saw that the tasks were not well suited to their gifted students, they accommodated in order to satisfy their needs. To state it differently, by means of the design based nature of the study, differentiated tasks and their specified principles were blended with the literature and implementation in real life environments, and these well-articulated products could be evaluated in these real-life environments. Therefore, this enabled not only the assessment and evaluation of tasks, but also the possibility to make adjustments in order to better meet the needs of mathematically gifted students in their regular mathematics lessons, which resulted in benefits for teachers and students.

Moreover, when the findings of the study were examined based on the several educational implications of Zone of Proximal Development, it could be clearly seen that the findings of the study coincide with these implications. That is, as the first implication, teachers offered to students challenging or higher level tasks that were beyond the curriculum (Hedegaard, 2009; Obukhova & Korepanova, 2009) so that they could enhance their knowledge by scaffolding. Secondly, the intervention increased communication and collaboration (Kravtsova, 2009) by allowing student-student or student-teacher interactions (Goos, Galbraith & Renshaw, 2002). Lastly, the findings presented the characteristics of differentiated tasks as well as differentiated tasks so that teachers could use these tasks to differentiate their instruction for the various educational needs of students in mixed ability classrooms, which is another implication of ZPD (Taber 2010).

To conclude, findings of the present study reflected that the application of these tasks in classrooms was effective in presenting a positive environment where the students were cognitively, emotionally and socially satisfied while teachers' awareness, self-adequacy and collaboration were developed. Besides, it was seen that these findings are not only confirmed by previous studies but also the discussion was taken one step further by bringing all these cognitive, emotional and social benefits together in one implementation. Based on these, the discussion about the implications for educational practices and recommendations for further studies would be subsidiary and supplementary. Hence, the following sections discuss these two dimensions in detail.

5.2. Implications for Educational Practices

As previously stated, both the aims and findings of this study are comprehensive because they include all the crucial elements of gifted education. That is, suitable tasks for mathematically gifted students and their important specifications as in the form of characteristics were two main outputs of the study. Furthermore, the evaluation of these tasks in terms of mathematically gifted students and their teachers were other crucial outputs. All these findings provide essential information to the teachers, school counselors, administrators, curriculum developers and teacher educators. Thus, some implications for these practitioners are discussed in this section.

Usefulness of the design is an important issue in conducting design based research (Mafumiko, 2006). Because of this reason, usability of the differentiated tasks in regular mathematics classrooms was discussed before mentioning some suggestions for their implementation in classrooms. Findings revealed that the activities could be applied in the classrooms without facing any problems. On the contrary, the study could solve pre-existing problems about gifted students' management in classrooms. That is, data from the pre-interviews and informal talks reflected that teachers had some serious problems regarding the management of their mathematically gifted students. This study not only provided cognitive, emotional and social benefits but also solved these problems. Similarly, teachers' concerns dwindled down as they became involved and learned in the process and the study provided many benefits to both students and teachers. Hence, it was seen that the activities were beneficial and usable for 5th and 6th grade mixed ability classrooms. Based on this, it could be deduced that these differentiated tasks should be a part of mathematics classrooms in order to help gifted students to perform their maximum potential. In addition to the tasks' usability for the well-being of mathematically gifted students, the issue is also important for all students in the classroom. It should be emphasized that the teachers mentioned the suitability and usefulness of tasks for all students in classrooms. Although those differentiated tasks were designed and developed in accordance with the developmental needs of the mathematically gifted students, they were also beneficial and interesting for the regular students in those classrooms. During the study, just as the gifted ones, the regular students also shared their positive feelings about the usage of differentiated activities in mathematics classrooms. Hence, it would be beneficial to use these tasks in regular mathematics classrooms for regular students because it may help to carry them one step further and it may help the students to see the holistic, interesting and relational structure of their mathematics lessons, which may have a positive effect on their disposition towards mathematics.

When it comes to how these tasks should be used in classrooms in terms of selecting proper implementation methods mentioned in the final design principles, it varies from classroom to classroom or from activity to activity. During the study, implementation methods varied with the classroom needs as well as the characteristics of each activity. I could say that, there is no best way or prescription for the implementation of differentiated tasks in classrooms. The activities are goal-oriented and useful as long as they are used with a system and justification. The best usage of the tasks changes in accordance with the teachers' priorities for their own classrooms as well as the characteristics of the activity. Hence, teachers should select the proper implementation methods to meet their own classrooms' needs.

As well as these suggestions for teachers, the issues could be discussed from the perspectives of school administrations and guidance services. As reflected in the findings, the teachers, the guidance service and school administration collaborated and worked in systematic discipline during the study. This not only helped to obtain a more effective implementation in classrooms, but also motivated the teachers to work collaboratively with these parts of the school. Thus, mentioning some recommendations for school administrations and the guidance service might be useful to obtain the whole picture of gifted education. For example, school administrations should support the teachers to conduct studies regarding gifted students in all classrooms. They can ask for additional studies, plans, programs and reports about activities for gifted students in classrooms. Moreover, they should establish an interaction among the classroom teachers and all other branches as well as the guidance service. The administration should at least direct and motivate the guidance service to organize collaborative work with the teachers about gifted students. In fact, in Turkey, guidance services mostly and sometimes only carry out studies and activities for the inclusive or problematic students, but the gifted ones also need special education and guidance service is the crucial point in gifted education in schools. They can surveil or observe these students' behavioral and spiritual changes. Moreover, they may meet with the parents to inform them about the situation and they can work on the study habits or the study environment of their children. Besides, they can regularly meet with the gifted students. Furthermore, if the student needs individual study, this could be ensured by means of the guidance service because they meet with students individually. In that way, the student and others won't feel privileged and it would prevent the problems in schools.

In addition to these, emphasis should also be given to teacher education in order to get to the root of the problem. In Turkey, teacher education programs lack the required importance regarding gifted students (Baykoç, 2104) because pre-service teachers graduate from universities with the lack of knowledge on giftedness. In fact, sometimes they do not even know what the meaning of giftedness is. At most, some of them take a course on special education but its content is mostly concentrated on children with disabilities. Hence, it is important that teacher education programs should include courses related with gifted students and they should also include opportunities for pre-service teachers to face with the gifted students to know and observe their characteristics. As the findings of this study revealed, the teachers were unaware of the mathematically gifted students and what could be done for these students at the beginning of the study. However, at the end of the study, they were aware and knowledgeable about mathematically gifted students and their educational opportunities. Hence, as these findings reflected, teacher education programs should give necessary importance to this issue. Additionally, teachers' general competence is another issue worth stressing because the teachers of gifted students should be well equipped with the subject matter knowledge, the knowledge of gifted students, pedagogical and pedagogical-content knowledge. However, most of the teachers are not well equipped in terms of knowledge and skills such as advanced content knowledge and alternative pedagogical strategies for gifted students (Rakow, 2012; Martin & Pickett, 2013). At that point, teachers should enhance their pedagogical content knowledge because gifted students may become more problematic in terms of both classroom management and cognitive requirements like advanced knowledge of subjects. At the beginning of the study, the teachers felt inadequate about their gifted students and they expressed that they experienced difficulty in managing these students in classrooms. However, as they became involved and learnt through the design based process, they could enhance their subject matter knowledge and how to manage and diminish classroom management problems of gifted students. For this reason, student knowledge, subject matter knowledge and knowledge of instructional strategies should be integrated into teachers' plans to reveal gifted students' potential, maintain their interest and meet their needs (Park 2005).

Numerous studies were carried out to present the crucial role of teachers' pedagogical content knowledge while designing their instructions parallel with both the requirements of the subject matter and student characteristics (Borko & Putnam, 1996; Carpenter, Fennema, Peterson, & Carey, 1988; Smith & Neale, 1989; Van Driel, Verloop, & De Vos, 1998). Thus, teacher education programs should aim to train qualified teachers both in their subject matter and pedagogical content knowledge; in depth exploration of concepts and effective teaching methods should be included in their programs (Işıksal, 2006). Moreover, teachers' philosophy of education should be concentrated on student centered teachings where they learn by doing, discovering and making sense of the concepts. Besides, teacher education programs should place more emphasis on conceptual learning rather than procedural ones by which gifted students get bored and perform poorer. Moreover, teachers should be taught how to establish a flexible classroom environment where students could feel free to express their own opinions and make discussions on the depth of mathematics. To provide all these opportunities, at least an elective course may be included in teacher education programs so that the teachers could learn how they can learn and satisfy their gifted students' needs.

Additionally, curriculum developers should give due importance to the lack of tasks that are well suit with the developmental and educational needs of mathematically gifted students. Both in their regular curriculum, program and textbooks, mathematically gifted students are deprived of the differentiated tasks. Curriculum developers should give a place to these types of tasks in the mathematics curriculum beginning from the early grades of their primary school. Hence, they could learn and enhance how to think mathematically, critically, and analytically. Moreover, mathematically gifted students should face with the challenging and non-routine tasks so that they could learn how to deal with these kinds of questions earlier. Besides, they should have opportunities to discover the interrelationships of mathematics with other disciplines of real life. In line with these, mathematics objectives should be integrated with those of the other lessons like history of mathematics. In this way, the students could see the holistic picture that all sciences are nested and connected to each other. What's more, modern age necessitates technology literacy and expertness. Due to the fact that these technological advances draw gifted students' interest (Periathiruvadi & Rinn, 2012), this role in their motivation should be incorporated with the mathematical tasks. That is, integrating technology, even by using calculators, computer office programs, Geogebra or Sketchpad, could be used to enhance conceptual understanding of mathematically gifted students while motivating them with these tools. Hence, curriculum developers might develop and add some objectives in line with the needs of gifted students like integration of technology or other disciplines in mathematics concepts in curriculum and classroom tasks. Last but not least, the content of the selective mathematics lessons, math applications or mind games lessons should be enriched and these lessons could be used as an opportunity to foster and perform mathematically gifted students' maximum potential. That is, some activities that are developed for gifted students' differentiated needs could be included in these lessons by curriculum developers. In this way, teachers' concerns about time management and overload curriculum requirements could be overcome. Besides, regular students in classrooms could also face non-routine, interesting and challenging tasks which can help them to develop their mathematical thinking and increase their disposition.

To sum up, parallel to the findings of this study and previous studies, implications for educational practices have been addressed in this section. Based on these, recommendations for further research are mentioned in the following section.

5.3. Recommendations for Further Research Studies

This study focused on the design, development and evaluation of differentiated tasks for 5^{th} and 6^{th} grade mathematically gifted students. Findings of the study have been discussed and implication for educational practices have been suggested thus far. Some recommendations for related further research studies are addressed in this section. Initially, regarding the sample of this study, some ideas could be recommended. Due to the fact that the sample involves mathematically gifted students, who are a special group of students that are rare in the population (Baykoç, 2014), the number of the mathematically gifted students in the six classrooms was few. Hence, the same study could be replicated with a larger sample. Moreover, as convenient sampling was utilized in this study, other studies could be conducted with random selection of the sample to ensure the representativeness of the sample for the country. Furthermore, the same study could be conducted with any other group of teachers by integrating different teachers in the design, development and evaluation processes. Moreover, not only mathematics teachers, but also other branch teachers, guidance services and school administrators could be more involved in the design and development processes. In this way, more comprehensive data could be obtained by taking various teachers' feedback into account.

Next, pre-school and early school years are crucial in shaping gifted students' beliefs, attitudes and study habits (Baykoç, 2014). Thus, identification, guidance and meeting their needs in classroom environments in these years are critical issues. When students are cognitively, emotionally and socially satisfied in their early years, development of their giftedness would be easier due to their positive disposition towards mathematics. Moreover, these students would be more open and able to think critically, mathematically and analytically because they would be accustomed to these styles of thinking beginning from their early ages. Thus, conducting a similar study with different grade levels is highly recommended. This study was carried out to develop tasks for 5^{th} and 6^{th} grade mathematically gifted students. Because identifying and supporting the giftedness at earlier age is important (Karnes & Johnson, 1991, Pfeiffer & Petscher, 2008, Sankar-DeLeeuw, 1999), development of tasks especially for the pre-school and primary levels is highly recommended. Moreover, it is also recommended to conduct such studies for students at the 7th and 8th grades as well as those in secondary grade levels. Moreover, the tasks developed through the present study were limited to learning domain of numbers. That is, development and evaluation of tasks for the other learning domains was not the scope of this study. Hence, development of these tasks for other learning domains are highly recommended because it can greatly enrich both the literature and opportunities of mathematically gifted students in regular classrooms.

Lastly, to what extent this study provided benefits to teachers or students could be assessed quantitatively, too. In such a case, those quantitative studies could be integrated to field test part or it could be added as a new phase of the study. In other words, this study could be conducted by making some changes to its overall methodology. For example, a longitudinal study that examines the students' needs through their earlier years or over a long period of time could be carried out. Furthermore, the extent to which teachers, families, classmates and curriculum planners are aware of the crucial characteristics of tasks for mathematically gifted students could be a topic for future research. What's more, the design principles of this study could be tested in other real life environments with other participant teachers and students. In this way, its efficiency could be tested or principles could be revised so as to better address the gifted students' needs in mathematics classrooms. Most importantly, within the scope of this study, differentiated tasks were only designed and developed in regular classrooms with regular curriculum and instructions. However, it would be feasible and highly recommended to examine these tasks with differentiated curriculum and instructions to see their exact effects in differentiated classrooms. Therefore, a more comprehensive understanding regarding the issue of mathematical giftedness and differentiated opportunities to mathematically gifted students could be obtained and this may help to fill the gaps both in theory and practice.

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APPENDICES

APPENDIX A: Characteristics of Tasks

Activity No	Characteristics in terms of Content					Characteristics in terms of Type o the Task									
	Challenging	Interesting	Higher Level of Thinking			Intelligent question	Math puzzle	Beyond Curriculum	Technology Integration	Problem Solving			Interdisciplinary		
			Analyzing	Evaluating	Creating					Non-routine	Real life	Math Modeling	History of math	Math & Science	Math & Turkish
1.		✓					✓				✓		✓		
2.	✓	✓	✓						✓	✓	✓				
3.	✓		✓			✓	✓								
4.		✓				✓				✓	✓			✓	
5.	✓	✓	✓	✓		✓				✓	✓				
6.	✓	✓	✓	✓						✓	✓				
7.		✓					✓								✓
8.	✓	✓	✓	✓			✓								
9.	✓	✓	✓	✓						✓	✓				
10.	✓	✓	✓				✓								
11.	✓	✓	✓							✓	✓				
12.	✓	✓	✓							✓	✓				
13.	✓	✓	✓							✓	✓				
14.	✓	✓					✓			✓	✓				
15.		✓	✓							✓	✓				
16.	✓		✓					✓		✓	✓				
17.		✓	✓				✓			✓					
18.	✓		✓							✓	✓				
19.	✓	✓	✓	✓						✓	✓				
20.	✓	✓	✓							✓	✓				
21.		✓									✓				

	Characteristics in terms of Content					Characteristics in terms of Type o the Task									
	Challenging	Interesting	Higher Level of thinking			Intelligent question	Math puzzle	Beyond Curriculum	Technology Integration	Problem Solving			Interdisciplinary		
			Analyzing	Evaluating	Creating					Non-routine	Real life	Math Modeling	History of math	Math & Science	Math & Language
22.	✓	✓	✓							✓					
23.	✓	✓	✓					✓		✓					
24.	✓	✓	✓						✓	✓					
25.	✓	✓	✓	✓					✓	✓					
26.	✓	✓	✓	✓					✓	✓		✓			
27.		✓	✓							✓					
28.	✓	✓	✓					✓		✓					
29.	✓	✓													✓
30.	✓	✓	✓	✓			✓								✓
31.	✓	✓	✓			✓				✓					✓
32.	✓	✓	✓			✓				✓	✓				✓
33.	✓	✓	✓			✓				✓	✓				
34.	✓	✓	✓			✓				✓	✓				
35.	✓	✓			✓					✓	✓	✓			
36.	✓	✓			✓					✓	✓	✓			
37.	✓	✓			✓										
38.	✓	✓		✓											
39.	✓	✓		✓											
40.	✓	✓		✓											

APPENDIX B: Objectives for tasks

Etkinlik	Kazanımlar
1. Etkinlik	5.1.2.4. En çok üç basamaklı iki doğal sayının çarpma işlemini yapar. 5-8 Matematik Programı: Matematik tarihi
2. Etkinlik	5.1.2.1. En çok beş basamaklı doğal sayılarla toplama ve çıkarma işlemi yapar. 5.1.1.2. En çok dokuz basamaklı doğal sayıların bölüklerini, basamaklarını ve rakamların basamak değerlerini belirtir.
3. Etkinlik	5.1.1.2. En çok dokuz basamaklı doğal sayıların bölüklerini, basamaklarını ve rakamların basamak değerlerini belirtir.
4. Etkinlik	5.1.2.1. En çok beş basamaklı doğal sayılarla toplama ve çıkarma işlemi yapar. 5.1.2.4. En çok üç basamaklı iki doğal sayının çarpma işlemini yapar. 5.1.2.10. Dört işlem içeren problemleri çözer. 6.1.1.4. Doğal sayılarla dört işlem yapmayı gerektiren problemleri çözer. Fen ve Teknoloji: 8.2.3. Yenilenebilir enerji kaynakları kullanmanın önemini vurgular.
5. Etkinlik	5.1.2.10. Dört işlem içeren problemleri çözer. 5.1.2.5. En çok dört basamaklı bir doğal sayıyı, en çok iki basamaklı bir doğal sayıya böler. 6.1.1.4. Doğal sayılarla dört işlem yapmayı gerektiren problemleri çözer. 6.1.2.1. Doğal sayıların çarpanlarını ve katlarını belirler. 6.1.2.4. Doğal sayıların asal çarpanlarını belirler.
6. Etkinlik	5.1.2.10. Dört işlem içeren problemleri çözer. 5.1.2.5. En çok dört basamaklı bir doğal sayıyı, en çok iki basamaklı bir doğal sayıya böler.

	6.1.1.4. Doğal sayılarla dört işlem yapmayı gerektiren problemleri çözer. 6.1.2.1. Doğal sayıların çarpanlarını ve katlarını belirler.
7. Etkinlik	5.1.2.1. En çok beş basamaklı doğal sayılarla toplama ve çıkarma işlemi yapar. 5.1.2.4. En çok üç basamaklı iki doğal sayının çarpma işlemini yapar. 5.1.2.5. En çok dört basamaklı bir doğal sayıyı, en çok iki basamaklı bir doğal sayıya böler. 6.1.1.2. İşlem önceliğini dikkate alarak doğal sayılarla dört işlem yapar. Türkçe: 5. Sınıf: Konuşmasında söz varlığını kullanır 6.Sınıf: Söz varlığını zenginleştirme: Kelimeler arasındaki anlam ilişkisini kavrar.
8. Etkinlik	5.1.2.4. En çok üç basamaklı iki doğal sayının çarpma işlemini yapar. 6.1.2.1. Doğal sayıların çarpanlarını ve katlarını belirler.
9. Etkinlik	5.1.2.10. Dört işlem içeren problemleri çözer. 6.1.1.4. Doğal sayılarla dört işlem yapmayı gerektiren problemleri çözer.
10. Etkinlik	5.1.2.1. En çok beş basamaklı doğal sayılarla toplama ve çıkarma işlemi yapar. 6.1.1.2. İşlem önceliğini dikkate alarak doğal sayılarla dört işlem yapar.
11. Etkinlik	5.1.2.10. Dört işlem içeren problemleri çözer. 6.1.1.4. Doğal sayılarla dört işlem yapmayı gerektiren problemleri çözer.
12. Etkinlik	5.1.2.10. Dört işlem içeren problemleri çözer. 6.1.1.4. Doğal sayılarla dört işlem yapmayı gerektiren problemleri çözer.
13. Etkinlik	5.1.2.10. Dört işlem içeren problemleri çözer. 6.1.1.4. Doğal sayılarla dört işlem yapmayı gerektiren problemleri çözer.

	5.1.1.3. Kuralı verilen sayı ve şekil örüntülerinin istenen adımlarını oluşturur.
14. Etkinlik	5.1.1.3. Kuralı verilen sayı ve şekil örüntülerinin istenen adımlarını oluşturur.
15. Etkinlik	5.1.1.3. Kuralı verilen sayı ve şekil örüntülerinin istenen adımlarını oluşturur. 5.1.2.1. En çok beş basamaklı doğal sayılarla toplama ve çıkarma işlemi yapar. 5.1.2.10. Dört işlem içeren problemleri çözer. 6.1.1.4. Doğal sayılarla dört işlem yapmayı gerektiren problemleri çözer.
16. Etkinlik	6.1.6.2. Bir bütünün iki parçaya ayrıldığı durumlarda iki parçanın birbirine veya her bir parçanın bütüne oranını belirler; problem durumlarında oranlardan biri verildiğinde diğerini bulur. 7.1.4.5. Doğru orantılı iki çokluğa ait orantı sabitini belirler ve yorumlar.
17. Etkinlik	5.1.2.4. En çok üç basamaklı iki doğal sayının çarpma işlemini yapar. 6.1.1.2. İşlem önceliğini dikkate alarak doğal sayılarla dört işlem yapar.
18. Etkinlik	4. Sınıf: Pay ve paydası en çok iki basamaklı doğal sayı olan kesirleri kesrin birimlerinden elde ederek isimlendirir.
19. Etkinlik	5.1.3.7. Birçokluğun istenen basit kesir kadarını ve basit kesir kadarı verilen birçokluğun tamamını birim kesirlerden yararlanarak hesaplar. 6.1.4.9. Kesirlerle işlem yapmayı gerektiren problemleri çözer.
20. Etkinlik	5.1.3.7. Birçokluğun istenen basit kesir kadarını ve basit kesir kadarı verilen birçokluğun tamamını birim kesirlerden yararlanarak hesaplar. 5.1.4.1. Paydaları eşit veya birinin paydası diğerinin katı olan iki kesrin toplama ve çıkarma işlemini yapar ve anlamlandırır. 6.1.4.2. Kesirlerle toplama ve çıkarma işlemlerini yapar. 6.1.4.6. Bir doğal sayıyı bir kesre ve bir kesri bir doğal sayıya böler, bu işlemi anlamlandırır. 6.1.4.9. Kesirlerle işlem yapmayı gerektiren problemleri çözer.

21. Etkinlik	5.1.3.7. Birçokluğun istenen basit kesir kadarını ve basit kesir kadarı verilen birçokluğun tamamını birim kesirlerden yararlanarak hesaplar. 5.1.4.1. Paydaları eşit veya birinin paydası diğerinin katı olan iki kesrin toplama ve çıkarma işlemini yapar ve anlamlandırır. 6.1.4.2. Kesirlerle toplama ve çıkarma işlemlerini yapar. 6.1.4.6. Bir doğal sayıyı bir kesre ve bir kesri bir doğal sayıya böler, bu işlemi anlamlandırır. 6.1.4.9. Kesirlerle işlem yapmayı gerektiren problemleri çözer.
22. Etkinlik	5.1.3.7. Birçokluğun istenen basit kesir kadarını ve basit kesir kadarı verilen birçokluğun tamamını birim kesirlerden yararlanarak hesaplar. 6.1.4.9. Kesirlerle işlem yapmayı gerektiren problemleri çözer.
23. Etkinlik	6.1.5.1. Bölme işlemi ile kesir kavramını ilişkilendirir. 6.1.4.6. Bir doğal sayıyı bir kesre ve bir kesri bir doğal sayıya böler, bu işlemi anlamlandırır.
24. Etkinlik	5.1.3.5. Sadeleştirme ve genişletmenin kesrin değerini değiştirmeyeceğini anlar ve bir kesre denk olan kesirler oluşturur. 5.1.5.1. Ondalık gösterimlerin kesirlerin farklı bir ifadesi olduğunu fark eder ve paydası 10, 100 ve 1000 olacak şekilde genişletilebilen/sadeleştirilebilen kesirlerin ondalık gösterimini yazar ve okur. 6.1.5.1. Bölme işlemi ile kesir kavramını ilişkilendirir.
25. Etkinlik	5.1.5.2. Ondalık gösterimde virgülün işlevini, virgülden önceki ve sonraki rakamların konumlarının basamak değeriyle ilişkisini anlar; ondalık gösterimdeki basamak adlarını belirtir. 5.1.5.2. Ondalık gösterimde virgülün işlevini, virgülden önceki ve sonraki rakamların konumlarının basamak değeriyle ilişkisini anlar; ondalık gösterimdeki basamak adlarını belirtir. 5.1.5.5. Ondalık gösterimleri verilen sayılarla toplama ve çıkarma işlemleri yapar. 6.1.5.2. Ondalık gösterimleri verilen sayıları çözümler.
26. Etkinlik	5.1.5.1. Ondalık gösterimlerin kesirlerin farklı bir ifadesi olduğunu fark eder ve paydası 10, 100 ve 1000 olacak şekilde genişletilebilen/sadeleştirilebilen kesirlerin ondalık gösterimini yazar ve okur.

	5.1.5.2. Ondalık gösterimde virgülün işlevini, virgülden önceki ve sonraki rakamların konumlarının basamak değeriyle ilişkisini anlar; ondalık gösterimdeki basamak adlarını belirtir. 6.1.5.1. Bölme işlemi ile kesir kavramını ilişkilendirir.
27. Etkinlik	5.2.3.3. Zaman ölçü birimlerini tanır, birbirine dönüştürür ve ilgili problemleri çözer.
28. Etkinlik	8.5.1.1. Bir olaya ait olası durumları belirler.
29. Etkinlik	Ortaokul matematik dersi kazanımlarında herhangi biriyle doğrudan ilişkili bulunamamıştır.
30. Etkinlik	Ortaokul matematik dersi kazanımlarında herhangi biriyle doğrudan ilişkili bulunamamıştır.
31. Etkinlik	Ortaokul matematik dersi kazanımlarında herhangi biriyle doğrudan ilişkili bulunamamıştır.
32. Etkinlik	Ortaokul matematik dersi kazanımlarında herhangi biriyle doğrudan ilişkili bulunamamıştır.
33. Etkinlik	Ortaokul matematik dersi kazanımlarında herhangi biriyle doğrudan ilişkili bulunamamıştır.
34. Etkinlik	Ortaokul matematik dersi kazanımlarında herhangi biriyle doğrudan ilişkili bulunamamıştır.
35. Etkinlik	Ortaokul matematik dersi kazanımlarında herhangi biriyle doğrudan ilişkili bulunamamıştır.
36. Etkinlik	Ortaokul matematik dersi kazanımlarında herhangi biriyle doğrudan ilişkili bulunamamıştır.
37. Etkinlik Kavram Haritası	5.1.1. Doğal Sayılar 5.1.2. Doğal Sayılarla İşlemler 5.1.3. Kesirler 5.1.4. Kesirlerle İşlemler: Toplama ve Çıkarma 5.1.5. Ondalık Gösterim 6.1.1. Doğal Sayılarla İşlemler 6.1.2. Çarpanlar ve Katlar

	6.1.3. Tam Sayılar 6.1.4. Kesirlerle İşlemler 6.1.5. Ondalık Gösterim (Alt öğrenme alanlarındaki tüm kazanımlar)
38. Etkinlik	6.1.2.1. Doğal sayıların çarpanlarını ve katlarını belirler. 6.1.2.2. 2, 3, 4, 5, 6, 9 ve 10'a kalansız bölünebilme kurallarını açıklar ve kullanır.
39. Etkinlik	5.1.5.3. Ondalık gösterimleri verilen sayıları sıralar. 6.1.5.3. Ondalık gösterimleri verilen sayıları belirli bir basamağa kadar yuvarlar 6.1.5.4. Ondalık gösterimleri verilen sayılarla çarpma işlemi yapar. 6.1.5.6. Ondalık gösterimleri verilen sayılarla 10, 100 ve 1000 ile kısa yoldan çarpma ve bölme işlemlerini yapar. 6.1.5.7. Sayıların ondalık gösterimleriyle yapılan işlemlerin sonucunu tahmin eder.
40. Etkinlik	*-Etkinlik 1:* 5.1.5.2. Ondalık gösterimde virgülün işlevini, virgülden önceki ve sonraki rakamların konumlarının basamak değeriyle ilişkisini anlar; ondalık gösterimdeki basamak adlarını belirtir. 6.1.5.2. Ondalık gösterimleri verilen sayıları çözümler. *-Etkinlik 2:* 5.1.2.4. En çok üç basamaklı iki doğal sayının çarpma işlemini yapar. *-Etkinlik 3:* 6.1.5.4. Ondalık gösterimleri verilen sayılarla çarpma işlemi yapar. 5.1.5.2. Ondalık gösterimde virgülün işlevini, virgülden önceki ve sonraki rakamların konumlarının basamak değeriyle ilişkisini anlar; ondalık gösterimdeki basamak adlarını belirtir. 6.1.5.2. Ondalık gösterimleri verilen sayıları çözümler. *-Etkinlik 4:* 5.1.4.1. Paydaları eşit veya birinin paydası diğerinin katı olan iki kesrin toplama ve çıkarma işlemini yapar ve anlamlandırır. 6.1.4.2. Kesirlerle toplama ve çıkarma işlemlerini yapar. *-Etkinlik 5:* 6.1.4.4. İki kesrin çarpma işlemini yapar ve anlamlandırır

APPENDIX C: Sample Classroom Usage for Tasks

1. Task - Gauss	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As an assignment
2. Task-Top. H. Mak.	As an individual task for gifted student As a whole class task that all students in classroom will perform it As a group working activity As an assignment
3. Task - Kart	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As an assignment
4. Task - Alüminyum Kap	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As an assignment
5. Task -Babaannenin yaşı	As an individual task for gifted student As a whole class task that all students in classroom will perform it As a group working activity In a separate Mathematics Center As an assignment

6. Task - İlginç Adam	As an individual task for gifted student As a whole class task that all students in classroom will perform it As a group working activity In a separate Mathematics Center As an assignment
7. Task - Ata Sözü	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As an assignment
8. Task - Matrix	As an individual task for gifted student As a whole class task that all students in classroom will perform it As a group working activity In a separate Mathematics Center As an assignment
9. Task - Gizemli Zarflar	As an individual task for gifted student As a whole class task that all students in classroom will perform it As a group working activity In a separate Mathematics Center As an assignment
10. Task – Mat. Bulmaca	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center

	As an assignment
11. Task - Yaş Pasta	As an individual task for gifted student In a separate Mathematics Center As an assignment
12. Task - Karınca	As an individual task for gifted student In a separate Mathematics Center As a group working activity As an assignment
13. Task - Kitap Kaç Sayfa	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As a group working activity As an assignment
14. Task - Doğum günü	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As an assignment
15. Task -Patt	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As an assignment
16. Task -Koşu Pisti	As an individual task for gifted student

	As a whole class task that all students in classroom will perform it In a separate Mathematics Center As a group working activity As an assignment
17. Task -Mat. Bulmaca Çarpma	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As an assignment
18. Task -Kesri Bulma	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As an assignment
19. Task - Taşlar	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As a group working activity As an assignment
20. Task - Bilye	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As a group working activity As an assignment

21. Task -Şeftali	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As an assignment
22. Task - Küçük ayılar	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As a group working activity As an assignment
23. Task - Pizza paylaştırma	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As a group working activity As an assignment
24. Task - Ondalık H.M.	As an individual task for gifted student As a whole class task that all students in classroom will perform it As a group working activity As an assignment
25. Task - Ondalık HM	As an individual task for gifted student As a whole class task that all students in classroom will perform it As a group working activity As an assignment

26. Task - Ondalık 0 tuşu HM	As an individual task for gifted student As a whole class task that all students in classroom will perform it As a group working activity As an assignment
27. Task - Doğum -Zaman Ölçme	As an individual task for gifted student As a whole class task that all students in classroom will perform In a separate Mathematics Center As an assignment
28. Task -Çay bardağı	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As a group working activity As an assignment
29. Task -Sayılar Alfabe İngilizce	As an individual task for gifted student As a whole class task that all students in classroom will perform In a separate Mathematics Center As an assignment
30. Task -Şifreli yazı	As an individual task for gifted student As a whole class task that all students in classroom will perform In a separate Mathematics Center As an assignment

31. Task - Garson Para Üstü	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As a group working activity As an assignment
32. Task - Ajan ve Patron	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As an assignment
33. Task - Rüya	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As an assignment
34. Task - 5 bayanı bul	As an individual task for gifted student As a whole class task that all students in classroom will perform it In a separate Mathematics Center As a group working activity As an assignment
35. Task - Voleybol	As an individual task for gifted student In a separate Mathematics Center As a group working activity As a Project based

	As an assignment
36. Task -Eğlence Parkı	As an individual task for gifted student In a separate Mathematics Center As a group working activity As a Project based As an assignment
37. Task -Kavram Haritası	As an individual task for gifted student In a separate Mathematics Center As a whole class task that all students in classroom will perform it As a project based As an assignment
38. Task -3 ardışık sayı	As an individual task for gifted student In a separate Mathematics Center As a project based As an assignment
39. Task -Ondalık 10'la çarpma	As an individual task for gifted student In a separate Mathematics Center As a project based As an assignment
40. Task -Tartışma -Keşfetme	As an individual task for gifted student In a separate Mathematics Center As a whole class task that all students in classroom will perform it As an assignment

APPENDIX D: Appropriateness of Tasks for Experts

Activity	Appropriateness in terms of				Any other Comments
	Gifted students 5th and 6^{th} grade	Language for students	Mathematical Thinking	Usage in this study	
1. Activity					
2. Activity					
3. Activity					
4. Activity					
5. Activity					
6. Activity					
7. Activity					
8. Activity					
9. Activity					
10. Activity					
11. Activity					
12. Activity					
13. Activity					
14. Activity					
15. Activity					
16. Activity					
17. Activity					
18. Activity					
19. Activity					
20. Activity					

APPENDIX E: Teacher Pre-Interview Questions

ÖĞRETMEN ÖN GÖRÜŞME SORULARI

1) Üstün yetenekli öğrenciler hakkında bilginiz var mı? Var ise, bu çocuklar hakkında neler biliyorsunuz?

2) Sınıfınızda daha önce hiç matematikte üstün yetenekli öğrenciniz oldu mu?

3) Şu anda sınıfınızda matematikte üstün yetenekli öğrencileriniz olduğunu düşünüyor musunuz?

4) Bu tarz öğrencilere yönelik sınıfınıza uygulayabileceğiniz etkinlik, materyal vs kaynaklarınız var mı? Var ise bunları ne şekilde kullanıyorsunuz?

5) Bu çocuklara yönelik kendinizi yeterli hissediyor musunuz?

6) Bu tarz çocuklara yönelik onların derse karşı motivasyonlarını sağlamak için geliştirdiğiniz yollar/öneriler var mı?

7) Bu konuda ne kadar yeterli olduğunuzu düşünüyorsunuz?

8) Bu tarz çocuklara yönelik onların zihinsen ihtiyaçlarını karşılayabilmek adına geliştirdiğiniz yollar/önerileriniz var mı?

9) Sınıfınızda bu çocuklara ilişkin olarak sınıf yönetimi adına zorluklar yaşıyor musunuz?

Evet ise, ne gibi zorluklar?

10) Bunları üstesinden gelebilmek için neler yapıyorsunuz?

11) Sınıfınızdaki matematikte üstün yetenekli çocuklara yönelik farklılaştırılmış materyaller kullanmak ister misiniz?

12) Bu tarz materyalleri tasarlamak ve geliştirmek ister misiniz?

13) Var olan bu tarz materyaller hakkında bilgi sahibi olmak derslerinizde kullanarak bu çocukları desteklemek ister misiniz?

14) Bu konuda söylemek istediğin başka şeyler varsa bizimle paylaşınız.

APPENDIX F: Teacher Post-Interview Questions

ÖĞRETMEN SON GÖRÜŞME SORULARI

1) Üstün yetenekli öğrenciler hakkında bilginiz var mı? Var ise, bu çocuklar hakkında neler biliyorsunuz?

2) Sınıfınızda daha önce hiç matematikte üstün yetenekli öğrenciniz oldu mu?

3) Şu anda sınıfınızda matematikte üstün yetenekli öğrencileriniz var mı?

4) Bu tarz öğrencilere yönelik sınıfınıza uygulayabileceğiniz etkinlik, materyal vs kaynaklarınız var mı?

5) Bu materyaller hakkında genel olarak ne düşünüyorsunuz?

6) Materyallerin kullanımı ve uygulanabilirliği açısından genel olarak neler söylemek istersiniz?

7) Materyallerin aşağıdaki yöntemler yardımıyla kullanılması hakkında ne düşünüyorsunuz?

   Sınıf içi - Grup - Haftanın/günün sorusu: - Bireysel:

8) Sınıfınızda da bu metotları kullanarak mı uygulama yaptınız?

9) Materyalleri sınıfta kullanırken hangi yöntemi daha uygun buluyorsunuz? (Sınıf içi, grup, haftanın sorusu, bireysel vs)

10) Bu materyaller matematik dersinde rutin olarak kullandığınız materyallerden farklı mıydı? Farklıysa hangi yönlerden farklı olduğunu açıklayınız.

11) Materyalleri tüm sınıf seviyesine göre değerlendirecek olursanız, kolay, zor, orta hangisi olduğunu söylersiniz?

12) Bu materyali kullandığınız süre boyunca olumlu/olumsuz sınıfınızda fark ettiğiniz bir değişiklik oldu mu? Olduysa açıklayınız.

13) Bu materyallerin kullanımına yönelik sınıftaki tüm çocukların tepkileri nasıldı?

14) Materyali ilgi çekici/ sıkıcı /olağan-rutin nasıl buldurlar?

15) Bu materyali kullandığınız süre boyunca sınıfınızdaki üstün yetenekli çocuğunuzda olumlu/olumsuz fark ettiğiniz bir değişiklik oldu mu? Olduysa açıklayınız.

16) Bu materyallerin kullanımına yönelik üstün yetenekli çocuğun tepkileri ne şekilde oldu?

17) Materyalleri üstün yetenekli öğrenciniz/lerinizin seviyesine göre değerlendirecek olursanız, kolay, zor, orta hangisi olduğunu söylersiniz?

18) Materyali ilgi çekici/ sıkıcı /olağan-rutin nasıl buldurlar?

19) Derslerde bu materyalleri kullanmanızın çocuklar açısından normal matematik derslerine etkileri/katkısı/zararı oldu mu?

20) Materyallerin yararlı/zararlı/normal olması hakkında ne düşünüyorsunuz? Açıklayınız.

21) Bu materyallerin kullanımı üstün yetenekli çocukların diğer üstün yetenekli arkadaşları arasında iletişimi artıracak etkiler yarattı mı? Yarattıysa ne gibi etkiler?

22) Bu program üstün yetenekli çocukların diğer normal arkadaşları arasında iletişimi artıracak etkiler yarattı mı? Yarattıysa ne gibi etkiler?

23) Üstün yetenekli çocukların kendilerine güvenleri anlamında bir değişiklik fark ettiniz mi? Ettiyseniz ne gibi değişikler?

24) Çocuklar materyallerin kullanımı için hevesli miydi?

Örnek verebilir misiniz?

Normal matematik derslerinde de bu hevesi var mıdır?

25) Materyaller çocukları zorlayıcılığı bakımından uygun muydu?

Tüm çocukları - Üstün yetenekli çocuğu

26) Genel olarak, bu materyallerin üstün yetenekli çocuğa yönelik ne gibi faydası olduğunu düşünüyorsunuz?

27) Bu materyallerin kullanımı için;

Avantajları nelerdir?

Dezavantajları nelerdir?

28) Materyallerin kullanımı öncesinde/sırasında/sonrasında zorluklar yaşadığınız oldu mu? Olduysa örnek vererek açıklayınız.

Öncesi, Sırası, Sonrası:

29) Materyallerin içeriğine ilişkin önerileriniz var mı?

30) Sizce bu materyaller en etkili ne şekilde kullanılır?

31) Sınıfınızda bu çocuklara ilişkin olarak sınıf yönetimi adına zorluklar yaşıyor muydunuz? Evet ise, ne gibi zorluklar?

32) Evet ise, bu materyallerin sınıfta kullanılmasıyla, yaşadığınız zorluklara ilişkin dikkatinizi çeken bir şeyler oldu mu?

33) Sınıfınızdaki üstün yetenekli çocuklara yönelik kendinizi yeterli hissediyor musunuz?

34) Bu tarz çocuklara yönelik onların zihinsen ihtiyaçlarını karşılayabilmek adına kendinizde geliştiğini düşündüğünüz noktalar var mı?

35) Bu çocukların sosyal ihtiyaçlarına yönelik geliştiğini düşündüğünüz noktalarınız var mı?

36) Bu materyalleri daha sonrasında da sınıflarınızda kullanmayı düşünüyor musunuz?

37) Evet ise, bir sonraki dönem kullanırken bu dönem yaptıklarınıza göre farklılaştıracağınız, ekleyeceğiniz, çıkaracağınız noktalar var mı? Var ise bunlar nelerdir?

38) Bunlara benzer, yeni materyaller tasarlamak ve geliştirmeyi ister misiniz? Böyle bir planınız var ise bizimle paylaşınız.

39) Genel anlamda bu çalışma size katkısı oldu mu? Olduysa ne gibi katkılar?

40) Bu süreç içerisinde diğer öğretmen arkadaşlarınızla etkileşimde bulundunuz mu? Ne gibi etkileşimler?

41) Bu süreç içerisinde diğer öğretmen arkadaşlarınızla ortak çalışmanız gereken noktalar oldu mu? Açıklayınız.

42) Diğer öğretmenlerle önceki etkileşimleriniz düşündüğünüzde, bir farklılık yaşadınız mı?

43) Bu süreçte rehberlik birimiyle etkileşimde bulundunuz mu? Açıklayınız

44) Rehberlik birimin görevi bu noktada sizce nasıl olmalıdır?

45) Bu süreçte okul yönetimiyle herhangi bir paylaşımınız oldu mu? Olduysa açıklayınız.

46) Okul yönetiminin bu noktada görevi sizce nasıl olmalıdır?

47) Bu çalışma sürecinde kişisel yaşamınızda herhangi bir farklılık yaşadınız mı? Yaşadıysanız açıklayınız.

48) Bu konuyla ilgili kişisel çevrenizde herhangi bir adım paylaşımda bulundunuz mu?

49) Bu çalışmaya ilişkin söylemek istediğiniz başka şeyler var mıdır? Varsa bizimle paylaşınız.

APPENDIX G: Students Pre-Interview Questions

ÖĞRENCİ ÖN GÖRÜŞME SORULARI

1) Matematik dersi hakkında ne düşünüyorsun?

2) Matematiği sever misin? Evetse, nesini seversin?

3) Matematik problemlerini, sorularını çözmekten hoşlanır mısın?

-Onları çözerken ne hissediyorsun?

4) Matematik dersinde zorlanıyor musun? (uğraştırıcı, düşündürücü etkinlik, soru uygulama vb gibi)

5) Matematik dersinde zorlanmak, uğraştırmak senin için ne anlama geliyor? / Ne tarz sorular, etkinlikler seni zorlar? Örnek verebilir misin?

6) Peki matematik dersinde zorlayıcı, uğraştırıcı etkinlikler olmasını ister misin?

7) Matematikte zorlandığında, uğraştırıcı sorularla karışlaştığında nasıl hissediyorsun?

8) Matematik derslerinde senin için ilginç/ ilgini çeken etkinlikler oluyor mu? Örnek verebilir misin?

9) Matematik derslerinin daha zorlayıcı olması için önerilerin var mı? Varsa nelerdir?

10) Matematik derslerinin ilgi çekici olması için önerilerin var mı? Varsa nelerdir?

11) Matematik derslerinde grup halinde çalışmayı mı seversin, bireysel mi?

12) Sen ve matematik hakkında başka söylemek istediklerin var mı? Varsa nelerdir?

APPENDIX H: Students Post-Interview Questions

ÖĞRENCİ SON GÖRÜŞME SORULARI

1) Son bir ay içindeki matematik derslerini düşündüğünde, derslerde en çok sevdiğin şeyler nelerdir?

2) Son bir ay içindeki matematik derslerini düşündüğünde, matematik öğretmenin ilgini çekecek şeyler yaptı mı? Yaptıysa bunlar nelerdir?

3) Son bir ay içindeki matematik derslerini düşündüğünde, matematik öğretmenin seni daha zorlayacak şeyler yaptı mı? Yaptıysa bunlar nelerdir?

4) Son bir ay içindeki matematik derslerini düşündüğünde, matematik öğretmenin matematikte daha iyi olabilmen için seni cesaretlendirecek/ilham verecek şeyler yaptı mı? Yaptıysa bunlar nelerdir?

5) Bu etkinlikleri ilgi çekici mi yoksa sıkıcı mı buluyorsun? Hangi yönlerden sıkıcı ya da ilgi çekici olduğunu açıklayınız.

6) Bu etkinliklerde en çok neyi seviyorsun/sevmiyorsun?

7) Bu etkinlikler sana göre kolay mı zor mu? Hangi yönlerden kolay ya da zor olduğunu açıklayınız.

8) Bu etkinliklerin sana faydalı olduğunu düşünüyor musun? Cevabın evetse hangi açılardan sana faydalı olduğunu açıklar mısın?

9) Bu etkinlikler senin matematiğe bakış açında değişikliklere sebep oldu mu? Olduysa ne gibi değişiklikler?

10) Bu etkinlikler senin sosyal yaşamında değişikliklere sebep oldu mu? Olduysa ne gibi değişiklikler?

11) Bu etkinliklere katılırken, etkinlik öncesinde, etkinlik sırasında ve etkinlik sonrasında nasıl hissettin? Bunların sebeplerini açıklar mısın?

12) Etkinliklerde bireysel mi çalıştın yoksa grup halinde mi çalıştın? Bireysel ya da grup halinde çalışma tercihinin sebeplerini açıklayınız.

13) Bunlara benzer daha çok etkinlikler yapmak ister misin? Neden?

14) Kendin bu etkinliklere benzer sorulara oluşturmak ister misin? Eğer istersen, oluşturacağın sorular ve onları nasıl oluşturmak ve uygulamak isteyeceğini açıklayın.

15) Varsa, bu etkinlikler hakkında önerilerin nelerdir?

16) Bunların dışında bu etkinlikler hakkında söylemek istediklerin nelerdir?

APPENDIX I: Teacher After Sheet Form

ÖĞRETMEN ETKİNLİK SONRASI FORMU

Öğretmen Adı **Etkinlik Adı:** **Tarih:**

1. Etkinlik hakkında genel izlenimlerinizi paylaşınız:

Genel öğrenci seviyesi bakımından:

Üstün Yetenekli Öğrenci seviyesi ve ihtiyaçları bakımından:

Uygulanabilirlik bakımından:

İçerik bakımından:

Sınıf yönetimi bakımından:

Zaman/Süre bakımından:

Diğer:

2. Etkinlikte en sevdiğiniz 2 şeyi ve sebebini yazınız.

1.
2.

3. Etkinlikte en sevmediğiniz 2 şeyi ve sebebini yazınız

1.

2.

4. Varsa, etkinliğe eklemek istedikleriniz:

5. Varsa, etkinlikten çıkarmak istedikleriniz:

6. Yorumlarınız:

APPENDIX J: Student After Sheet Form

ÖĞRENCİ ETKİNLİK SONRASI FORMU

1. Bu etkinliği sevdim/ sevmedim çünkü ………………………………………………………………

……

2. Etkinlik sıkıcıydı/ilgi çekiciydi çünkü ………………………………………………………………

……

3. Etkinlik kolaydı/ zorlayıcıydı çünkü……………………………………………………………..........

……

4. Bugün bu etkinlik sayesinde şunları fark ettim:
………

5. Bu etkinlik normal matematik dersi etkinliklerinden farklıydı/farklı değildi çünkü ………

6. Bu etkinlik matematik hakkındaki düşüncelerimi değiştirdi/değiştirmedi, çünkü ………

7. Etkinliği çözerken …………………………….. hissettim.

8. Etkinliğe 10 üzerinden……………… puan veririm, çünkü…

9. Etkinlikte sevdiğin 2 şeyi yaz Etkinlikte sevmediğin 2 şeyi yaz

1.

2.

10. Bunların dışında etkinlik hakkında söylemek istediklerim:

APPENDIX K: Student Assessment Form

ÖĞRENCİ DEĞERLENDİRME SORULARI

1) Son bir ay içindeki matematik derslerini düşündüğünde, matematik öğretmenin ilgini çekecek şeyler yaptı mı? Yaptıysa bunlar nelerdir?

2) Son bir ay içindeki matematik derslerini düşündüğünde, matematik öğretmenin seni daha zorlayacak şeyler yaptı mı? Yaptıysa bunlar nelerdir?

3) Bu yaptığınız etkinlikleri ilgi çekici mi yoksa sıkıcı mı buluyorsun? Hangi yönlerden sıkıcı ya da ilgi çekici olduğunu açıklayınız.

4) Bu etkinliklerde en çok neyi seviyorsun/sevmiyorsun?

5) Bu etkinlikler sana göre kolay mı zor mu, açıklayınız.

6) Bu etkinliklerin sana faydalı olduğunu düşünüyor musun? Açıklayınız.

7) Bu etkinlikler senin matematiğe bakış açında değişikliklere sebep oldu mu? Olduysa ne gibi değişiklikler?

8) Bu etkinlikler senin sosyal yaşamında değişikliklere sebep oldu mu? Olduysa ne gibi değişiklikler?

9) Bu etkinliklere katılırken, etkinlik öncesinde, etkinlik sırasında ve etkinlik sonrasında nasıl hissettin? Neden?

10) Etkinliklerde bireysel mi çalıştın yoksa grup halinde mi çalıştın? Bireysel ya da grup halinde çalışma tercihinin sebeplerini açıklayınız.

11) Bunlara benzer daha çok etkinlikler yapmak ister misin? Neden?

12) Kendin bu etkinliklere benzer sorulara oluşturmak ister misin? Eğer istersen, oluşturacağın sorular ve onları nasıl oluşturmak isteyeceğini açıklayın.

13) Bunların dışında bu etkinlikler hakkında söylemek istediklerin, önerilerin nelerdir?

APPENDIX L: Vita

VITA

1. Personal Information

Surnama, Name: Özdemir, Duygu

Nationality: Turkish (TC)

Date and Place of Birth: April, 5 1988, Karabük

Marital Status: Married

e-mail: duyguaydemr@gmail.om

2. Education

Degree	**Institution**	**Year of Graduation**
Bachelor of Science	METU, EME	2011
Ph.D.	METU, ELE	2016

3. Publications

Baykoc, N., Uyaroglu, B., **Aydemir, D**., & Seval, C. (2012). A new dimension in education of Turkish gifted children. *Procedia-Social and Behavioral Sciences*,*47*, 2005-2009.

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4. Presentations at the International Meetings

Aydemir, D. & Işıksal, M. (2015, January). *Gifted Students' View on History of Mathematics in Mathematics Clasrooms*. Paper presented at World Academy of Science, Engineering and Technology International Journal of Educational and Pedagogical Sciences, Paris, France.

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5. Presentations at the National Meetings

Aydemir, D. & Teksöz, G. (2014, Eylül). Çevre eğitiminin matematik derslerine entegre edilmesine ilişkin öğrenci görüşleri. Paper presented at XI. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi, Adana, Turkey.

Aydemir, D. & Çakıroğlu, E. (2013). Üstün yetenekli ilköğretim öğrencilerinin Matematik Derslerine ilişkin algıları. *In Proceedings of the 12th MATDER Semposium,* 266-268, Ankara, Turkey.

Baykoç, N. &**Aydemir, D.** (2014, Eylül). "*Sınıfımdaki Üstün Yetenekli Çocuk Eğitimci Eğitimi" nin Öğretmen Görüşlerindeki Değişiklilere Etkis*i. Paper presented at IV. Ulusal Üstün Zekali ve Yeteneklilerin Egitimi Kongresi, Istanbul, Turkey

Baykoç, N. & **Aydemir, D.** (2014) 3 Yaşındakı Üstün Yeteneklı Çocuklarda Sayı Algısı, Kavramı, ICECI 2014. Uluslararası Erken Çocuklukta Müdahale Kongresi, Erken Çocuklukta Müdahale Alanında Köprüler Kurmak, 3-6 Nisan 2014 Antalya Türkiye.

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6. National Books/Book Chapters

Baykoç, N. & **Aydemir, D**. (2014). Prof. Dr. Necate Baykoç Üstün Yetenekliler-Dahiler Enstitüsü ve Merkezi. In N. Baykoç (Ed.), *Üstün Yetenek Gelişimleri Eğitimleri* (pp.98 – 134). Ankara: Vize Yayıncılık.

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APPENDIX M: Turkish Summary

MATEMATİKTE ÜSTÜN YETENEKLİ ÖĞRENCİLERE YÖNELİK FARKLILAŞTIRILMIŞ ETKİNLİKLERİN TASARLANMASI VE GELİŞTİRİLMESİ

1. Giriş

Dünyada üstün yetenekli öğrenciler ve onların eğitim süreçlerindeki ihtiyaçları büyük önem kazanmıştır (Hannah, James, Montelle & Nokes, 2011). Üstün yetenekli öğrenciler birçok alanda başarılı olabilecek yüksek bir potansiyele sahiptir fakat; bu potansiyellerinin açığa çıkarılıp çıkarılamayacağı birçok faktöre bağlıdır (Vlahovic, Vidovic & Arambasic, 1999). Ancak şu bir gerçektir ki, üstün yetenekli öğrencilerin neredeyse hepsi, zamanlarının büyük bir kısmını normal gelişim gösteren öğrencilerle birlikte aynı sınıf ve okul ortamı içerisinde geçirmektedirler (Westberg, Archambault, Dobyns, & Salvin, 1993). Fakat, bu sıradan sınıf ortamları, üstün yetenekli öğrenciler için bazı sınırlılıklar içermektedir (Deizmann & Watters, 2001). Bu çocuklarda olan çabalama, mücadele etme, sınırları zorlama ve daha karmaşık, üst düzey bilgiyi elde etme isteği karşılanmamaktadır (Dimitriadis, 2011). Buna ek olarak, normal sınıf ortamlarında, diğer arkadaşlarına göre daha hızlı öğrenen ve “neden?”, “nasıl?” sorularının yanıtlarını arayan üstün yetenekli çocuklar çoğu zaman sıkılmakta ve bu sınıf ortamlarında kaybolmaktadırlar (Gadanidis, Hughes & Cordy, 2011). Diğer taraftan, okullarda üstün yetenekliler için uygun programlar olsa bile, bu programlar; öğretmen yetersizlikleri, sınıf ortamı, müfredat kaygısı ve normal gelişim gösteren diğer çocukların ihtiyaçları gibi sebeplerden dolayı yeterli düzeyde uygulanma fırsatı bulamamaktadır (Westberg ve diğerleri, 1993).

Özellikle, matematik dersleri, bu öğrencilerin potansiyellerinin ortaya çıkarılabilmesi için çok daha fazla dikkat ve önem gerektirmektedir. Matematikte üstün yetenekli öğrencilerin tanılaması ve teşhisleri için birçok araştırma yapılmış ve yaklaşımlar geliştirilmiş olmasına rağmen, matematikte üstün yeteneklilik ile ilgili ulaşılabilen çalışmalarda ortak ve net bir tanım bulunmamaktadır (Pantazi, Christou, Kontoyianni & Kattou, 2011). Ancak, matematikte üstün yetenekli öğrencilerin bazı önemli ve ortak özellikleri mevcuttur. Sayılar ve semboller arasında ilişkisel bir kavrayışa sahip olmak, bunları gerçek yaşamla ve gerçek yaşamdaki uygulamaları ile ilişkilendirebilmek, günlük yaşamda kullanabilecek düzeyde yorumlayabilmek, matematiksel kavramları ve problemleri farklı yollardan, alışılagelmişin dışında bir hızla ve doğrulukta yorumlayabilmek ve çözebilmek bu karakteristik özelliklerden bazılarıdır (Fıçıcı & Siegle, 2008; Sriraman, Haavold & Kyeonghwa, 2013). Normal sınıf ortamlarında, kendilerini mücadele etmeye ve zorlamaya itmeyen, potansiyellerini tümüyle kullanmaya gereksinim duymayan bu öğrenciler zamanla körelip var olan kabiliyetlerini ve potansiyellerini kaybedebilmektedir (Dimitriadis, 2011). Bu yüzden matematikte üstün yetenekli öğrenciler, kendilerini fark etmeye, potanesiyellerini kullanabilmeye ve keşfedilebilmeye yardımcı olacak zihinsel ve bilişsel ek destek uygulamalara ya da etkinliklere ihtiyaç duymaktadırlar.

Üstün yetenekli öğrencilerin zihinsel destek ihtiyaçlarının yanı sıra, sosyo-duygusal açıdan da desteğe ihtiyaçları vardır (Callard-Szulgit, 2003; Fonseca, 2011). Etkinlikler zorlayıcı olduğu kadar, üstün yetenekli çocukların ilgilerini çekebilecek özelliklere de sahip olmalıdır (Karaduman, 2010; Wilkins, Wilkins, & Oliver, 2006; Johnson, 2000). Eğer çocuklar bu ilgi çekici, eğlenceli etkinliklerden mahrum kalırlarsa matematiğe karşı olumsuz bir tutuma sahip olmaktadırlar (Maxwell, 2001 Park & Park, 2006). Çocukların bu zihinsel ve duygusal ihtiyaçlara ek olarak, sosyal gelişimlerine yönelik ihtiyaçları da üzerinde durulması gereken ayrı bir konudur (Colangelo & Davis, 2003). Vygotsky'nin belirttiği gibi, sosyal etkileşimler öğrencilerin düşüncelerinin şekillendirilebilmesine yardımcı olur (Driscoll, 2000). Fakat; bu üstün yetenekli çocukların doğaları gereği ilgi alanlarında ve gelişimsel özelliklerinde var olan farklılık onların diğer sınıf arkadaşlarıyla iletişimlerinde bazı zorlukları beraberinde getirmektedir (Baykoç, 2014; Cornell, 1990). Örneğin, bu çocuklar bazı durumlarda, sınıfa karşı sınıfın "inek öğrenci"si olmaktan kaçınmak için başarılarını, yapabileceklerini ve var olan potansiyellerini saklayarak ters tepki geliştirmek zorunda kalabilmektedirler (Delisle, 1987; Higham & Buescher, 1987). Benzer şekilde, ilişkilerinde yaşadıkları bu sosyal ve duygusal sorunlar onların yalnız kalmalarına ya da ileriki yaşamlarında ciddi sosyal güçlükler yaşamalarına neden olabilmektedir (Morelock & Feldman, 2003). Bu sosyal, duygusal ve zihinsel ihtiyaçlara yönelik problemler üstün yetenekli öğrencilerde yetersiz başarı gösterme sorununa neden olabilmektedir (Davis & Rimm, 2004; Montgomery, 2000; Philips & Lindsay, 2006; Shaughnessy, 2004). Bu üstün yetenekli, yetersiz başarıya sahip olan öğrencilerin birçoğu ise okulu va okulda yapılan etkinlikleri itici, anlamsız ve yersiz bulmaktadır (Ford et al. 1998; Martin & Pickett, 2013). Bu yüzden, sınıf ortamlarında yetersiz başarı, zihinsel, duygusal ve sosyal doyumsuzluk gibi istenmeyen sonuçlar doğurabileceğinden, üstün yeteneğin keşfedilmesi ve geliştirilmesi dikkatle geliştirilmiş materyallerle sağlanmalıdır (Baykoç, 2010; Saunders, 2003; Seeley, 2004).

Diğer taraftan, üstün yetenekli çocuklar vakitlerinin çok büyük bir kısmını sınıf ortamlarında geçirdikleri için, öğretmenlerin bu çocukları farketmeleri ve gözlemleyebilmeleri adına eşsiz bir imkana sahip olduğu da göz ardı edilmemelidir. (Diezmann & Watters, 2001; Tiesco, 2003; VanTassel-Baska, 2005). Diğer bir deyişle, öğretmenler bu sürecin başını çeken ve bu anlamda kilit role sahip olan kişilerdir (Baykoç, 2010; Delisle, 2003; Mogensen, 2011). Ancak, şu da bir gerçektir ki, birçok matematikte üstün yetenekli öğrenci öğretmenlerin farkındalıklarının olmaması nedeniyle sınıf ortamlarında keşfedilemeden kaybolup gitmiştir (Baykoç, 2011; Freehill, 1981; Rotigel & Fello, 2004). Bu sebeple, öğretmenler matematik dersinde üstün yetenekli öğrencilerine yönelik imkanlar sağlayarak, onların matematikte başarabildiklerini eğlenererek deneyimleyebilmelerine ve kendilerine olan güvenlerini arttırmalarına fırsat vermelidirler (Anderson, 2013; Rotigel & Fello, 2004; Wilkins et al., 2006). Eğer öğretmenler, bu çocuklar için ekstra bir şeyler yapmazlarsa, okul etkinlikleri onlar için hayatları boyunca sıkıcı ve gereksiz olarak görülecektir (Martin & Pickett, 2013). Bu sebeple, öğretmenler sınıf içi etkinliklerini, materyallerini ya da programlarını sınıflarındaki üstün yetenekli çocuklara yönelik olarak modifiye etmeli ya da farklılaştırmalıdırlar (Martin & Pickett, 2013; McCollister & Sayler, 2010; Gadanidis, Hughes & Cordy, 2011; Reis &McCoach, 2000; Rotigel & Fello, 2004; Uyaroğlu, 2011).

Özetle, matematikte üstün yetenekli öğrenciler, normal sınıf ortamlarında çok daha sistematik ve onlar için ayrıntıların planlanabildiği bir düzene ihtiyaç duyarlar (Diezmann & Watters, 2003; Johnson, 2000; Sriraman, 2013; Trna, 2014). Ayrıca, üstün yetenekli öğrencilerin keşfedilmesi ve potansiyellerinin geliştirilmesi ülkelerin geleceği açısından önemli olduğu gibi, bu öğrencilerin eğitim olanaklarından yaralanma hakları da göz ardı edilemeyecek bir durumdur (Baykoç, Aydemir & Uyaroğlu, 2014). Eğer sınıf ortamları, bu çocukların eğitimsel ve gelişimsel ihtiyaçlarına cevap veremezse, bu çocuklar öğretmenlerin gözünde en zor ve düzen bozucu öğrenciler olarak görülebilirler. (Chamberlin & Chamberlin, 2010). Bu yüzden, onlara uygun eğitim olanakları sunmak sadece çocukların ihtiyaçlarına değil öğretmenlerin sınıf yönetimlerine de katkı sağlayacaktır (Anderson, 2013; Diezmann & Watters, 2003; Dimitriadis, 2011). Eğer bu çocuklar keşfedilemez, tanılandırılamaz ve doğru yönlendirilemezlerse sınıf ortamlarında kaybolup gidebilir ve beklentilerden, potansiyellerinden çok daha az oranda başarılı olan çocuklar grubuna girebilirler (Martin & Pickett, 2013).

Erişilebilen alanyazınında çalışmalar (Anderson, 2013; Baykoç, 2010; Chamberlin & Chamberlin, 2010; Fıçıcı & Siegle, 2008; Gadanidis et al., 2011; Hekimoğlu, 2004; Pierce, Cassady, Adams, Neumeister, Dixon, & Cross, 2011; Rotigel & Fello, 2004; Sternberg, Ferrari, Clinkenbeard, & Grigorenko, 1996; Tieso, 2002; Tomlinson et al., 1994, Wilkins et al.,2006) üstün yetenekli öğrencilerin ihtiyaçları doğrultusunda modifeye edilmiş, farklılaştırılmış, zenginleştirilmiş, hızlandırılmış eğitimlerinin ya da bu çocukların tanımlamalarının ve özelliklerinin önemi üzerinde yoğunlaşmıştır. Benzer şekilde, matematikte üstün yetenekliler ile ilgili çalışmalar ise bu çocukların karakteristik özellikleri, tanılanmaları ve okullardaki farklılaştırılmış eğitim ihtiyaçları üzerinde yoğunlaşmıştır (Diezmann & Watters, 2003; Dimitriadis, 2011; Fıçıcı & Siegle, 2008; Mogensen, 2011; Rotigel & Fello, 2004; Sriraman, Haavold, & Kyeonghwa, 2013). Türkiye'de erişilebilen alan yazında ise matematikte üstün yetenekli öğrenciler hakkında çok nadir çalışmalara (Altıntaş, 2009; Aydemir & Çakıroğlu; 2013; Aygün, 2010; Budak, 2007; Boran, & Aslaner, 2008; Karaduman, 2010) rastlanmaktadır.

Teorideki ve pratikteki bu boşluktan yola çıkarak bu çalışma, matematikte üstün yetenekli beşinci ve altıncı sınıf öğrencilerine yönelik farklılaştırılmış etkinlikler tasarlamayı ve geliştirmeyi hedeflemektedir. Bu temel hedefe bağlı kalarak, çalışmanın üç farklı amacı bulunmaktadır. İlk olarak, beşinci ve altıncı sınıf matematikte üstün yetenekli öğrencilere yönelik farklılaştırılmış etkinliklerin karakteristik özelliklerini ortaya çıkarmak amaçlanmıştır. Ayrca, bu çalışma ile bu etkinliklerin öğretmenlere ve matematikte üstün yetenekli öğrencilere faydalarının incelenmesi de amaçlanmaktadır. Tüm bu amaçlara ve temel hedefe bağlı olarak, aşağıda verilen araştırma sorularına cevap aranmıştır:

- Beşinci ve altıncı sınıf matematikte üstün yetenekli öğrencilerin zihinsel, duygusal ve sosyal ihtyaçlarını karşılamaya yönelik farklılaştırılmış materyaller nasıl tasarlanır, geliştirilir ve değerlendirilir?

  - Beşinci ve altıncı sınıf matematikte üstün yetenekli öğrencilerin zihinsel, duygusal ve sosyal ihtyaçlarını karşılamaya yönelik tasarlanan ve geliştirilen farklılaştırılmış materyallerin özellikleri nelerdir?

- Beşinci ve altıncı sınıf matematikte üstün yetenekli öğrencilere yönelik farklılaştırılmış materyallerin öğretmenlere faydaları nelerdir?

- Beşinci ve altıncı sınıf matematikte üstün yetenekli öğrenciler için hazırlanan farklılaştırılmış materyallerin matematikte üstün yetenekli öğrencilerin zihinsel, duygusal ve sosyal ihtiyaçlarını karşılamaya yönelik faydaları nelerdir?

2. Yöntem

2.1. Araştırma Yöntemi

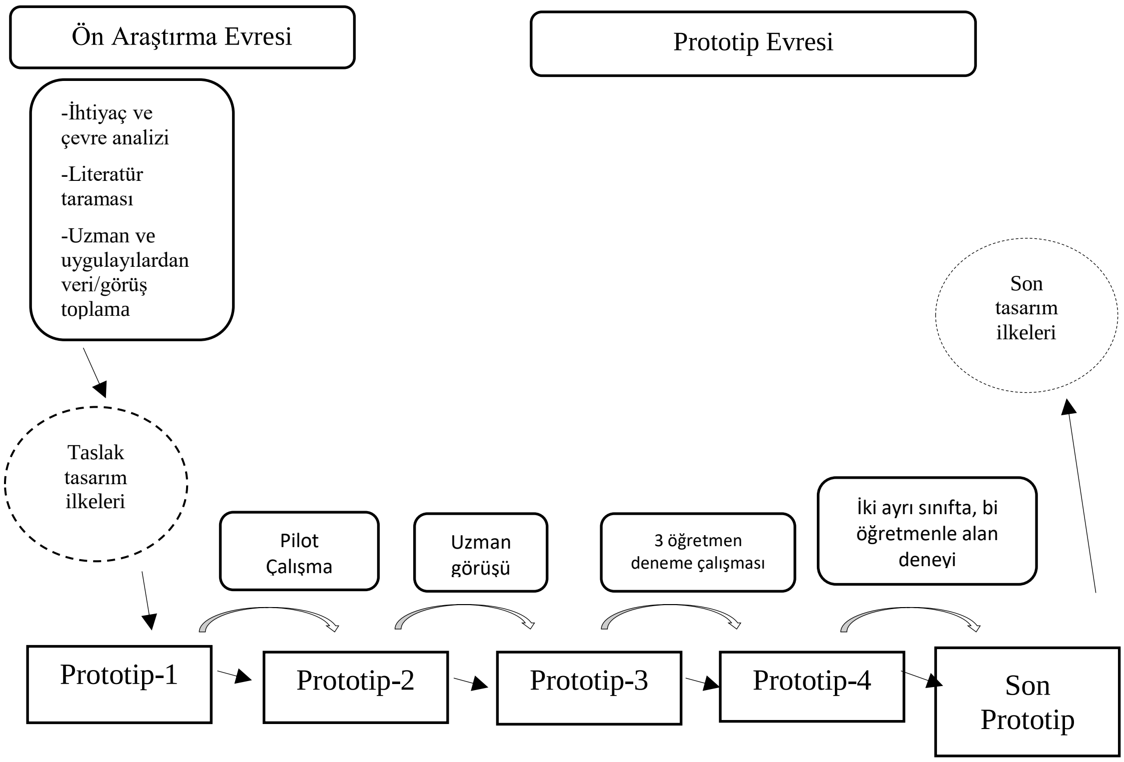
Bu çalışmanın önemi ve amaçları teoride var olan bilgilerden destek alarak pratikte var olan problemi çözmeyi gerektirmektedir. Bilindiği ve daha öncesinde bahsedildiği gibi, matematikte üstün yetenekli öğrenciler normal sınıf ortamlarında kendilerine yönelik bazı eğitimsel imkanlardan mahrum kalmaktadırlar. Bu sebeple, bu çalışmada onlara bu eğitimsel imkanları sağlayabilecek, hem teorik yanı güçlü hem de pratikte, gerçek yaşamda kullanışlı olacak farklılaştırılmış materyallerin kullanılması amaçlanmıştır. Etkinliklerin geliştirilmesinden sonra sınıf ortamlarında etkinliklerinin ve kullanılışlılıklarının değerlendirilmesi çok önemlidir (Nieveen, 1999). Bu sebeple, tasarlanan materyaller gerçek yaşam ortamlarında, yani normal sınıflarda kullanılarak her aşamada geliştirilmiş ve değerlendirilmiştir. Bu çalışmada, tüm bu amaçlara hizmet edebilecek en iyi yöntem olarak tasarım tabanlı araştırma metodu kullanılmıştır. Van den Akker, Gravemeijer, McKenney ve Nieveen (2006), tasarım tabanlı araştırmada teori ve pratiğe, üründen çok sonuca odaklanmanın, uygulayan kişi ve katılımcıların iş birliği ile gerçek yaşam problemine çözüm üretmenin önemini belirtmiştir. Yani tasarım tabanlı araştırma yöntemiyle, gerçek yaşamda var olan bir problemin çözümüne yönelik, sistematik çalışmalar yardımıyla eğitim ürünlerinin tasarlanması, geliştirilmesi ve değerlendirilmesi gerçekleştirilebilir (Bannan-Ritland, 2003; Kelly, 2006; Plomp, 2013; Nieveen 2013).

Tasarım tabanlı araştırma yöntemi, eğitim alanında gelişmelere ve yeni teorik tabanlı kullanılabilir bir ürünün ortaya çıkmasına olanak sağlar (Trna, 2014; Trna & Trnova, 2012). Yani, hem teoriye katkıda bulunurken hem de kullanılabilir bir ürünün tasarımı, geliştirilmesi ve değerlendirilmesi aşamaları kaydedilebilir (Kennedy-Clark, 2013; Masole, 2011; Van den Akker, Gravemeijer, McKenney, & Nieveen, 2006). Teori ve pratik arasında köprü görevi gören bu yöntem sayesinde öğretmenler, araştırmacılar, okul yöneticileri, uzmanlar araştırma ve geliştirmesürecinin tümüneetkin olarak katılabilirler (Van den Akker et al., 2006). Bu durum da tasarım tabanlı araştırma modelinin diğer araştırma modelinden farklı olarak insanların iş birliği ve etkileşim içerisinde olarak, grup çalışması sonucunda bir ürün ortaya çıkarılmasını sağlar (McKenney, 2006). Bu sebeplerden dolayı, her ne kadar çok yaygın kullanılıyor olmasa da üstün yetenekliler alanında tasarım tabanlı araştırma modelinin kullanılması etkili ve uygun olabilmektedir. (Jen, Moon & Samarapugavan, 2015). Bu araştırma modeli, bu çalışmanın amaçları ile örtüşerek maksimum etkiyi sağlayacağı düşüncesi ile kullanılmıştır.

2.2. Araştırma Evreleri ve Veri Toplama

Çalışma *ön araştırma evresi ve prototip evresi* olmak üzere iki temel araştırma evresinden oluşmaktadır (Şekil 2.1). Ön evre aşaması var olan durumu anlamak ve teorik çerçeve oluşturmak adına gerekli ve önemlidir (Clark, 2013). Bu aşamada, gerçek yaşamda var olan problemi tanımlayabilmek ve anlamlandırabilmek amacıyla ihtiyaç ve çevre analizi gerçekleştirilmiştir. Türkiye'deki üstün yetenekli çocukların matematik dersleri hakkındaki görüşleri alındığında, bu çocukların kendilerine uygun etkinliklerden yoksun oldukları göülmüştür (Aydemir & Çakıroğlu, 2013). Ayırıca, öğretmenlerin sınıflarındaki üstün yetenekli çocuklara yönelik görüşleri alındığında ise, bu konu hakkındaki bilgilerinin yetersiz olduğu ortaya çıkmıştır (Baykoç & Aydemir, 2014). Matematikte üstün yetenekli öğrenciler, öğretmenleri ve örnek farklılaştırılmış materyaller hakkında alan yazın taraması yapılarak konu hakkında detaylı ve bilimsel bir çerçeve oluşurulmaya çalışılmıştır (Anderson, 2013; Baykoç, 2010; Chamberlin & Chamberlin, 2010; Fıçıcı & Siegle, 2008; Gadanidis, Hughes & Cordy, 2011; Hekimoğlu, 2004; Pierce, Cassady, Adams, Neumeister, Dixon, & Cross, 2011; Rotigel & Fello, 2004; Sternberg, Ferrari, Clinkenbeard, & Grigorenko, 1996; Tieso, 2002; Tomlinson, Tomchin, & Callahan, 1994, Wilkins et al.,2006).

Bunların yanı sıra, kritik insanlarla görüşme, araştırmacının kendi deneyimleri, konferanslardan elde edilen dönütler gibi resmi olmayan diğer ön araştırma çalışmaları da var olan problem durumunu açıkça ortaya koymak adına ön araştırma evresi kapsamında gerçekleştirilmiştir. Benzer amaçla, üstün yetenekli çocukların eğitimi alanında bir uzman, diğer öğretmenler ve uygulayıcılar ile de görüşmeler yapılarak konu hakkında bütünsel bir bakış açısı kazanılmaya çalışılmıştır. Böylece, ön araştırma evresinden elde edilen tüm veriler yönlendirme sağlayarak çalışmanın dışsal geçerliliğine (Van den Akker et al., 2006; Masole, 2011) ve taslak tasarım ilkelerinin şekillenmesine katkıda bulunmuştur.



Şekil 2.1 Araştırma Evreleri (p.46)

Araştırmanın ikinci evresi olan *prototip evresi*nde ise ön araştırma evresinde elde edilen veriler ışığında, tasarlanan farklılaştırılmış materyallerin geliştirilmesi ve değerlendirmesi gerçekleştirilmiştir (Clark, 2013; Masole, 2011; Van den Akker, Branch, Gustafson, Nieveen, & Plomp, 1999).Protiplerin geliştirilmesi ve değerlendirilmesi gerçekyaşam problemlerinin çözümü sürecinde tasarım ürünlerinin sürekli ve sistematik bir şekilde değerlendirilerek düzenlemeler yapılmasına olanak sağlar(McKenney, Nieveen & van den Akker, 2006). Böylece, tasarım ilkeleri teori ve uygulama ile beslenerek son halini almış olur (Masole, 2011).

Prototipler ve alan deneyi olarak iki ayrı kısma ayrılan bu evrede, prototipler aşamasında veriler Ankara/Altındağ bölgesinde bulunan bir devlet okulunda görev yapan üç öğretmen ile dört ayrı sınıftan elde dilmiştir. Bu sınıflarda bulunan 115 öğrenciye, tez kapsamında Türkçeye uyarlanma çalışması yapılan Üstün Yetenekli Çocuklar İçin Matematiksel Beceriler Testi (TOMAGS) uygulanmıştır. Öğretmen aday gösterme ve öğrencilerin TOMAGS sonuçlarına göre yedi öğrenci çalışma sürecinde matematikte üstün yetenekli olarak belirlenmiştir. Diğer taraftan, alan deneyi aşamasında ise veriler Ankara/Yenimahalle bölgesinde bulunan bir devlet okulunda görev yapan öğretmen ile iki ayrı sınıfta bulunan öğrencilerden 2014-2015 eğitim öğretim yılı bahar döneminde toplanmıştır. Toplam 61 öğenciye uygulanan öğretmen aday gösterme ve TOMAGS sonucunda öğrencilerden sekizi matematikte üstün yetenekli olarak belirlenmiştir. Aşağıda, alt katgorilere ayrılarak bu prototip aşamaları hakkında bilgi verilmiştir.

2.2.1. Prototip-1 ve Pilot Çalışma

Ön araştırma evresinden elde edilen veriler ışığında, beşinci ve altıncı sınıf öğrencilerine yönelik sayılar alt öğrenme alanına ilişkin kırk farklı etkinlik taslak tasarım ilkeleri yönlendirmesi ile ilk prototip olarak düzenlenmiştir. Tasarlanan farklılaştırılmış materyaller, Ankara/Çankara bölgesinde bulunan bir özel okulda araştırmacı tarafından 2014-2015 güz dönemi boyunca pilot çalışma sürecinde değerlendirilmiştir. Materyaller anlaşılabilirlik, uygulanabilirlik ve uygunluk açısından araştırmacı tarafından değerlendirilerek sürekli revize edilmiştir. Bu süreçte araştırmacının, uygulayıcı ve gözlemci olarak çoklu role sahip olması materyallerin uygulanabilirliğine ilişkin güçlü ve zayıf noktalarını birinci gözden görebilme ve anında düzeltmeye olanak sağlaması açılarından faydalı olmuştur (Patton, 1990; McKenney, Nieveen, & Van den Akker, 2006; Van den Akker et al., 2006). Bunun yanı sıra, öğrencilerle yapılan görüşmelerde etkinliklerin revize gerektiren noktaları ve matematik derslerinde kullanımı hakkındaki yorumlar alınmıştır.

2.2.2. Prototip-2

Prototip-1'den elde edilen verilere göre geliştirilen materyaller ve tasarım ilkeleri ile prototip 2 düzenlenmiştir. Ardından, bu prototip 2 formundaki materyaller ve ilkeler hakkında üçü matematik eğitimi alanında, biri ise üstün yetenekliler alanında olmak üzere dört ayrı uzman görüşü bireysel olarak alınmıştır. İçerik, teknik yeterlilik, seviyeye uygunluk ve sınıf ortamlarında kullanışlılık üzerine uzman değerlendirmesi yapılan materyaller aşağıda verilen dokümanları içermiştir:

- Matematike üstün yetenekli çocuklar için farklılaştırılmış etkinlikler,
- Her etkinlik için karakteristik özelliklerin (tasarım ilkeleri) belirlendiği tablo (Appendix A),

- Etkinliklerin orta öğretim matematik müfredatı kazanımlarıyla ilişkilendirilmesi (MoNE, 2013, Appendix, B),
- Farklılaştırılmış materyallerin özelliklerinin işlemsel tanımları,
- Etkinliklerin olası sınıf içi kullanımlarına yönelik öneriler (Appendix C),
- Uzmanlar için etkinliklerin uygunluğuna ilişkin kontrol listesi (Appendix D).

Böylece, prototip-2 matematiksel altyapı, üstün yetenekli çocuklar ve matematik için uygunluk, matematik derslerinde kullanılabilirlik ve materyallerin karakteristik özellikleri bakımından uzmanlar tarafından değerlendirilmiştir. Uygulama alanında kişilerle yapılan iş birliği kadar, uzmanlarla yapılan iş birliği de materyallerin kullanılabilirliği ve uygunluğu bakımından önemli bir role sahiptir (Cobb et al., 2003; Masole, 2011). Bu sebeple, bu aşama farklılaştırılmış matematik etkinliklerinin geçerliliği ve uygulanabilirliği hakkında önemli ipuçları sağlamıştır (Plomp & Nieveen, 2007).

2.2.3. Prototip 3

Uzman görüşlerinden ve geri dönütlerden elde edilen veriler prototip-3'ün geliştirilmesini sağlamıştır. Son şeklini alan prototip, daha önce bahsedilen bir devlet okulunda görev yapan üç ayrı matematik öğretmeni tarafından beş farklı sınıfta denenmiştir. Bu okul, araştırmacı tarafından iki ayrı sebepten dolayı amaçlı örneklem olarak seçilmiştir. İlk sebep, okulda görev yapan öğretmenlerden birinin etkili, verimli ders işleyişi, bilimsel çalışma yapma tecrübesidir. İkinci sebep ise, pilot çalışmanın bir özel okula devam eden ve ailelerinin sosyo-ekonomik seviyeleri yüksek olan öğrencilerle gerçekleştirilmiş olmasıdır. Diğer bir deyişle, etkinliklerin sosyo-ekonomik ve başarı seviyesi daha düşük okullarda da etkili olup olmadığı incelenerek etkinliklerin genellenebilirliğini arttırmak amaçlanmıştır. Bu sebeple ilk olarak öğretmen ve okul, amaçlama yöntemiyle seçilmiştir. Bu okulda görev yapan matematik öğretmenlerinden diğer iki tanesi ise elverişli örnekleme yöntemiyle çalışmanın katılımcıları olarak seçilmiştir.

Çalışmanın veri toplama sürecine gelindiğinde üçgenleştirme tekniği kullanılarak olay ve durum hakkında daha geniş ve bütünsel bakış elde etmek amaçlanmıştır (Masole, 2011; Maxcy, 2003). Bu bağlamda, öğretmen ve öğrencilere yönelik görüşmeler, gözlemler, içerik ve doküman analizleri veri toplama araçları olarak kullanılmıştır.

Çalışmanın başlangıcında, araştırmacı, katılımcı öğretmenler ve okul yöneticisi ile süreç hakkında genel bilgilendirme sağlamak amacıyla bir toplantı yapılmıştır. Bu toplantı sonrasında, öğretmenlerin ilk görüşlerinin alındığı bireysel yarı yapılandırılmış görüşmeler gerçekleştirilmiş ve onların sınıflarındaki üstün yetenekli çocuklar, bu çocukların özellikleri ve ihtiyaçları hakkındaki farkındalıklarının ortaya çıkarılması amaçlanmıştır (Appendix E). Bu görüşmelerden sonra, öğretmenlere üstün yetenekli öğrencilerin özellikleri ve farklılaştırılmış etkinlikler hakkında bilgi vermek amacıyla tekrar bir toplantı yapılmış ve öğretmenlere okumaları ve takip etmeleri için bazı kaynaklar önerilmiştir. En önemlisi ise, öğretmenlerden prototip-3‘te son halini almış olan etkinlikleri ve tasarım ilkelerini incelemeleri ve her etkinliği içerik, uygulanabilirlik bakımlarından yorumlamaları istenmiştir. Tüm bu incelemeleri yaparken ise, sınıflarındaki matematikte üstün yetenekli olableceğini tahmin ettikleri çocukları aday göstermeleri istenmiştir. Ardından, bu sınıflarda bulunan çocukların tümüne TOMAGS testi uygulanarak, çalışmanın öğrenci örneklemi olan yedi matematikte üstün yetenekli öğrenci belirlenmiştir.

Uygulama öncesi etkinlikleri inceleyen öğretmenlerle etkinliklerin içeriği, uygulanabilirliği ve gerekli düzeltmeler hakkında ara görüşmeler yapılarak her öğretmenin kendisine göre bir zaman ve etkinlik çizelgesi oluşturması sağlanmıştır. Böylece, her öğretmen hangi ders saatinde, hangi etkinliği kullanacağına dair bir plan ve program yapmıştır. Bu programa bağlı kalarak, öğretmenler altı hafta boyunca sınıflarında materyalleri kullanmış, araştırmacıyla birlikte öğrenci tepkilerine, içerik ve kullanılabilirliğine göre sürekli düzenlemeler yapmıştır. Böylece, deneme uygulamaları süresince etkinlikler araştırmacı, öğretmenler ve öğrencilerin iş birliği ile değerlenidirilerek geliştirilmiştir (Masole, 2011). Altı hafta sonunda tamamlanan etkinliklerden sonra, aynı öğretmenlerden yarı yapılandırılmış görüşme aracılığıyla uygulamalar hakkındaki görüşleri, uygulamanın öğrencilerine ve kendilerine etkileri ve faydaları hakkında bilgi toplanmış ve öğretmenlerin üstün yetenekli çocuklar hakkındaki görüşleri ve farkındalıklarını yapılan ilk görüşmelerle karşılaştırmak amacıyla veriler toplanmıştır (Appendix F). Ayrıca öğretmenlerden, her etkinlik sonrasında etkinlik sonrası değerlendirme kağıdını doldurmaları ve görüşlerini bildirmeleri istenmiştir (Appendix I).

Diğer taraftan, çalışmanın diğer katılımcıları olan öğrencilerden de benzer yöntemlerle veriler toplanmıştır. Öğrencilerle, matematik dersleri hakkındaki görüşleri, ihtiyaçları ve beklentileri hakkında ön görüşme yapılmıştır (Appendix G). Uygulama boyunca, öğrencilerden yapılandırılmamış görüşmeler, öğrenci değerlendirme formları (Appendix K), etkinlik sonrası görüş formları (Appendix J) ve etkinlik kağıtları yoluyla sürekli veri toplanmıştır. Uygulama sonrasında ise, öğrencilerle son görüşmeler yapılmış ve öğrencilerin matematik dersi, yapılan uygulamalar ve bu materyellerin sınıflarında kullanımına ilişkin fikirleri alınmıştır (Appendix H).

Tüm bunlara ek olarak, araştırmacı süreç boyunca gözlemler yapmış ve bir günlük tutarak revize edilmesi gereken noktalar, sözel olmayan olumlu ya da olumsuz öğrenci tepkileri, öğretmenlerin zorluk çektiği durumlar gibi durumları not etmiştir. Ayrıca, yapılan görüşmeler ve tüm sınıf içi uygulamalar, çalışma sonrasında incelenmesi amacıyla ses kaydına alınmıştır. Tüm bu toplanan veriler ve değerlendirmeler ışığında prototip-3'ün sınıf ortamında denenme süreci tamamlanmış ve bir sonraki bölümde bahsedilen prototip-4 oluşturulmuştur.

2.2.4. Prototip 4

Prototip 3'ün üç ayrı öğretmen ile beş farklı sınıf ortamında denenmesi sonrasında, uygulama sürecinde sürekli elde edilen dönütler yardımıyla prototip-4 oluşturulmuştur. Bu süreç içerisinde öğretmenlerin düzenlenmesini ya da eklenmesini istedikleri bazı noktalar olmuştur. Örneğin, ilk uygulama sonrasında öğretmenlerin talebi üzerine öğrenci etkinlik formunun yanı sıra, kendileri için açıklamaların, vurgulanması gereken noktaların ve uygulamaya ilişkin ipuçlarının bulunduğu bir kitapçık hazırlanarak onlara verilmiştir. Ayrıca tüm öğretmenlerin talebi üzerine bu kitapçıklara etkinliklerin cevap anahtarları eklenmiştir. Bunların yanı sıra, bazı etkinliklere öğrenciler açısından daha kullanışlı olması ve tasarım ilkelerine uygunluk bakımından değişiklikler yapılmıştır. Uygulama boyunca, ilgi çekiciliği zorluğu ya da disiplinlerarası uygulamaların gerekliliğine dair vurgulanması gereken noktalar değiştirilerek etkinliklerin asıl amaçlarına uyması ve öğrencilerin ihtiyaçlarına cevap verebilmesi adına önemli değişiklikler yapılmıştır.

Tüm bunlara bağlı olarak, gerekli bulunan durumlarda tasarım ilkelerinde de bazı düzenlemeler yapılmıştır. Örneğin, iki ayrı başlık altında dağınık olarak ele alınan taslak tasarım ilkeleri öğretmenlerin ve araştırmacının işbirliği sonucunda vardığı karar ile içerik bakımından, etkinlik çeşidi bakımından ve uygulama metodu bakımından özellikler olarak üç ayrı başlık altında toplanmıştır. Zorlayıcı, ilgi çekici ve üst düzey düşünme gerektiren etkinlik özelliklerinin içerik bakımından tasarım ilkeleri olarak ele alınması gerektiğine karar verilirken, problem çözme, zeka sorusu, matematik bulmacası, disiplinlerarası etkinlik gibi özelliklerin etkinliğin çeşidini bildirdiğine ve bu başlık altında toplanması gerektiğine karar verilmiştir. Tüm bu özellikler bakımından geliştirilen etkinliklerin sınıf içerisinde uygulanmasına yönelik tasarım ilkeleri ise uygulama metodu bakımından özellikler olarak ele alınmıştır. Tüm bu materyallere ve tasarım ilkelerine yönelik olarak yapılan düzenlemelerle prototip-4 elde edilmiş ve bir sonraki bölümde anlatılanların deneyiminde uygulanmaya hazır hale getirilmiştir.

2.2.5 Alan Deneyi

Bilindiği üzere prototiplerin alan deneyi öncesi gerçek yaşam ortamlarında denenmesi çalışmanın güvenilirliğini artırmaktadır (Clark, 2013). Prototiplerin denenmesi sonucunda elde edilen Prototip-4, alan deneyi çalışmasında Ankara/ Yenimahale bölgesinde bulunan bir devlet okulunda görev yapan bir öğretmen ile iki ayrı sınıfta uygulanmıştır. Böylelikle materyallerin kullanışlılığı ve etkililiği farklı sosyo-ekonomik seviyelere sahip ortamlarda denenmiştir.

Alan deneyi çalışmasında etkinlikler, bilimsel araştırma deneyimi ve etkin sınıf içi öğretimi sebebiyle amaçlı olarak seçilmiş olan öğretmenin matematik sınıflarında beş hafta boyunca uygulanmıştır. Diğer uygulamalardan farklı olarak, alan deneyinde öğretmen odak noktası olarak tutulurken, araştırmacı geri planda durarak öğretmene destek sağlamıştır. Bu uygulamanın sebebi, etkinliklerin sınıf içerisindeki uygulanabilirliği, kullanışlılığı ve etkililiğinin araştırmacının direk desteği olmadan öğretmen tarafından nasıl gerçekleştirilebildiğinin incelenmesidir.

Araştırma sürecinin diğer basamakları deneme uygulamalarında olduğu gibi ilerlemiştir. Sınıflarda bulunan tüm öğrenciler, öğretmen aday gösterme ve TOMAGS sonuçlarına göre değerlendirilerek matematikte üstün yetenekli olan sekiz öğrenci belirlenmiştir. Çalışmaya katılan öğretmenin üstün yetenekli çocuklar ve ihtiyaçları hakkındaki görüşleri yapılan ilk görüşme sırasında alınmış ve ardından öğretmen konu hakkında bilgilendirilerek ona çeşitli kaynaklar sunulmuştur. Kaynaklarin öğretmene sunulmasından bir hafta sonra öğretmenle tekrar görüşme yapılarak öğretmenin programına, müfredat ve öğrencilerinin durumuna göre bir zaman çizelgesi oluşturulmuştur. Sınıf gözlemlerinin öğretmen tarafından yapıldığı alan deneyi uygulamasında, öğretmen ayrıca öğrencilerinden 'etkinlik sonrası formları' ve 'öğrenci değerlendirme formları' nı toplamıştır. Önceki uygulamalara benzer şekilde, öğrenciler ve öğretmenle ilk ve son görüşmeler yapılmış, etkinliklerin kullanımının görüşlerindeki farklılıklara etkisi incelenmiştir. Bunun yanı sıra, etkinlikler uygulanırken materyallere ya da tasarım ilkelerine yönelik gereken düzenleme ya da değiştirmeler anlık yapılarak etkinliklere ilişkin son prototipin geliştirilmesi sağlanmıştır.

2.3.Veri Analizi

Nitel çalışmaların doğası gereği, bu çalışmanın veri analiz süreci pilot çalışma ile başlamış ve veri toplamanın sonuna kadar devam etmiştir. Yani, nitel araştırma sürecinde veri toplama ve analiz süreçleri iç içe ve bire bir bağlantılı olduğu için (Creswell, 2007; Glaser & Strauss, 1967) çalışma boyunca sürekli analiz gerçekleştirilmiştir (Miles & Huberman, 1994).

Veri analizi süresince sürekli araştırma sorularını hatırlamak ve bu çerçevede analizlere yön vermek önemlidir (Miles & Huberman, 1994). Bu sebeple, veri analizinin her aşamasında araştırma sorularına paralellik gözetilmiştir. Ayrıca, verilerden yeterli ya da net bilginin elde edilemediği durumlarda katılımcıların kendilerine sorular sorularak gerekli noktalar netleştirilmiştir. Analiz süreci boyunca öğretmenler için “TS, TM, TN, TR” öğrenciler için ise “S1, S1, S3 vb…” gibi rumuzlar kullanılmıştır.

Verilerin analizi sürecinde doğru yolu izleyebilmek için, tasarım tabanlı araştırma ve benzer verilerin analizleri hakkında fikir sahibi olmak adına ilk olarak, ilgili literatür taraması gerçekleştirilmiştir. Bunun yanı sıra, araştırma amacına en uygun olacak şekilde Merriam’ın (1998) nitel çalışmalara uygun olarak bahsettiği altı çeşit analiz yöntemi incelenmiştir. Tasarım tabanlı araştırma metodu temellendirilmiş teori çalışmalarına benzetilmektedir ve sürekli karşılaştırmalı analiz, bu yöntemde en çok kullanılan analiz yöntemidir (Merriam, 1998). Tüm bu sebeplerden dolayı, sürekli karşılaştırmalı analiz metodunun çalışmanın amacına ve araştırma sorularına en uygun analiz yöntemi olduğuna karar verilmiştir.

Ayrıca, çalışma verileri Glaser ve Staruss (1967)’ un bahsettiği araştırma analiz aşamaları ile analiz edilmiştir. İlk olarak, öğrenci ve öğretmen görüşmeleri ile sınıf ses kayıtları veri analizinin ön gereksinimini yerine getirmek amacıyla (Cormack, 1991; Creswell, 2009) yazılı hale getirilmiştir. Tüm bu veriler, araştırmacının notları, öğrenci ve öğretmen etkinlik sonrası formları, çalışma kağıtları ve değerlendirme formları ile bir araya getirilmiştir. Bu farklı veri kaynakları üçgenleştirme metoduyla daha güvenilir bulgular elde edilmesine yardımcı olmuştur (Denzin, 1989). Kodlama ve kategoriler aşamasına geçilmeden önce, tüm veriler baştan sonra bir kaç defa okunarak bütüncül bir bakış açısı sağlayabilmek için incelenmiştir (Creswell, 2007). Ardından analiz için gerekli ve ilgili olan veriler ile diğerleri birbirinden ayrılmıştır (Glaser & Straus, 1997). Görüşmelerden elde edilen verilerin kodlanmasının ardından, örüntü oluşturan benzer kategoriler bir araya getirilerek ilk taslak kategoriler oluşturulmuştur. Ardından, gözlemlerden, formlardan elde edilen diğer veri setleri ile benzer örüntülerin ve kategorilerin varlığı üzerine inceleme yapılmıştır.

Bu süreç içinde kodlamaların tanımları analiz sürecinin sağlıklı ve tutarlı yürümesi açısından çok önemli olduğu için (Miles & Huberman, 1994), kategori ve kodlamalar süreç boyunca aynı anlamlarda kullanılmaya çalışılmıştır. Tüm veri setlerinde inceleme yapılırken bazı kategoriler ihtiyaca göre elenmiş, bazı kategorilerin içerikleri değiştirilmiş ya da genişletilmiştir. Hatta bazı durumlarda, iki farklı kategori bir araya getirilerek yeni anlamlar kazandırılmıştır. Böylece, süreç sonucunda sürekli karşılaştırılan ve değerlendirilen veriler ile kesin kategoriler elde edilmiştir. Tüm gerekli verilerin uygun kategoriler altında toplandığı ve yeni kategorilerin oluşmadığı görülerek (Lincoln & Guba, 1985) kategorilerin doyuma ulaştığı sonucuna varılmıştır. Ardından, her kategori kendi içerisinde incelenerek gerekli görülen durumlarda kategoriler, alt kategorilere ayrılmış; hatta bazı durumlarda alt alt kategorilere ayrılmıştır (Creswell, 2007). Böylece veri analizleri sonucunda bir sonraki bölümde anlatılacak olan üç temel kategori ve alt kategorileri elde edilmiştir.

3. Bulgular ve Öneriler

Çalışma bulguları matematik derslerinde kullanılmak üzere, matematikte üstün yetenekli çocuklara yönelik olarak geliştirimiş olan farklılaştırılmış etkinliklerin özellikleri, öğretmenlere ve matematikte üstün yetenekli öğrencilere yönelik faydaları olmak üzere üç ayrı grupta ele alınmıştır.

3.1.Beşinci ve Altıncı Sınıf Matematikte Üstün Yetenekli Çocuklara Yönelik Farklılaştırılmış Etkinliklerin Özellikleri

Tasarım tabanlı araştırma sürecinde tasarlanan ve geliştirilen farklılaştırılmış etkinlikler ile taslak tasarım ilkeleri süreç sonunda son şeklini almış ve temel tasarım ilkeleri olarak bahsettiğimiz özellikleri belirlenmiştir. Matematikte üstün yetenekli öğrencilere yönelik geliştirilen farklılaştırılmış etkinliklerin aşağıda bahsedilen üç temel özelliğe sahip olması gerektiği görülmüştür. Ayrıca bu üç temel özelliğe sahip olması beklenen etkinliklerin, bu özelliklerin alt kategorilerinden en az birini sağlaması gerektiğine karar verilmiştir.

3.1.1. İçerik Bakımından Özellikler

Farklılaştırılmış etkinliklerin özeliklerinin içerik bakımından aşağıda belirtilen üç alt kategoriye ayrıldığı ve etkinliklerin bu alt kategorilerden en az birinin özelliklerini sağlaması gerektiği görülmüştür.

Zorlayıcı: Zorlayıcılık ve anlamda karmaşıklık, üstün yetenekli çocukların etkinliklerinde bulunması gereken özelliklerden biridir (Chamberlin, 2002; Deizmann

& Watters, 2001, 2005; Gavin, Casa, Adelson, Sheffield & Spinelli, 2007; Karaduman, 2010; Sriraman, 2003).

İlgi Çekici: Üstün yetenekli öğrencilere yönelik geliştirilen etkinliklerin ilgi çekici olması, öğrencilerin dikkatini çekebilmesi adına önemlidir (Johnson, 2000; Karaduman, 2010; Wilkins, Wilkins, & Oliver,2006). Bu yüzden, sıradan olmayan, yenilikçi, dikkat ve merak uyandıran etkinlikler bu çocuklara sunulmalıdır.

Üst Düzey Düşünme Gerektiren: Üstün yetenekli öğrencilerin ihtiyaçlarını karşılayabilmek için onların etkinliklerini farklılaştırırken onlara üst düzey düşünme becerilerini kullanmalarını gerektiren etkinlikler sunulmalıdır (Chamberlin & Chamberlin, 2010; Freiman, 2006; Karaduman, 2010; Sriraman, 2003). Böylelikle, öğrencilere eleştirel düşünme becerileri kazandırılmış olur ki, üstün yetenekli çocuklar bu anlamda geliştirilmesi gereken doğal bir beceriye sahiptir (Ktistis, 2014). Bu etkinliklerin tasarlanmasında Bloom (1956)'un taksonomisinden faydalanmak anlamlı bir yol olacaktır. Bu taksonomiye göre analiz, değerlendirme ve yaratma basamakları üst düzey düşünme becerilerini ifade etmektedir (Anderson et al., 2001).

3.1.2. Etkinlik Çeşidi Bakımından Özellikler

Farklılaştırılmış materyallerin özeliklerinin etkinlik çeşidi bakımından aşağıda belirtilen altı alt kategoriye ayrıldığı ve etkinliklerin bu alt kategorilerden en az birinin özelliklerini sağlaması gerektiği görülmüştür.

Problem Çözme Etkinliği: Problem çözme etkinlikleri, üstün yetenekli çocuların eğitimsel süreçlerine dahil edilmelidir (Freiman, 2006; Gavin, 2009; Greenes, 1997; Karaduman, 2010; Pierce, Cassady, Adams, Neumeister, Dixon, & Cross, 2011; Renzulli, 1986; Tieso, 2002). Bu anlamda, rutin olmayan, (Arslan & Altun, 2007), gerçek yaşamla ilişkili ya da matematiksel modelleme problemleri yararlı olacaktır.

Disiplinlerarası Etkinlikler: Branşlar ya da disiplinlerarası kaynaşmayı gerektiren disiplinlerarası etkinlikler (Beane, 1997), üstün yetenekli öğrencilere matematiğin diğer bilimler içerisindeki veya gerçek yaşamdaki rolünü dikkat çekici bir biçimde ortaya çıkarabileceği için önemlidir (Berger, 1991; Freiman, 2006; Greenes, 1997; Karaduman, 2010; Renzulli, 1986; Sriraman, & Sondergaard, 2009). Örneğin, matematiğin tarihi (Aydemir & Çakıroğlu, 2013, fen ve matematik (Aydemir & Teksöz; 2014; Jianguo, 2004), matematik ve dil ilişkisini yansıtan etkinlikler bunlara örnektir.

Müfredat Ötesi Etkinlikler: Üstün yetenekli öğrencilerin normal müfredat kazanımlarının üstündeki etkinliklerle karşılaştırılması onların daha fazlasını öğrenme ihtiyaçlarını karşılamak ve meraklarını gidermek adına faydalı olacaktır (Rotigel & Fello, 2004; Johnson, 2000; Karaduman, 2010).

Teknoloji İle Desteklenmiş Etkinlikler: Birçok üstün yetenekli çocuğun teknoloji kullanımı adına yetenekli, ilgili ve başarılı olduğu gerçeğinden yola çıkarak, onların motivasyonlarını sağlama noktasında teknolojinin matematik etkinliklerine iliştirilmesi faydalı olacaktır (Johnson, 2000; Siegle, 2004). Ayrıca teknoloji, öğrencilere kendi gelişimsel hızları doğrultusunda ilerlemelerine olanak sağladığı için (Kaput, 1992; Özçakır, 2013) farklılaşan ihtiyaçlarına cevap verebilmek adına anlamlı bir seçenek olarak görülebilir.

Zeka Sorusu Etkinlikleri: Üstün yetenekli öğrencilere zeka sorusu etkinliklerinin sunulması daha fazlasını düşünme, merak etme ve motivasyonunu artırma ihtiyacı duyan bu çocuklar için etkili seçeneklerden biri olabilir (Baykoç, 2011; Johnson, 2000; Freiman, 2006).

Matematik Bulmacası: Üstün yetenekli çocukların etkinliklerini farklılaştırmak, motivasyonlarını ve yaratıcılığı arttırmak adına matematik bulamacalarını öğrenciler için geliştirmek ve sağlamak, ihtiyaçlarını karşılamaya yardımcı olabilecek etkinliklerdendir (Freiman, 2006; Gavin et al., 2009).

3.1.3. Uygulama Metodu Bakımından Özellikler

Farklılaştırılmış materyallerin özeliklerinin uygulama metodu bakımından aşağıda belirtilen yedi alt kategoriye ayrıldığına ve etkinliklerin bu alt kategorilerden en az biri ile uygulanmasının uygun olanacağına karar verilmiştir.

Tüm Sınıf Uygulaması: Bu metod ile, farklılaştırılmış etkinlikler normal sınıf etkinlikleri gibi, aynı anda tüm sınıfta bulunan öğrencilerin faydalanabileceği şekilde uygulanabilir (Chamberlin & Chamberlin, 2010). Böylelikle üstün yetenekli çocukların etiketlenme ya da ayrıcalıklı davranılma problemi ortadan kalkmış olur. Tüm sınıf uygulaması süresince, zorluk çeken diğer öğrenciler için öğretmen zaman tanıdıktan sonra ipuçları verebilir ya da bir kaç arkadaşıyla ortak çalışma yapmasına izin verilebilir.

Üstün Yetenekli Öğrenci İçin Bireysel Uygulama: Farklılaştırılmış etkinlikler üstün yetenekli çocuğa ayrı olarak, ekstra bireysel çalışma şeklinde sunulabilir (Chamberlin & Chamberlin, 2010). Böylece, bu çocukların sınıfta sıkılmama, daha fazlasını isteme ve zorlanma ihtiyaçlarına çözüm bulunmuş olur. Fakat bu noktada, etkinliklerin üstün yetenekli çocuklara ayrıcalıklı oldukları için veriliyor olmasından ve dikkat çekici uygulamalardan sakınılması önemlidir. Bu sebeple, sınıf içinde bireysel ek çalışma alınabilecek durumların öğretmen tarafından öncesinde belirtilmesi önemlidir. Örneğin, sınıf içinde tamamlanması gereken etkinliklerini bitiren her öğrenciye bu farklı etkinliklerin verilebileceği tüm sınıfa söylenmeli, üstün yetenekli çocuk gibi etkinliği bitiren diğer çocukların da yararlanması sağlanmalıdır.

Matematik Merkezi Uygulaması: Matematik merkezi uygulaması, sınıf içinde öğrencilerin kendilerinin ya da öğretmenlerinin oluşturabilecekleri, zorlayıcı, eğlenceli, ilginç matematiksel etkinliklerin, kaynakların, araştırmaların bulunduğu bir uygulamadır **(**Diezmann & Watters, 2001; Hannah et al. 2011; Sriraman, & Sondergaard, 2009; Wilkins et al., 2006). Geliştirilen farklılaştırılmış materyaller sınıf içerisinde belirlenen bu merkeze koyularak, öğretmenin ve sınıfın birlikte aldığı kurallar dahilinde kullanılabilir. Yine bu noktada, merkezden tüm öğrencilerin, belirli koşullar dahilinde yararlanabileceği ve etkinliklerin tüm çocuklar için olduğu vurgusu unutulmamalıdır. Bu materyallere ek olarak, çalışma sürecinde gözlemlendiği gibi TÜBİTAK Yayınları kitapları, Bilim Çocuk, Dünyalı gibi araştırma dergileri, akıl oyunları ya da bulmacaları gibi dergiler bu merkezde çocukların kullanımı için bulundurulabilir.

Proje Tabanlı Uygulama: Etkinlikler, öğrencilerin kendi başına ya da grup halinde belirli bir süreç boyunca tamamlayabilecekleri proje tabalı uygulama ile öğrencilere sunulabilir (Diffily, 2002; Stanley, 2012). Süreç içerisinde öğrenci uygulamalarının takibi çok önemli olup öğrencilerin boş zamanları, tenefüs araları, okul dışı zamanlar gibi dönemlerde bu uygulamaları tamamlamaları ancak belirli kuralları belirli süreler içinde yerine getirmeleri vurgulanmalıdır. Alışma süresince, öğretmenlerin etkinlik çeşitleri arasında en fazla matemiksel modelleme etkinliklerini bu uygulama ile kullandıkları görülmüştür. Bu durumun ise modelleme problemlerinin doğası gereği daha geniş düşünce ve zamana yayılabilen özelliklerini kullanma ihtiyacından, öğretmenlerin ise sınıf ortamları içerisinde yeterince vakit ayıramadıklarından kaynaklandığı düşünülmektedir.

Bazı Öğretim Metodları: Tartışma, Keşfetme, Sorgulama: Tartışma (Johnsen & Ryser, 1996), keşfetme (Johnson, 2000; Wilkins et al. 2006), sorgulama (Johnson, 2000; Sriraman & Sondergaard, 2009) metodları, geliştirilen etkinliklerin etkili uygulanabilmesi ve üstün yetenekli öğrencilerin gelişimsel ve öğrenme ihtiyaçlarına cevap verebilmesi bakımından uygun bulunmuştur.

Ödev Etkinliği Uygulaması: Geliştirilen farklılaştırılmış etkinlikler öğrencilere ödev şeklinde uygulanabilir (Johnson, 2000). Bu bağlamda, çalışma sürecinde gözlemlenen farklı uygulama teknikleri kullanılabilir. Örneğin, öğretmenler sınıftaki diğer öğrencilere normal ödev etkinliklerini sunarken üstün yetenekli öğrencilerine bu farklılaştırılmış etkinlikleri sunabilir ya da öğretmenler, bu çalışmanın uygulamasında görüldüğü gibi farklı ödev etkinlikleri hazırlayarak, öğrencilerinin kendilerinin seçmesini isteyebilir. Örneğin, on alıştırma tipi örnek ya da üç tane zorlayıcı matematik problem ya da bir tane farklılaştırılmış etkinlik gibi. Son seçenek olarak ise, öğretmenler tüm öğrencilere rutin ödevlerini verirken, ekstra ödev almak isteyen çoçuklar için bu etkinlikleri sunabilir ancak; ekstra ödevi alan ve tamamlayan öğrencinin ödüllendirilmesi ya da farklı şekillerde takdir edilmesi uygulamanın sürdürülebilirliği açısından önemlidir.

3.2.Farklılaştırılmış Etkinliklerin Öğretmenlere Faydaları

Bu çalışmada, matematikte üstün yetenekli öğrenciler için geliştirilen farklılılaştırılmış etkinliklerin uygulamaya katılan öğretmenlerin farkındalıklarına, öz yeterliliklerine ve işbirliklerine faydaları olduğu ortaya çıkarılmıştır.

3.2.1. Öğretmenlerin Farkındalıklarına Faydaları

Matematikte üstün yetenekli öğrencilere yönelik geliştirilen farklılaştırılmış etkinliklerin sınıf içerisinde kulanımının çalışmaya katılan öğretmenlerin farkındalıklarına katkısı incelendiğinde, çalışma başlangıcından çalışma süreci ve sonucuna kadar ciddi farklılıklar yaşandığı ortaya konulmuştur. Çalışma öncesinde, öğretmenlerin çoğunun üstün yetenekli öğrenciler hakkında neredeyse hiç bilgi sahibi olmadıkları, bilgi sahibi olan öğretmenlerin ise bu çocukların özellikleri ve ihtiyaçları hakkında farkındalıklarının olmadığı görülmüştür.

Tasarım tabalı araştırma metodunun doğasında var olan, katılımcıların katılımıyla gelişimin sağlanması sebebiyle, öğretmenler üstün yetenekli çocukları tanıyabilme, özelliklerini öğrenebilme ve gözlemleyebilme, geliştirilen farklılaştırılmış etkinliklere verdikleri tepkileri sorgulayabilme fırsatları bulmuşlardır. Böylelikle, çalışma başlangıcında bu çocuklar hakkında bilgilerinin ve farkındalıklarının olmadığını belirten öğretmenlerin, çalışma sonunda bu konuda duyarlı ve farkındalık sahibi bireyler olarak yorum yapabildikleri ve sınıflarındaki öğrencilere bu anlamda olanaklar sağlayabildikleri görülmüştür.

3.2.2. Öğretmenlerin Öz Yeterliliklerine Faydaları

Çalışmanın öğretmenlerin öz yeterliliklerine yönelik faydalarına gelindiğinde, çalışma öncesinde öğretmenlerin sınıflarındaki üstün yetenekli çocuklar için kendilerini yetersiz hissettikleri görülmüştür. Hatta bazı öğretmenler, çalışma sürecinde araştırmaya ve öğrenciye yetersiz olacağı düşüncesiyle endişeye kapıldıklarını belirtmişlerdir. Ancak, çalışma sürecinde ve sonrasında tüm öğretmenlerin üstün yetenekli öğrencileri hakkında öz yeterliliklerinin arttığı görülmüştür. Hatta öğretmenler, çalışma sürecinde geliştirilen ve kullanılan etkinliklere ek olarak kendilerinin etkinlik geliştirebilecek kadar öz yeterliliklerinin arttığını ifade etmişlerdir.

3.2.3. Öğretmenlerin İş Birliklerine Faydaları

Farklılaştırılmış materyallerin sınıf içerisnde kullanımı ve süreç boyunca geliştirilmesinin, çalışmaya katılan öğretmenlerin farkındalıkları ve öz yeterliliklerinin yanı sıra, diğer öğretmenlerle olan iş birliklerine katkısının olduğu görülmüştür. Normal matematik dersi uygulamalarında her öğretmenin kendi özel planlaması ve yolu olduğu için bir araya gelme, konular hakkında fikir edinme ya da paylaşımda bulunma ihtiyacı duymayan öğretmenler, çalışma sürecinde birbirleriyle ortaklaşa çalışma yapmaya ve fikir edinmeye ihtiyaç duymuşlardır. Bu durumun sebeplerinden birinin, üstün yetenekli çocuklar hakkında kendilerini yetersiz hissetmeleri olabileceği düşünülmektedir. Ayrıca bu konu öğretmenler tarafından bilinmeyen, eğitimi alınmamış hatta öncesinde hiç karşılaşılmamış bir konu olarak düşünüldüğünde, diğer öğretmenlerden yardım almaya ve düşüncelerini işbirliği içerisinde paylaşarak etkinliklerin geliştirilmesine ihtiyaç duymuş olabilmektedirler.

3.3.Farklılaştırılmış Materyallerin Matematikte Üstün Yetenekli Öğrencilere Faydaları

Bu çalışma, matematikte üstün yetenekli öğrenciler için geliştirilen farklılaştırılmış etkinliklerin tasarlanma ve geliştirilme sürecinin matematikte üstün yetenekli öğrencilerin, zihinsel, duygusal ve sosyal ihtiyaçlarını karşılamak adına faydalı olduğunu ortaya koymuştur.

3.3.1 Öğrencilerin Zihinsel İhtiyaçlarını Sağlamaktaki Faydaları

Çalışma öncesinde matematikte üstün yetenekli öğrencilerden toplanan veriler, onların normal sınıf ortamlarında zihinsel yeterliliklerine ve ihtiyaçlarına yönelik bazı ihtiyaçlarının olduğunu ve sınıf ortamlarında bu ihtiyaçlarının karşılanamadığını ortaya koymuştur. Ancak sonrasında, farklılaştırılmış materyallerin onların rutin matematik derslerinde uygulanmaya başlaması ile birlikte zihinsel ihtiyaçlarına cevap verebilecek etkinliklerle karşılaşmaktan duydukları tatmini belirtmişlerdir. Uygulama boyunca ve uygulama sonrasında toplanan veriler, bu çocukların etkinliklerin ihtiyaç duydukları zorlayıcılık, yaratıcılık, problem çözme, düşünme, muhakeme becerilerini geliştirmelerine olanak sağladığını ortaya koymuştur. Böylece, zihinsel ihtiyaçlarının karşılandığını düşünen çocukların potansiyallerinin açığa çıkarıldığı ve geliştirilebildiği sonucuna varılmıştır.

3.3.2. Öğrencilerin Duygusal İhtiyaçlarına Faydaları

Bulgular, çalışmanın matematikte üstün yetenekli öğrencilerin duygusal ihtiyaçlarına önemli katkılarının bulunduğunu göstermiştir. Duygusal anlamda ilgi çekici, heyecan verici, merak uyandırıcı etkinlikleri tercih ettiklerini belirten öğrenciler, çalışma başında normal matematik derslerinde bu tarz duyguları yaşayamamaktan ve bu yüzden derslerdeki sıkılmalarından şikayetçi olmuşlardır. Ancak, çalışma boyunca yapılan gözlemler ve toplanan veriler, öğrencilerin sınıfta yapılan farklılaştırılmış etkinliklerden büyük keyif aldıklarını ortaya koymuştur. Ayrıca, çalışmanın başında matematiğe karşı ilgisizliğini ve dersin sıkıcılığını dile getiren öğrencilerin, matematiğe karşı tutumlarının olumlu yönde değiştiği, matematiğe farklı bakış açılarıyla bakabildikleri görülmüştür.

3.3.3. Öğrencilerin Sosyal İhtiyaçlarını Sağlamaktaki Faydaları

Çalışma sürecinin sosyal anlamda farklı sorunlar yaşayan üstün yetenekli öğrenci gruplarına sosyal ihtiyaçları bakımından faydaları olduğu görülmüştür. Çalışmaya katılan öğrenci gruplarında iki temel sosyal sorun olduğu ortaya konmuştur. Diğer öğrenciler arasında yüksek ders notları ve farklı ilgi alanları bakımından popüleritesi çok fazla olmayan, kendi halinde sessiz, içine kapanık öğrencilere çalışma sürecinde akranlarıyla kaynaşma, grup içerisinde doğal lider seçilebilme gibi faydaları olmuştur. Buna ek olarak, normal sınıf uygulamalarında çok fazla sıkıldığı için hareketlenen, ders gidişatını ve öğretmenin programını aksatan çocukların ise, etkinlik ile sıkılmadan oyalandıkları, derse karşı motivasyonları arttığı için zamanlarını derse katılım ve etkinliklerle uğraşarak geçirdikleri görülmüştür.

Kaynakça

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APPENDIX N: Tez Fotokopisi İzin Formu

ENSTİTÜ

Fen Bilimleri Enstitüsü [ ]

Sosyal Bilimler Enstitüsü [x]

Uygulamalı Matematik Enstitüsü [ ]

Enformatik Enstitüsü [ ]

Deniz Bilimleri Enstitüsü [ ]

YAZARIN
Soyadı : Özdemir
Adı : Duygu
Bölümü : İlköğretim

TEZİN ADI (İngilizce): Design and development of differentiated tasks for 5th and 6th grade mathematically gifted students

TEZİN TÜRÜ: Yüksek Lisans [ ] Doktora [x]

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir. [ ]
2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir. [ ]
3. Tezimden bir bir (1) yıl süreyle fotokopi alınamaz. [x]

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: