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EXPLORING CHALLENGES OF MATHEMATICS TEACHERS WHO TEACH HIGH SCHOOL MATHEMATICS FOR VISUALLY IMPAIRED STUDENTS IN TURKEY

A MASTER'S THESIS

BY

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Gamze Baykaldı

September 2017

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Curriculum and Instruction.

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ABSTRACT

EXPLORING CHALLENGES OF MATHEMATICS TEACHERS WHO TEACH HIGH SCHOOL MATHEMATICS FOR VISUALLY IMPAIRED STUDENTS IN TURKEY

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M.A., Program of Curriculum and Instruction

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In inclusive education, every child is supported in such way that no child falls behind. For this purpose, inclusive education practices unite students with individual differences that are in the same educational environment. However, many teachers, regardless of their specialty, hold negative attitudes towards inclusive education. Therefore, it is necessary to explore the experiences and actions of mathematics teachers while teaching high school mathematics to visually impaired (VI) students by considering what kind of challenges they encounter and to what extent these challenges affect teachers' willingness to accept the inclusion of these students. This qualitative study aimed to explore this subject using a grounded theory as a specific method. Semi-structured interviews conducted with eight mathematics teachers who had experience teaching VI students were analyzed using the constant comparative method. Major findings were categorized into five themes: teaching mathematics practices, the mathematics curriculum, preparation of material, assessment practices, and beliefs regarding inclusive education and VI students. The findings showed that

teachers were divided into two groups in terms of their commitment to inclusive practices. The first group was described as reluctant to teach VI students, and the second was willing to run effective inclusive practices. Findings were discussed in terms of existing research on teachers' preparedness for, and belief in, inclusive education.

Key words: *Inclusive education, teachers' beliefs on inclusive education, visually impaired students, mathematics education*

ÖZET

TÜRKİYE'DE GÖRME ENGELLİ ÖĞRENCİLERE LİSE MATEMATİĞİ ÖĞRETEN MATEMATİK ÖĞRETMENLERİNİN KARŞILAŞTIKLARI ZORLUKLARIN ARAŞTIRILMASI

Gamze Baykaldı

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Kaynaştırma eğitimi içerisinde tüm öğrenciler, hiç bir çocuk geride kalmayacak şekilde desteklenir. Bu amaçla kaynaştırma eğitimi uygulamaları bireysel farklılıkları olan tüm öğrencileri aynı eğitim ortamı içinde bir araya getirir. Buna rağmen, alanına bakmaksızın birçok öğretmen kaynaştırma eğitimine karşı olumsuz tutuma sahiptir. Bu yüzden, matematik öğretmenlerinin görme engelli öğrencilere lise matematik öğretirken edindikleri deneyimleri, ne tür zorluklarla karşılaştıkları ve bu zorlukların ne ölçüde öğretmenlerin kaynaştırmaya istekli olduklarını etkilediği dikkate alınarak araştırılması gereklidir. Bu nitel çalışma görme engellilere lise matematik öğreten öğretmenlerin karşılaştıkları zorlukları araştırmayı amaçlamıştır. Bu amaca uygun olarak gömülü teori kullanılmıştır. Sürekli karşılaştırma yöntemi ise görme engellilerle çalışma deneyimi olan sekiz matematik öğretmeni ile yapılan yarı yapılandırılmış mülakatları analiz etmek için kullanılmıştır. Ana bulgular matematik öğretimi uygulamaları, matematik müfredatı, materyal hazırlığı, değerlendirme uygulamaları, öğretmenlerin kaynaştırma eğitimi ve görme engelli öğrenciler üzerine

olan görüşleri ve kaynaştırma eğitiminde eşitliği açıklayan altı ana başlık altında sunulmuştur. Bulgular öğretmenlerin kaynaştırma uygulamalarını kabul ediş durumlarına göre ikiye ayrıldığını göstermektedir. Birinci grup, görme engelli öğrencilere öğretimde isteksiz olanlar olarak tanımlanırken, diğer öğretmen grubu etkili kaynaştırma uygulamalarını yürütme konusunda isteklidir. Bulgular öğretmenlerin kaynaştırmaya hazırlıklı oluşu, kaynaştırma eğitimi üzerine olan görüşleri hakkında yapılmış araştırmalar ışığında tartışılmıştır.

Anahtar Kelimeler: *Kaynaştırma eğitimi, öğretmenlerin kaynaştırma eğitimine karşı görüşleri, görme engelli öğrenciler, matematik eğitimi*

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CHAPTER 1: INTRODUCTION

Introduction

"*Introductio in analysin infinitorum*" is the name of a precalculus textbook that is considered to be one of the greatest mathematics books ever written (Calinger, 2016). In addition, "$e^{\pi i} + 1 = 0$" is considered to be one of the most famous formulas in mathematics. Who created these masterpieces of mathematics? Actually, the answer is Leonhard Euler (1707–1783), who is considered to be the greatest mathematician living in the eighteenth century. Euler was also visually impaired (VI), and he completed almost half of his work after his total blindness. Euler was not the only VI mathematician; Nicholas Saunderson (1682–1739), Louis Antoine (1888–1971), Lev Semenovich Pontryagin (1908–1988), Bernard Morin (1931–) and Zachary J. Battles (1966–) were also VI (Jackson, 2002). Although these pioneer mathematicians are regarded as an inspiration to the VI students, teachers sometimes believe that VI students cannot learn mathematics (Köseler, 2012; La Voy, 2009).

This study focuses on the difficulties experienced by mathematics teachers working with VI high school students. Mathematics teachers' particular problems in the inclusive classrooms and how they manage to deal with these problems are worth investigating. Therefore, the perspective of teachers on the current situation of teaching high school mathematics for VI students was systematically explored.

Background

In Turkey, approximately 4.6 % of those between 10–19 years of age are identified as individuals with special needs (Turkish Statistical Institute, 2002). Individuals with special needs have equal educational rights, as established in the Turkish Disability Act (MoNE, 2006). This Act guarantees disabled students' rights to inclusive education practices. According to the Education Regulations of the Disabled Students, inclusive education mandates that students with and without disabilities learn together in the same classroom (MoNE, 2006). They must have the opportunity to interact and share their experiences with their peers (Durna, 2012). In this way, inclusion may result in building a sense of belonging for students with special needs (Moore, Gilbreath, & Muiri, 1998). Furthermore, most parents state that inclusive education meets their children's needs sufficiently (MoNE, 2010). This positive approach explains the increase in the number of students with special needs placed in inclusive classrooms (MoNE, 2010).

Although inclusion is thought of as a reform (UNESCO, 2010), its effectiveness is still a topic of debate (Ajuwon, Sarraj, Griffin-Shirley, Lechtenberger, & Zhou, 2015). However, many researchers assert that the success of inclusive education depends on the type of disability of the students (Hines & Johnston, 1996; Murray, 2009; Parasuram, 2006). Unlike students with mental impairments, students with physical impairments may benefit from inclusive education (Scruggs & Mastropieri, 1996). One of the groups with physical impairments that benefit the most from inclusive education is VI students. According to Bayram, Corlu, Aydın, Ortaçtepe and Alapala (2015), inclusive education may meet their social needs, but not their academic ones. In inclusive educational environment, social awareness related to the

disabled is promoted among both VI and sighted students (Şahbaz, 2007). Factors that influence the academic achievements of VI students are teachers' attitudes, inadequate material, and ineffective teaching methods (Brendon, 2015).

According to studies concerning the implementation of inclusive education, there are several challenges for both teachers and VI students (Uysal, 1995; Kargın, Acarlar, & Sucuoğlu, 2005; Brendon, 2015). For instance, unequal teaching approaches are a problem in mathematics classroom for VI students (Bayram et al., 2015). These challenges affect teachers' willingness to accept inclusion (De Boer, Pijl Sip, & Minnaert, 2011). Regardless of their subject, many teachers hold negative attitudes towards inclusive education and students with special needs (Ajodhia-Andrew & Frankel, 2010; McCray & Mc Hatton, 2011; Rakap & Kaczmarek, 2010). Teachers' negative beliefs and attitudes affect the learning atmosphere in a bad way and impede effective inclusive practices (Cassady, 2011; Köseler, 2012; Taylor & Ringlaben, 2012). Therefore, it is important to determine teachers' perspective and beliefs on inclusive education and VI students (Parasuram, 2006; Avramidis & Norwich, 2002).

This is especially true in the case of mathematics education, where teachers become vital for ensuring equity in mathematics education (UNESCO, 2010). Although many teachers interpret the concept of equity in different ways (Bartell & Meyer, 2008), the concept of equity in mathematics is defined as the assumption that all students have the right to equally access all curricular areas as well as high quality instruction and teaching (Brahier, 2016). In this sense, mathematics teachers are expected to create an effective learning environment and alter the way they teach mathematics to use appropriate teaching methods for all (NCTM, 2000). Providing a

high quality curriculum, effective teaching methods, and appropriate materials and resources is required to implement the equity principle in order to decrease the gaps between students with different needs (Allexsaht-Snider & Hart, 2001). Consequently, teachers should make their lessons more equitable by creating an academically and socially ideal teaching and learning environment for all students (MoNE, 2006).

Problem

In Turkey, there are few studies that address teaching mathematics to disabled students, such as those with hearing, speech, and visual impairments, as well as the mentally disabled. Previous research conducted on VI high school students revealed that applying appropriate teaching methods, materials and resources for VI students plays an important role in learning (Bayram et al., 2015). Nevertheless, in Turkey, high school mathematics teachers seem to have limited knowledge about the special needs of students with visual impairment and experience difficulty in determining how to address the specific needs of their students while teaching mathematics (Köseler, 2012). All of these limitations lead to challenges for mathematics teachers while teaching. Consequently, it is necessary to explore the experiences of mathematics teachers who teach high school mathematics for VI students by focusing on what challenges they encounter and what they did to overcome these challenges.

Purpose

The main purpose of the current study is to explore the challenges and actions of mathematics teachers who teach high school mathematics for VI students. It is

necessary to gain an understanding of teachers' preparedness for inclusive education. Furthermore, the study aimed to give a voice to these mathematics teachers so that their perspective on teaching mathematics for VI students may be reflected on.

Research questions

The study was guided by the following major research question:

How can mathematics teachers' challenges and actions related with teaching high school mathematics for VI students be explored?

Sub-questions

- In what ways do mathematics teachers adapt their teaching methods to students with visual impairments in inclusive classrooms to make mathematics accessible?
- What are the high school mathematics teachers' beliefs about inclusive education when they encounter these challenges?
- What support do mathematics teachers need to efficiently teach mathematics to VI students after experiencing these challenges?

Significance

This study provides important insight into the experience of mathematics teachers instructing VI students in high school mathematics. In addition to the challenges found in this study, some solutions addressed by teachers' experiences may enrich the research on pedagogical content knowledge for teaching mathematics in inclusive education. Investigation into the challenges of teaching mathematics to VI students may provide insights to address teachers' beliefs and attitudes towards inclusive education. Such insights could help educators design quality teacher preparation

programs and develop mathematics programming that addresses diverse learning needs. In addition, the findings introduced by this study may be used to inform policy decisions and develop a program that facilitates collaboration between special educators and high school teachers.

Definition of key terms

MoNE: Ministry of National Education

NCTM: National Council of Teachers of Mathematics

VI students: Visually impaired students

ERDC: Education Regulations of the Disabled Students (Özel Eğitim Hizmetleri Yönetmeliği)

CHAPTER 2: REVIEW OF RELATED LITERATURE

Introduction

This study aims to explore the challenges and actions of high school mathematics teachers instructing visually impaired (VI) students. The purpose of this chapter is to present a general overview of the mathematics teachers' current involvement in implementing inclusive teaching methods for VI students. For this reason, the chapter is organized under three major headings: (a) Inclusive Education, (b) Visual Impairments in Inclusive Education, and (c) Teachers' Involvement of Inclusive Implementation.

Inclusive education

Although there is no singular definition of inclusion, inclusive education is generally defined as a learning environment within which all students are welcomed into general education classes and learn together with differentiated instruction, high quality interventions and support (Salend, 2011). This creates a collaborative school culture that supports the individual needs of all students (Allan & Sproul, 1985). This has led to the belief that all children, irrespective of disabilities, learning styles, gender, language, race, and economic status, should learn together (Sands, Kozleski, & French, 2000). These differences are embraced in inclusive schools. Thus, inclusive education incorporates students with individual differences into the same educational environment (Phinias, Jeriphanos, & Kudakwashe, 2013).

The historical background of inclusive education

Inclusive education was shaped in the United States with the Education for All Handicapped Children Act (EAHCA) in 1975. This act included the fundamental term that defines inclusive education: the least restrictive environment. According EAHCA, the least restrictive environment is an environment where students with special needs may spend as much time as possible with other students and be integrated into educational settings (Smith, Polloway, Patton, Dowdy, & Doughty, 2015). After the EAHCA, the Individuals with Disabilities Education Act (IDEA) was published and renewed several times, though its main purpose has not changed since 1975. Its essential goal is to provide educational rights and protections to children with special educational needs (SEN). For this purpose, schools endeavor to ensure accessible, free and qualified public education for students with disabilities.

The disability act and legislative developments in the United States aroused similar movements in other countries. In the United Kingdom, first the Education Act and Regulations was published, and then the SEN Code of Practice (SENCP) went into practice in 1994 in order to provide high-quality education to all. Following the Code of Practice, principles of inclusive education were formed by regarding how education systems are designed, how classrooms are managed and how teachers address individual needs. This provided a clear framework for identifying, diagnosing, and answering students' SEN. A welcoming environment was created for all students without any discrimination. Moreover, the SEN and Disability Act (2001) established the rights of students with SEN and was amended to make a clear commitment to effective inclusion practices.

In Turkey, the idea of school inclusivity was mentioned in the Primary Instruction and Education Law (1983), which emphasized that schools should provide support and accommodations for students with SEN. However, a gap between legislation and lack of implementation existed because the law was unclear. For this reason, the principles of special education were expanded in law KHK 573 (1997). This mandated the development of Individualized Education Plans for students with SEN and the usage of appropriate teaching methods (Item 12). In (Item 14), a 'special education support service' was proposed. This is because individuals requiring special education must be given special education support in order to partake in the educational environment. For this reason, the opportunity for both personal and group education is provided. Individuals requiring special education in the compulsory education period are implemented into educational programs. These programs aimed to improve basic life skills and meet their learning needs regardless of their levels of inability.

In addition to these improvements in legislation, the Education Regulations of the Disabled Students (ERDC, or Özel Eğitim Hizmetleri Yönetmeliği) was implemented. Here, the definition of inclusive education was provided for the first time (2000). The principles of inclusive education are stated as follows in Item 68:

a) Individuals requiring special education have the right to receive education with their peers in an educational institution.
b) Services are planned in terms of individuals' educational needs, not of their incapability.
c) Services are school-based.

d) Decision-making processes take place depending on parent-school-pedagogic diagnosis and assessment team cooperation.
e) Every individual is able to learn and be taught.
f) Inclusion is a special type of education implementation provided within a program.

Besides items a–f stated above in the regulations, there was a section that determined the tasks and responsibilities of those taking part in inclusion. For instance, the teacher must take precautions in order to enable the social acceptance of students with special education needs by their peers, make assessments by taking into account their individual developments, and personalize his/her program (MoNE, 2000). In this regard, teachers cooperated with parents and other related institutions and organizations.

Implementation of inclusive education

Just as there are different definitions of inclusive education, there are different types of inclusive education as well — full, partial and no inclusion (Beukelman & Mirenda, 2005). Full inclusion is more welcoming of individuals with SEN into the education program because it supports students with disabilities participating side by side with their peers (Morris, 2000). It requires additional classroom support with trained staff and sufficient resources (Kauffman & Hallahan, 2005). In partial inclusion, students with disabilities are allowed some flexibility to attend class, and they may select a more specialized setting for the remainder of their time (Jensen, 2015). No inclusion or specialized inclusion supplies special education programs and specialized classrooms with professionals such as special educators to students with

disabilities. These types of inclusive education are implemented in different ways. For instance, in Turkey, inclusive education is implemented at all levels of primary, middle, and secondary education. Moreover, there are specialized primary and middle schools for students with disabilities that implement the no inclusion model, but the full inclusion model is the only option for students in secondary schools (Döke, Garip, Bülbül, & Özel, 2012).

With the development of inclusive education practices, the idea of arranging schools and classrooms in a form that includes all students has been further adopted. Therefore, inclusion adaptations, including individualized practices, were categorized into different regulations as follows: (1) Physical regulations, (2) Regulations concerning process, (3) Regulations related to the class climate, (4) Educational regulations, and (5) Regulations concerning implementations (Smith, Polloway, Patton, Dowdy, & Doughty, 2015). The first task was to determine the needs of individuals benefiting from inclusive education, and for this reason, MoNE published a guide in 2010 that gathered individuals' common characteristics under eight major groupings, such as individuals with physical, mental, or psychological disabilities or impairments.

Today, although there is not a fixed template for the implementation of inclusive education, it is an accepted fact that inclusive education is more than simply sitting together (Bülbül, 2011). Despite this, methods for implementing inclusive education were not clarified adequately (Kargın, Güldenoğlu, & Şahin, 2010), which is why many studies in the literature concern how inclusion should be implemented effectively (Duhaney & Salend, 2000; Lindsay, 2003; Scruggs & Mastropieri, 1996).

Studies in Turkey have been limited compared to studies abroad (Batu, 1998; Diken, 1998; Kırcaali-İftar, 1992).

Visual impairments in inclusive education

There are different categories and medical terms to identify the visual capacity of individuals. A VI person has an abnormally low level of visual acuity. According to the World Health Organization, a person with low vision has vision between 20/70 and 20/200 (2015). They are able to read by using magnifying glasses or bringing the paper closer to their eyes. However, a totally VI person has visual acuity worse than 20/200 in the best possible circumstances and cannot perceive light (Tuncer, 2009). Moreover, impairment of vision may occur at any point in life. For instance, a person may have a congenital visual impairment or may lose sight at some later stage of life (Enç, 2005).

Barriers in the inclusion of VI students

Students with visual impairments encounter social and academic barriers in inclusive education practices (Cheong, Abdullah, Yusop, Muhamad, Tsuey, & Wei, 2012). Although one of the aims of inclusive education is to create social awareness in VI and sighted students (Sucuoğlu, Ünsal, & Özokçu, 2005), this may not occur because in the mind of the public, a natural consequence of blindness is restricted participation in social life (Durna, 2012). Helen Keller, an activist with total VI and hearing impairment, explained this best: "The chief handicap of the blind is not blindness, but the attitude of seeing people towards them." She mentioned that VI individuals have a high risk of being ostracized by society. To reduce this, many countries regulate their educational policy and conduct studies on the social effects

of inclusive education. Bayram (2015) stated the beneficial points of inclusive education on social awareness in her study. It was found that inclusive education increased the awareness of both VI and sighted students. She emphasized that students had more interactions and were more prepared for social life by increasing disability awareness. In addition, Cheong and his colleagues (2012) showed that when the interaction between sighted and VI students increased, sighted students started to develop strategies to understand the difficulties of VI students and created practical solutions to help them.

The generally limited adaptation of teaching and learning environment in inclusive education causes VI students to face academic challenges (Mwakyeja, 2013). Therefore, an improper learning environment automatically interrupts VI students' learning process (Johnsen, 2001). Studies show that following a flexible curriculum, using sufficient materials, designing differentiated teaching methods and implementing appropriate assessment procedures are required to provide an effective learning atmosphere to VI students (Simon, Echeita, Sandoval, & Lopez, 2010; Bayram et al., 2015). Moreover, Smith, Geruschat and Huebner (2004) showed that students with low vision could not access the curriculum at the same time as their peers. Konza (2008), another researcher, demonstrated that VI students may miss most visual based content, and as such, visual based content has been removed from the national curriculum so as to prevent difficulties in the modifications of materials. However, there should be differentiated resources and tactile materials that increase the access of the curriculum (Rosenblum & Herzberg, 2011). If the lesson's materials are not designed correctly, VI students may not participate actively in them (Buhagiar & Tanti, 2011). The Braille alphabet is an essential tool for VI students to

reach written materials (Karshmer, Gupta, & Pontelli, 2007) because they must learn through the sense of touch. Therefore, it is critical to understand that multisensory experiences are necessary for VI students' education. However, there is an insufficient number of knowledgeable teachers that understand the necessity of the nonvisual approach and design tactile materials such as shapes and graphics for teaching (Kapperman & Sticken, 2003). In addition, there is often an insufficient amount of time for tactile materials to be used in the lesson (Akakandelwa & Munsanje, 2012).

The involvement of teachers in inclusive implementation

In many countries, inclusive education implementation has increased significantly over the past four decades (Forlin & Chamber, 2011). As inclusive implementation has gained momentum in schools, the role of teachers in inclusive education practices has been confirmed to be a fundamental determinant of the success of inclusive education (Forlin, 2004). According to Forlin, teachers should cater to different students' learning needs and integrate differentiated practices into their course material. Additional support was found in Florian's (2008) study, which posited that the main role of teachers was to design specific instructional methods to meet students' needs. Salem (2013) stated that the teacher is the most influential person in the implementation of inclusive education. Because the role of the teacher is vital for running a successful inclusion program, it is critical to understand what teachers think about inclusive education (Rakap & Kaczmarek, 2010).

Teachers' attitudes towards inclusive education

A person's attitude influences their behaviors and responses to challenges in their daily lives (Gardner & Lambert, 1972). Because it is believed that teachers' attitudes towards inclusion are correlated with their practices in inclusion (Avramidis & Norwich, 2002; Greene, 2017; Parasuram 2006; Scruggs, & Mastropieri, 1996), it is not surprising that numerous studies on teachers' attitudes toward inclusion and beliefs about their capability to teach students with disabilities in inclusive education classrooms have been conducted in many different countries. Although it has been argued that teachers are required to have positive attitudes toward inclusion (Avramidis & Norwich, 2002; Ryan & Gottfried, 2012), they have a mixed reaction to the implementation of inclusive practices in the classroom. For example, in a study conducted by Bunch (2008), teachers who had positive attitudes towards inclusion believed that inclusive education had positive effects on the social development of students. Similarly, results attained by Greene (2017) indicated that teachers had positive attitudes towards the philosophical framework of inclusion; however, they had negative attitudes towards teaching students with disabilities in their classroom. According to Yada and Savolainen's (2017) study, although many Japanese teachers believed inclusive education was necessary, they had a high level of anxiety about students with disabilities in their own classrooms. In their study, Horne and Timmons (2009) stated that the teachers had concerns about inclusion, and their attitudes towards inclusion were not particularly positive. Thawala (2015) investigated the challenges encountered by teachers and concluded that those challenges caused the negative attitude of teachers towards inclusive education. In another study, Naicker (2008) listed those challenges as being large class size, lack of resources, high stress level, time constraints, and a lack of knowledge and

competencies. The low level of awareness in teachers led to their negative attitudes towards inclusive education (Yada & Savolainen, 2017). These findings supported the concept that the teachers were unwilling to involve students with disabilities in their own classrooms (Savolainen, Engelbrecht, Nel, & Malinen, 2012).

There are studies that showed the factors that influence teachers' attitudes towards inclusion. Gender, age, teaching experience, training, the severity of the disability, and environmental factors were found to influence teachers' attitudes in some studies; however, those variables were inconsistent across studies (Avramidis & Norwich, 2002). For example, older teachers with more teaching experience were reported to have more negative attitudes in some studies (Savolainen et al., 2012), but other researchers found that age and experiences in teaching were not a determinant of teacher attitude (Avramidis, Bayliss, & Burden 2000). In another example, some studies showed that training gave teachers a more positive attitude than teachers with little or no training in inclusive education had (Avramidis, Bayliss, & Burden 2000; Parasuram, 2006). However, Forlin and Chambers (2011) reached a different solution in their study. They found that a training program that provided information about inclusive education raised teachers' awareness of inclusive education, but it did not improve their attitudes towards inclusion. On the contrary, it raised teachers' concerns on how to manage inclusive practices.

In Turkey, a limited number of studies have been conducted on teachers' attitudes towards inclusive education (Diken, 1998; Uysal, 2003). These studies generally indicated that teachers had negative attitudes towards inclusion (Avcıoğlu, Eldeniz-Çetin, & Özbey, 2004; Önder & Eratay, 2007; Rakap & Kaczmarek, 2010; Uysal,

2003). In his study, Diken (1998) aimed to compare the attitudes of teachers who had a disabled student in their classroom to those who did not. The results of the study revealed that very few teachers held positive attitudes towards inclusion and were willing to including students with disabilities in their own classroom. The main purpose of the study of Rakap and Kaczmarek (2010) was to investigate the opinions of teachers on the inclusion of students with different disabilities into their classrooms. The results of their study revealed that teachers working in elementary schools had negative attitudes towards inclusion. They found that teachers that received in-service education and had experiences in inclusion held more positive attitudes towards inclusion than teachers who did not receive specific education or experienced inclusion did.

Teacher preparation

Teachers play an important educational role in enhancing the quality of teaching and learning activities. Hoy (2000) emphasized that teachers' needs had to be taken into consideration to raise preparedness for inclusive education. According to Hall and Engelbrecht (1999), the needs of teachers were listed under four groups as follows: (1) Need for knowledge, (2) Need for competencies, (3) Emotional needs, and (4) Need for support. They concluded that in-service teacher education about including SEN students into general classrooms was required to provide teachers with the knowledge and competencies necessary to teach in inclusive classrooms. Hoy and Spero's (2005) study supports the results of previous studies. They found that in-service programs about inclusive education practices developed better teacher competencies and self-efficacy when implementing inclusion (Heck, Banilower, Weiss, & Rosenberg, 2008). However, many studies show that there are limited

training programs that give information on how inclusive education is applied. For instance, Naicker revealed that 85% of their participants, who were selected from 120 primary and secondary school teachers, did not have any training programs to prepare them for inclusion. For this reason, teachers thought that they had limited knowledge of inclusive education. He emphasized that teachers' lack of knowledge and limited skills led to negative attitudes towards inclusive education. Therefore, he suggested that training programs should be arranged to understand the integration of inclusion. In another study, Leyser and Tappendorf (2001) highlighted the fact that additional training programs for teachers working in inclusive classrooms promoted positive attitudes towards inclusive education. In Turkey, many studies have shown that both primary and secondary school teachers lacked knowledge about inclusion implementation (Avcıoğlu, Eldeniz-Çetin, & Özbey, 2004; Babaoğlan & Yılmaz, 2010; Batu & Kırcaali-İftar, 2005). Furthermore, many of them highlighted that they did not have any support or training (Sucuoğlu & Kargın, 2006). As such, in-service training and professional development programs were vital for the support of inclusive practices (Uysal, 2003). In their study, Batu and Kırcaali-İftar (2005) emphasized that the preparedness of teachers was necessary for successful inclusion.

CHAPTER 3: METHOD

Introduction

This study focuses on exploring the challenges and actions of mathematics teachers who teach high school mathematics to visually impaired (VI) students. In this study, exploratory approaches were used to critically analyze mathematics teachers' lived experiences with VI students in their classrooms regarding their preparedness for inclusive education. This chapter describes the research design, participants, data collection, instrumentation, and data analysis, which ensured trustworthiness and a working hypothesis.

Research design

In the current study, qualitative research methods were used to explore the challenges faced by mathematics teachers instructing VI students. The grounded theory was the specific method was used in this study and was chosen because, as Glaser and Strauss stated, "the analyst jointly collects, codes, and analyzes … data and decides what data collect next and where to find them, in order to develop … theory as it emerges" (1967, as cited in Merriam, 2009, p. 30). The grounded theory was used to understand the problem, and then research questions emerged from this problem. The results were represented in themes deduced from the experiences of the mathematics teachers.

Participants

The participants taking part in this study were purposively selected from among mathematics teachers. The purposive sampling was used to select nonrandom participants because it ensured that the sample was suitable for the current study (Lincoln & Guba, 1985). Having experience teaching mathematics to VI students was a major criterion that determined the sample of the present study. The participants had different ages, taught at different types of school, and varied in the length of experienced time and number of VI students that they had taught. I proceeded until the data reached a saturated level; in other words, until there was no new in-depth information and the replication of the data increased (Morse, Barrett, Mayan, Olson, & Spiers, 2008).

I followed a series of steps to find participants; using gatekeepers, using two key respondents' suggestions, making phone calls to ask schools whether they had VI students, and using my own personal contacts. First, there were two gatekeepers who facilitated access to potential respondents and guided me to information about potential respondents (Seidman, 2013). One of them was a VI graduate student at a psychology department. She included me in an email group of VI persons and asked them to suggest participants according to my criteria. Although this attempt remained inconclusive, she helped me contact her high school mathematics teacher. Another gatekeeper was an educator at the university, and one of his research interests was accessible science education for VI students. He shared the name of a school which, in all likelihood, consisted of teachers that fit the criteria. Second, two key respondents who met the criteria and worked different high schools recommended other potential respondents. Third, I made a phone call to every school in the district

of Çankaya and Yeni Mahalle (in Ankara) and found participants who had teaching experience with VI students. Fourth, three mathematics teachers who worked with VI students were known to the researcher from a community of mathematics educators as colleagues and personal friends.

In sum, the sample was a group of mathematics teachers who taught high school mathematics for VI students. There were eight participants: two of them had gained their experiences from volunteer tutoring with VI students, while six of them gained their experiences from inclusive classroom practices. More details about participants' profiles are given in chapter four.

Data collection

The data of the present study primarily came from interviews conducted with participants, the observation of participants during and after the interview, and relevant documents. Through the process of data collection, different strategies were used to contact the participants. For example, some of the participants were called on the telephone before a face-to-face meeting, while others simply had face-to-face meetings in order to ask for the commitment of their time for an interview. Interviews were carried out in face-to-face and person-to-person meetings at a comfortable and quiet place because the topic may be sensitive to talk about in the presence of strangers or in a place where they may not feel comfortable (Macnaghten & Myers, 2004). In these meetings, the purpose of the study and the process of the study were first explained to the participants. Second, their permission was requested using an informed consent form. This consent form included: 1) the purpose of the study and how the research was conducted, 2) information on voluntary participation

and their right of withdraw from the interview session at any time, and 3) permission to record an audiotape. Appendix A presents a sample of this consent form and Appendix B presents interview questions in English.

Instrumentation

In grounded theory, "the researcher is the primary instrument of data collection and analysis*"* as well as other qualitative research results (Merriam, 2009, p.15). According to Lincoln and Guba (1985), "the researcher, by necessity, engages in a dialectic and responsive process with the subject under the study" (p. 44–45). In this way, the researcher acquires much more flexibility and has the chance to reveal the participants' beliefs, values and experiences (Guba, 1981). Therefore, the researcher's personal experiences and interests in the focus of the current study affect this dialectic and responsive process.

The profile of the researcher

I was born in 1990 in Kayseri. I completed my bachelor's degree in mathematics. During my four-year education at the university, I voluntarily participated in several non-governmental organizations (NGOs). One of them was educational organization that supported the equality of opportunity in education. Being a volunteer there developed my point of view that all children should be given the chance to discover their potential. At the end of my volunteer work, I noticed my great enthusiasm towards teaching, and I started tutoring a student with a mild learning disability in mathematics. I often had difficulty teaching, and I was losing my motivation day after day. At those times, my roommate, who had a visual impairment, encouraged me to overcome these difficulties. She shared her challenging experiences in learning mathematics and her teachers' strategies. I listened to her experiences with great

interest. After graduating with my bachelor's degree, I wanted to enter the teaching profession, so I applied to the Bilkent University Graduate School of Education's Curriculum and Instruction with Teaching Certificate Program. Through my education at Bilkent University, I took several courses on learning how to make learning relevant and differentiated for all students. I promoted the idea that ensuring equity in the classroom was the main role of a teacher. One day, one of my educators (days after he became my supervisor) had me watch a video about VI students' geometry learning strategies. They were practicing what they learned about geometry by acting it out. After that, I started to explore ways that VI-impaired students learn mathematics and geometry. I read the thesis "Exploring the Academic and Social Challenges of Visually Impaired Students in Learning High School Mathematics" written by İrem Bayram and decided to conduct a research study to discover the challenges of mathematics teachers working with VI students in high school.

Due to my personal interests and strengths as a researcher, I was the main data-gathering instrument for several reasons. First, I had experience living with a VI person, and had developed my point of view on teaching-learning mathematics for VI students by listening to her experiences. Second, I was educated as a mathematics teacher whose teaching philosophy was based on ensuring equity in the classroom. Third, I was trained in conducting qualitative research.

Developing the interview protocol

Interviewing was necessary to understand past events that cannot be replicated again and exist only in someone else's mind (Patton, 2002). Conducting in-depth interviews revealed the participants' interpretation of their experiences (Charmaz,

2006). Hence, interviews had an important role in the data collection of the current study (Cresswell, 2007).

The interview protocol helped the researcher remember the key points of the interview process and systematically gain data about the respondents. Therefore, the interview protocol was composed of two sections: interview arrangement and interview questions. The first section was required to plan and arrange the interview process to follow several procedures. I carefully determined the settings, where the meetings would take place, and the amount of time each meeting would take. I also determined what equipment (voice recording equipment, note-taking materials) would be required. I started each interview by recalling the purpose of the current study. I reminded them of their right to skip any question and withdraw from the interview session at any time. Their permission to use a voice recorder was requested before the interview. During the interviews, I worked attentively to provide a natural flow and asked for clarifications on the questions and answers.

The second section of the interview protocol was comprised of the interview questions. I prepared the initial set of interview questions using the literature and my experiences in differentiated classroom settings. The initial set of interview questions was formed to acquire meaningful data about the challenges of mathematics teachers educating VI students. Interview questions may reveal participants experiences, opinions, feelings, knowledge and backgrounds (Patton, 2002). I asked the same question in different ways during the interview in order to minimize doubt about the completeness of the participants' remarks, and I avoided leading questions that would encourage the participants to respond in a certain way. Instead of leading

questions, I preferred open-ended and ideal position questions, such as, "Would you describe what you think the ideal teaching atmosphere for VI students would be?" This type of question would encourage the participants to relay in their own words what they would change or not change about the teaching atmosphere.

Interview process

Data for this current study came from the semi-structured interviews. All interviews were conducted face-to-face, allowing me to observe the respondents' body language and gestures. All of the interviews lasted at least an hour and were conducted in the native language of the participants (Turkish). Except for one interview, all interviews were recorded, and permission to audiotape was obtained by signing a consent form before the each interview. The one exception was not recorded because the participant did not give permission to be audiotaped. I wrote down answers during this interview and took observation notes.

Observations

Observations provide the researcher with information about how participants act and how things are in a natural setting (Lincoln & Guba, 1985). Observations of participants were conducted both during and after the interview. During the interview, I had visual contact with the participant in order to obtain in-depth information on the respondents' expressions and gestures. These observations helped me to understand how participants' reactions changed. However, after the interview, I was able to observe just one participant in her classroom during a lesson. Throughout this experience, I took notes about teaching practices, teacher attitudes towards VI students, and the learning atmosphere. All these observations helped me

improve the follow-up interview questions. I could not observe two of the other participants while teaching mathematics to VI students. In one case, the school administration refused my observation request, and the other was an inappropriate time to observe because it was the last week of the semester and there were no students in the class.

Artifacts

It was suggested that the researcher use different data collection methods so as to employ triangulation (Denzin, 1978). Therefore, several artifacts were collected to enrich the data. These artifacts included written documents coming from observation notes and a video recording related to equity in education that included one of the participants. To strengthen the data, I used these artifacts by writing memos about code units.

Journals

I kept a reflexive journal that described my experiences during this current study in detail and documented my own reflections on the topic. Observations of participants, facilities and the teaching atmosphere were recorded in this reflexive journal. I also kept a methodological journal that included discussions with my peer-debriefer and notes from my methodological readings. Both journals guided me in constructing a research design, working hypothesis, and interpreting the results of data analysis.

Data analysis

Data analysis is “the process of making meaning of the data” (Merriam, 2009, p. 175). In this regard, the aim of data analysis may be interpreted as finding answers to

the research questions. Data analysis and collection interacted with each other because data collection was an ongoing process that continued through the data's analysis (Lincoln & Guba, 1985).

In this current study, data came from interviews, observations and written artifacts. Data was analyzed using the constant comparative method, which included unitizing, coding data and recognizing the patterns, categorizing similar categories, and identifying the themes (Glasser & Strauss, 1967, as cited in Gonzalez, 2004). These themes indicated commonalities and differences between participants' experiences in teaching high school mathematics and perceptions of inclusive education.

First, interview data in Turkish was transcribed from recordings into a word processing software files. Second, the transcripts were opened with a software program that helped the researcher to organize, classify and systematically categorize tools. Using this, I broke down the transcripts into even smaller coding units. While I continued the coding process line by line, I was writing memos for each code, at which time I benefited from my reflective journals, observation notes and other written documents. The program helped me to use a code-and-retrieve approach which allowed codes to be assigned to labeled passages and memos; data could then be retrieved using a particular code. Third, I prepared hard copies of these 109 codes using 74 pages. Because there was too much paper, I divided them into seven subgroups, which were titled mathematics teachers, VI students, inclusive education system, physical conditions, assessment strategies, and others. These subgroups enabled me to make systematic categorization. See the sample card at the next page:

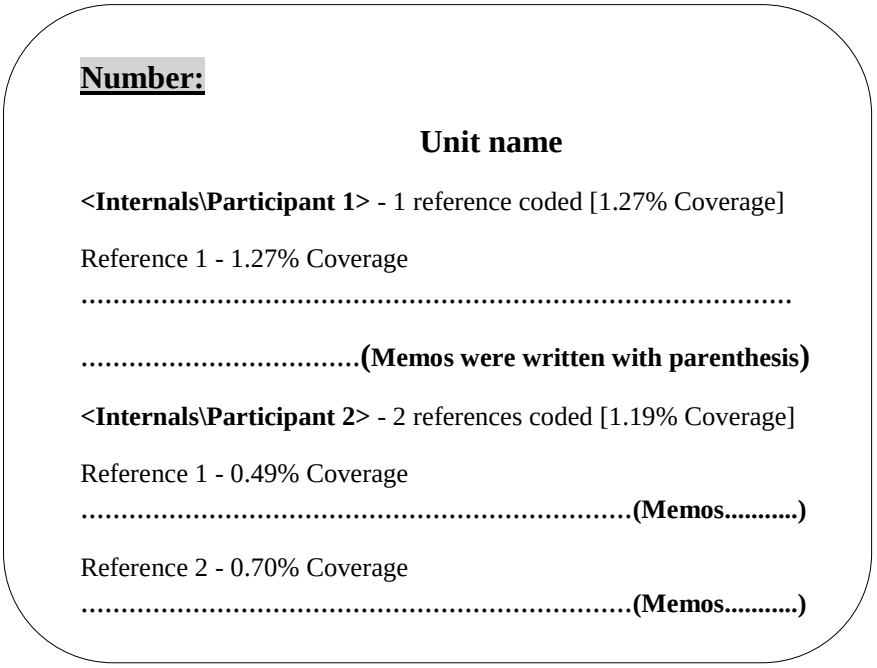

Figure 1. An example of a card

The aim of this categorization was "to bring together into provisional categories those cards that apparently relate to the same content" (Lincoln & Guba, 1985, p. 347). I started with one subgroup of cards to collect similar codes into one category. In the process of categorization, one card, which included a code with labeled passages and memos, was selected and studied. The relevancy of the card was then checked against existing categories. I placed the card within the related category or created a new category for it, and then assigned a number for each category. This process was repeated until all cards were finished. Each card could be part of more than one category; in this case, the card was duplicated. Fourth, after analyzing all cards, I wrote categories on A3 paper to see the names of all cards at the same time (Appendix C presents a photo of A3 paper). In this way, I made several re-checks with my peer-debriefer to determine whether a card was in the appropriate category. Table 1 shows the 39 categories identified through this analysis.

Table 1
The categories of the study

1. Student's self confidence	2. Experiences with VI students	3. Braille
4. Student's needs	5. Resources for teachers	6. Voice recording
7. Individual learning style	8. Classroom management	9. Communication between teacher and VI students
10. Student's educational background	11. Teacher's awareness	12. Organization of lesson
13. Student's motivation	14. Teacher's bias	15. Suggestions- solution
16. Communication between VI students and friends	17. Teacher's complaints	18. Criticism of Inclusive education
19. Communication between teacher and parents	20. Teacher's perspective	21. Special Education
22. Private tutoring institution	23. Lesson preparation	24. Physical condition of the school
25. Academic achievement	26. Teaching methods	27. Assessment system
28. Academic effects	29. Time management	30. Examination Problem
31. Teacher's motivation	32. Lesson content	33. Guidance
34. Teacher's profile	35. Material usage	36. Discrimination
37. Attitudes towards İnclusive Education	38. Usage of Technology	39. Equity

Finally, through the help of my peer-debriefer, I combined similar categories to reduce category numbers and constructed themes. These themes are presented in

Table 2
The themes identified by the study

1. Teaching mathematics practices
2. Mathematics curriculum
3. Preparation of materials
4. Assessment practices
5. Beliefs on inclusive education and VI students

Ensuring trustworthiness

According to the constructivist research approach, ensuring trustworthiness — that is ensuring validity and reliability in qualitative research — involves four criteria: credibility, transferability, conformability and dependability (Lincoln & Guba,

1985). I used five elements, which were prolonged interviews, peer-debriefing, triangulation, maximum variation, and researcher reflexivity.

Credibility:

Credibility corresponds to the truth value of the findings of a particular study. However, from a positivist approach, "data do not speak for themselves; there is always an interpreter" (Ratcliffe, 1983, p. 150). Therefore, a qualitative researcher may never capture the "truth" utterly (Ratcliffe, 1983, p. 150). There are several strategies that a researcher may use to increase the probability of producing credible findings. First, I used a prolonged interview that lasted at least an hour in order to increase the credibility of my findings by spending an adequate time to collect data. During and after the interviews, I made observations on how to get close to the participants in order to understand their perspectives on the phenomenon. Second, I used the peer-debriefer method to discuss the isomorphism between data and reality. My peer-debriefer checked the data analyzing process and helped me to assess the commonalities and differences between participants. She attempted to address my bias, clarified my interpretations, and explored the findings that emerged from the data. This chosen peer was educated in conducting quantitative and qualitative research and informed of the role of the peer-debriefer before these discussions. Third, I used the triangulation strategy, which involves the use of multiple methods, sources of data, investigators and theories (Denzin, 1978). I applied multiple methods of data collection, such as interviews, observations, and written documents. Observations provided information about how participants acted and how things seemed in a natural setting. Documents also provided a description of the participants' actions, attitudes and beliefs.

Transferability:

Transferability corresponds to external validity in the positivistic approach to reveal the generalizability of the results. Therefore, it is required to make a detailed description of the study to enable readers to transfer the findings into other settings appropriately. To enhance transferability, I attempted to select the study sample at maximum variation. The age, type of school, length of time they had worked for, and number of VI students they experienced were all varied in the current study. Purposefully using variation in sample selection made the results generalizable to more teachers.

Dependability and confirmability:

According to Lincoln and Guba, dependability and confirmability have a close tie (1985). The concept of confirmability corresponds to the objectivity of the study. I tried to ensure the confirmability of the study by keeping detailed reflexive journals for observations, interview notes, and personal experiences.

Working hypothesis

The working hypothesis of the current study is restricted to this particular context, yet it may be generalized from the outcomes of this study (Erlandson, Harris, Skipper &Allen, 1993). The working hypothesis of the study was that mathematics teachers educating VI students encountered several challenges.

CHAPTER 4: RESULTS

Introduction

In this study, I aimed to understand the challenges and actions of mathematics teachers who teach high school mathematics for visually impaired (VI) students. To achieve this aim, I critically analyzed high school mathematics teachers' experiences, beliefs regarding inclusive education and VI students, and preparedness for inclusive education. There are two parts in the results section: descriptions of the profiles of each participant and key findings that emerged from the qualitative analysis.

The profiles of the participants

The backgrounds of participants are demonstrated in this section by using demographic data and describing their profiles in detail. Table 3 provides demographic data on teachers' ages, years of teaching mathematics and teaching experience with VI students, number of VI students they have experienced, and elapsed time since their experiences with VI.

Table 3
Demographic Characteristics of Interviews and Observation Participants

Participant	Age	Yrs. Teaching Mathematics	Yrs. teaching exp. with VI students	Number of VI students	Elapsed time since their exp. with VI students
Kerem	46	24	2	1	1
Erkan	45	21	5-6	3-4	4
Seda	51	27	4-5	12-13	Continued
Emel	43	21	6	15	Continued
Burak	44	21	5	More than 20	3
Nur	26	1	1	1	Continued
Gizem	28	Pre-service teacher	1	2	1
Ceren	26	Pre-service teacher	1	3	2

Kerem: He was working as a mathematics teacher in a private high school in İstanbul. He was feeling pleased that his school supports inclusive education for students with Down syndrome, learning difficulties, and visual disabilities. Kerem said that his school always encourages teachers to employ diverse resources and materials. Furthermore, he actively followed the development of educational technology worldwide because he wanted to integrate technology effectively into the mathematics classes in Turkey.

Erkan: He was working in a high school that was one of the pilot inclusive education schools in Ankara. Erkan stated that 21 years ago, he received his first experience, then he taught mathematics to more than five VI students. He stated that in the beginning of his experience, he made an effort to learn braille numbers, but then he gave up. He emphasized that his colleagues and he had not attended any in-service training programs on the pedagogical practices of inclusive education.

Seda: She served as the head of department after working in the same school for seventeen years. According to the thoughts of VI students living in Ankara, her school is a well-known school that implements inclusive education. She had six or seven VI students who stayed in the school dorm with peers. In addition to these experiences, she had six months of tutoring experience with a VI student. However, she stated that she always started her lessons with low motivation and felt continual anxiety that her lessons were not beneficial to them.

Emel: She had been a mathematics teacher for 21 years in different state schools applying inclusive education in Ankara. It was her 12th year at a popular high school

preferred by VI students. When I held the interview with her, she had one 12th-grade student [referred to as a pseudonym, Ahmet, in the upcoming stages]. She thought that she could not teach mathematics to her VI students.

Burak: His school was one of the pilot schools implementing inclusive education in Ankara. For this reason, he worked with more than 20 VI students from different cities, both in the school and the dormitory. Burak said that he did not receive training in how to apply inclusive education practices for VI students. Moreover, he had further experience with a VI person. He had a VI roommate when he went to a boarding high school. He said that his friend's mathematics scores were better than his. By considering that experience, he said that he believed if a VI person was able to succeed in mathematics, then others could easily succeed. However, he said that he since lost his belief.

Nur: She has been in the first year of her teaching career at a state school, but she worked as a volunteer teacher in an education center for six years. She expressed her thoughts that guided her to become a teacher as follows: "I always wondered how a child learns mathematics." She said that she started working as a volunteer to gain experience of children's needs. In her first year of teaching a ninth-grade class, she met a VI student who had low vision and learning difficulties.

Gizem: I personally knew her because we were receiving master's education at the same university to become qualified mathematics teachers. She said that she obtained her experience with VI students from two different periods. The first was in an education center as a volunteer while she was studying a bachelor's degree at a

university. Then, she did not have knowledge of teaching. During her first experience, she prepared a 12th grade VI student for a university entrance exam for a year. Her second experience occurred at a specialized training center while she was pursuing a master's degree on a teacher education program. According to her explanation, the specialized training center was a small institution that was established by volunteers' efforts. She stated that through the second experience, her awareness increased significantly. In addition to her experience, she had an opportunity to observe how VI students were educated in the United Kingdom.

Ceren: She gained valuable experience of teaching mathematics to VI students because during her master's degree, she took a role as a volunteer mathematics tutor of VI students at a special course center. After this experience, she conducted a research study to point out the academic and social challenges facing VI students in learning high school mathematics. Therefore, she collected rich knowledge of the practical and theoretical issues of the mathematics education of VI students. She emphasized the nonexistence of special pedagogical education in teaching mathematics to VI students during her tutoring.

Theme 1: Teaching mathematics practices

There is no doubt that a lesson plan keeps teachers on track to set routines and prepares them for unpredictable events in their classrooms. Preparing an effective lesson plan is one of the main responsibilities of teachers. An effective lesson plan helps teachers think deliberately about their choice of objectives, teaching strategies, and materials (MoNE, 2010). It also allows teachers to organize their lessons. However, some of the participants, especially experienced teachers, thought that they

did not need to plan their lessons. They stated several reasons why they did not plan their lessons. For example, Erkan claimed that limited time for planning was one of the noteworthy excuses for not planning his lessons. He stated, "I have never used a written lesson plan because of a lack of time. A lesson plan [referring to a daily written lesson plan] was just a thing that was controlled by an inspector." The real reason for not planning his lesson was that he thought that writing a lesson plan was a waste of time, I thought. In addition, Ceren said that she always tried to prepare elaborate lesson plans inside her head, but only sometimes wrote them down in detail on paper. She stated that she gained a wide range of knowledge about how to develop a detailed lesson plan through her master's degree from a mathematics teacher education program. She explained how she tried to organize her time for planning a lesson for VI students:

> I spent most of my time selecting appropriate topics. I should have known how to teach those topics and spent my time learning appropriate ways. Therefore, I always checked different books to find proper examples. Many times, I researched mathematics activities on the Internet for my blind students... I spent extra effort creating tactile materials to maximize teaching and learning opportunities [for them].

At first glance, her explanations seemed to me like complaints about having limited time, but afterward, some reflection on my own, I noticed that she just wanted to give an example of her challenges in the lesson-planning process. She supported the view that every teacher could meet their students' needs providing that they spent effort and time on developing appropriate teaching practices.

Mathematics is often represented by using specialized symbolic notations, graphs, tables, and formulas. Therefore, the primary way of representing mathematics is usually in writing. All participants stated that this situation caused some problems in teaching and learning mathematics because their VI students were not able to read mathematical notations and graphs in the same way that their sighted students could. According to Ceren, for this reason, a teacher should be careful in reading algebraic expressions with the correct intonation. She explained her experiences that reveal the effects of correct intonation on her VI students' understanding as follows:

> When my VI students misunderstood the expression in the exponential numbers, I realized that intonation and emphasis on the word played an important role in mathematical representations. For example, if the expression is meant to be x^{3+4}, I should say "x to the power of 3 plus 4" rather than "x to the power 3 [pause] plus 4," which sounds like $x^3 + 4$. Or I should use parentheses for the former, such as "x to the power with left parenthesis 3 plus 4 with right parenthesis."

Thanks to Ceren's detailed explanation, I obtained an opportunity to experience how a teacher's intonation influences understanding of an expression. While I was listening to the recording of our interview, I placed myself in a VI student's place: I closed my eyes and imagined the written symbolic expression presented by her. Understanding the progression of a solution was a challenge for me, as well. I wonder how many different results would be found by students when a teacher reads the mathematical expression "One plus three over two plus four." $\frac{3}{2}$, $\frac{13}{2}$, $\frac{2}{3}$, and 6 might be possible results for different solutions. Most importantly, I became aware that it was a challenge for a mathematics teacher to eliminate such ambiguities for their VI students.

Another participant, Gizem, touched on an important point by stating that teachers should be able to teach learners how to construct mental pictures. Even in unfavorable conditions, such as without materials and resources, she tried to use models of visual representations to reinforce conceptual understanding:

> I had difficulty representing a curve. Ultimately, she [her VI student] had never seen a curve and I did not know how a curve was shaped in her mind when I asked her… In some verbal integration questions [i.e.: Volumes of solids of revolution in real life], she needed to sketch the geometric figures in her mind. Thus, I attempted to use her hand or my leg to represent a curve [as a tactile learning strategy].

She added that using three-dimensional objects could be a powerful way to help her VI student visualize mathematics. Our interview consequently helped me think more deeply about how a high school mathematics teacher designs an activity so that students can "see" mathematics.

The computational complexity of mathematical operations was mentioned as a challenge for both VI students and teachers. Examples were given by Kerem and Burak. According to Kerem, his VI student usually became bored with studying algebra and arithmetic. This student became easily confused when he was asked to solve a problem with steps. For this reason, Kerem faced with resistance against performing arithmetic. Similar to Kerem, Burak summarized his experience as follows:

> My VI students had low computational abilities. Therefore, I could not teach them to solve exponential number and root questions with more than three steps. They were not able to keep the results in their minds. How many times could I repeat it?

His comment made me conclude that he became tired of repeating his instructions because he thought that his effort to teach mathematics would be a waste of time.

The majority of participants stated that giving appropriate directional cues was important for VI students. They stated that both teachers and VI students faced challenges when some vague directional cues were used to explain terminology. They agreed that the unclear instruction confused their VI students, especially while learning new mathematical concepts. For instance, Emel said that she tried to avoid using pronouns, but she often forgot:

> My VI students always gave me notice not to use phrases such as *look at, here, take this*, and *put it there* [referring to demonstrative pronouns], but I often forgot to read out everything written on the board. The reason was that I had become accustomed to teaching sighted students over 21 years.

Another participant, Ceren, highlighted that VI students had to listen carefully to understand given verbal descriptions. For this reason, she stated that she talked too much to explain and repeat everything: "Giving a detailed oral description doubled the standard lesson duration [40 min]." She emphasized that she was exhausted both mentally and physically at the end of her lessons. Moreover, Ceren stated, "After some time, the VI student became tired. He was continuously listening and trying to understand by hearing. Thus, they were easily confused by my explanations. After

the lesson, I did not want to do anything. I had lost my energy and motivation."

Similarly, Seda complained about the necessity of talking too much. Seda thought that the solution to this challenge was ignoring VI students in some cases. According to Seda, VI students did not have any opportunity to skip all the questions asked throughout the lesson. Therefore, there was no need to repeat all the questions for them. She said that, for this reason, she had even excluded her VI students from certain questions.

Erkan and Seda strongly believed that writing is a required action when students learn mathematics. They were concerned about their VI students' writing limitations. In addition, Seda described her concerns:

> Some of my VI students tried to write by using their instrument [a braille typewriter], but they gave up on writing in the short lesson time. First, they warned me to decrease the pace of the lesson. This took the greater part of our lesson, and generally, I forgot about what I said while waiting.

A different concern related to the writing barrier in was mentioned by Emel. She said that she had students with low partial vision as well. She had to be careful in writing on the board because the font size and the color of the board marker affected their visual acuity. However, she complained that she had to pay attention to provide these conditions.

Theme 2: Mathematics curriculum

I asked the participants how they evaluated the high school mathematics curriculum in terms of being challenging but achievable for all to learn. Their answers were not

surprising to me, because the vast majority of the participants stated that many mathematics topics were challenging to teach to VI students. Furthermore, some topics were never taught to VI students. For example, Ceren stated that the mathematics curriculum covered mostly visual materials. She claimed, "Teaching mathematics to VI students is difficult because the nature of mathematics places particular importance on visualization." As a result, she stated that teachers need extra time and effort to convert visual parts of mathematics into the appropriate form. She said, "Even with extra effort and time, it could be difficult for them to succeed in mathematics, but not impossible."

Other participants, Burak and Erkan, claimed that a teacher cannot teach all mathematics content to VI students in detail. Burak said, "How can I teach them division of polynomials when even sighted students cannot be taught?" He explained that the VI students had a low ability to perform mathematical operations; hence, they were not able to succeed in mathematics. He claimed, "They would need to be a genius [to perform the division of polynomials." His words reveal his prejudice that VI students cannot learn mathematics. I totally disagreed with him because they do not need to be a genius to perform rigorous mathematics. In my view, everyone can learn mathematics, but some students make connections more quickly than others. Therefore, teachers need to set achievable objectives and design differentiated teaching activities to teach challenging mathematics topics by considering students' different needs. In brief, his opinions differed from what the education program claims (i.e., "Every student can learn mathematics").

Another participant, Seda, supported the idea held by Burak and Erkan that teachers are able to teach limited mathematics topics to VI students. She said, "Our curriculum was intensive to teach them [her VI students]." I wonder whether if the curriculum had been less intensive, the teacher would have used differentiated strategies to teach VI students mathematics in depth. I do not think that teachers who had prejudices against VI students could design a teaching activity to make the VI students active learners. Seda stated that teachers had to rush to teach topics in a short period. She said, "In ministry regulations [the curriculum], there are such meaningful sentences that teachers should work by reaching the level of students' knowledge. But this is not possible in practice. [In this way], topics cannot be completed." She maintained that teachers are able to teach limited mathematics topics to VI students.

Some of the teachers stated that there were frequently changes in the mathematics curriculum that created chaos in education; Erkan highlighted the underlying reasons for this chaos. He claimed that the mathematics curriculum and materials, especially books, were altered approximately every two years. He complained about how teachers could organize their classroom without familiarizing themselves with the new curriculum. In addition, Seda claimed that mathematics textbooks were changed each year without asking for teachers' opinions. Their claims might have not have been true because the mathematics curriculum has altered twice in a decade. Similarly, the books started to be reconstructed according to the renewed current curriculum in a span of three years based on teachers' advice. I believe that they asserted their claims to find external excuses. In this way, they felt that they would not be responsible for the negative results of the curriculum.

Half of the participants said that "the curriculum should be different for sighted students." For example, Burak suggested that only basic mathematics should be selected for them. Another participant, Seda, suggested assigning a new specialized curriculum to VI students:

> The VI students should have a different mathematics curriculum. For instance, when I was working in a vocational school for girls, I suggested that they should be educated by considering their professions. The department of needlecraft [in the vocational school] requires measurement, or the art department focuses on ratio and proportion. Not everyone needs to learn trigonometry. The same idea should apply for blind students. We should teach them mathematics as far as they are able to learn it.

Regarding learning geometry, the teachers' opinions were divided: "VI students are able to perform geometry" or "They are not able to perform geometry." On the one hand, Burak, Erkan, Seda, and Emel stated that they had difficulty teaching geometry topics. When I asked participants about their geometry-related concerns, they were eager to express them. They usually stressed VI students' capability of performing geometry. Burak claimed that teaching mathematics to VI students might have been possible, but geometry was an exception. Emel worried about how to teach geometry to her VI students. She asserted that mathematics could be possible to teach compared with geometry. She said that she did not know how to represent geometric objects to them. She highlighted the following: "There was absolutely a teachable method, but I don't know it." Another participant, Seda, thought that VI students had great difficulty learning geometry. She added that geometry was a difficult subject even for sighted students. She stated that one can solve 100 questions, but one can

fail in the 101st question. Therefore, “Geometry is about what you understand.” I noticed that these participants thought that the regulation of exemption was a good decision taken by the Ministry of National Education (MoNE). However, Erkan emphasized that the exemption regulation was not clear for teachers. He complained that he did not know what the regulation regarding geometry lessons: “It was not in-depth…” Unfortunately, he said that in his geometry class, he asked students to sit behind desks. Erkan asserted that he could teach just the definitions of shapes. His VI students were able to understand what a triangle looks like. Similarly, in Seda’s geometry class, she explained the following:

> In the beginning, my partially sighted student sat at the front desks. I noticed the effort he required to understand simple topics. I always asked him the definitions or properties of the regular shapes in the exam. Afterwards, he was not interested in the lesson. Therefore, I did not need to push him to be active.

On the other hand, Nur, Ceren, Gizem, and Kerem supported that VI students were capable of learning geometry provided that the teacher follows a rigorous, proper curriculum with differentiated methods. For example, Nur claimed, “VI students are able to learn an advanced level of geometry because the sighted teacher can produce tactile images for them. Keeping equations in their minds may be much more difficult than learning geometry.” Another participant, Gizem, explained the role of the teacher in effectively structuring teaching and learning experiences. She explained her teaching ideas elaborately:

> First, the teacher should start to teach the fundamental concepts, such as angles, angle bisectors, and the median. These concepts should be stored in VI students’ minds in a meaningful way. Then, tactile materials can be designed to improve

their spatial imaginations. Moreover, a method of discussion can be used to understand the differences between a closed half-line, line segment, line, and point.

After the explanation, she attracted attention to the challenges of the teacher in they have limited time and knowledge of how to teach geometry for blind learners. She thought that the teachers should spend much more time on preparing geometry lessons than mathematics lessons.

Theme 3: Preparation of materials

Materials are essential for making all areas of the mathematics curriculum accessible to VI students. The adaptation of printed instructional materials, tactile materials, and usage of technology in teaching mathematics allow VI students to gain a deeper understanding of the subject. Providing students with a meaningful learning experience with supportive materials is one of the teachers' responsibilities. In accordance with this responsibility, it was expected that none of the teachers would deny mathematics teachers' important role in designing and using materials. However, a group of teachers did not have the same idea. They believed that lack of knowledge and time did not allow them to design particular materials. Thus, they thought that they should not have held this important role. In contrast, another group of teachers was aware of their responsibilities. By sharing their particular experiences and challenges, they revealed the role of teachers in material design and usage. Therefore, I have conveyed the two sides' opinions and their challenging experiences in designing and using particular materials.

When I asked the teachers what kinds of written materials they used in teaching mathematics to VI students, most of them could not give specific examples. For example, only two of the teachers referred to mathematics textbooks with braille. These two participants, Ceren and Seda, said that they had heard about the existence of the braille mathematics textbooks from their VI students. They stated that MoNE subject books were converted into the braille alphabet to meet VI students' written source needs. However, they emphasized that their students had never accessed these books because they were a limited edition. Ceren showed me possible challenges when braille mathematics textbooks were used: "[First], the teacher has to learn the braille alphabet to check the VI student's work in the class. [Second], before the lesson, the teacher has to match between the braille and standard mathematics textbooks."

Another participant, Seda, told me that she did not prefer using standard textbooks published by the MoNE because she did not like the content in the textbooks. She complained about the limited number of examples and exercises in the textbooks. Instead of using them, she collected her examples from a wide range of booklets and three different books. In addition, Seda said that she sometimes recommended that her sighted students buy particular exercise books to prepare for university entrance exams. However, she stated that she could not give recommendations to the VI students because these exercise books were written for sighted students and used visual representations. Thus, they were not appropriate for VI students. She remarked that the lack of appropriate written material for her VI students made her feel upset and helpless.

Similar to Seda, Burak complained about the lack of written materials for VI students. "I could not hand out a simple written worksheet to my VI students," he stated. According to him, the lack of written materials caused inequity in the classroom.

Another participant, Ceren, approached the issue more critically. She said that a teacher should try to find a solution to the lack of written material. Thus, she created the project idea of an accessible braille mathematics textbook. She explained that she would convert selected exercise mathematics books into braille to provide resources for university entrance exams. However, she apparently realized that braille was not appropriate for mathematics. She described how futile her idea was: "Braille was not regarded as a significant tool [by her VI students]. Besides, mathematical symbols and notations could not be transferred into braille because of the linear nature of writing in braille." Consequently, she gave up her project.

Ceren explained how she tried to use technological tools while teaching mathematics. For example, she encouraged her VI students to use a voice recorder. She explained that she used a voice recorder for exercise questions and solutions to facilitate re-listening at any time. However, she said that her VI students did not like listening using the voice recorder, because it might have caused some confusion. According to the VI students, she said that they could not rewind the recorder. Thus, it was not as effective as she had planned. She concluded that the effectiveness of technological materials in teaching depended on how the teacher integrated them into the lesson and students' adaptation to using those materials.

In contrast to Ceren's students, Kerem's student used his computer as a voice recorder. He said that his VI student could follow the lesson by using his computer's reading software. He told me that in this way, he could access some of his VI student's work easily when he checked his computer. These two different experiences explicitly showed that there were some advantages and disadvantages of using a voice recorder in the teaching and learning processes.

Although Nur has not started to use a smart board yet, she had significant concerns with it. She said that she did not know how to integrate the smart board into her teaching. She claimed that using a smart board in her lesson might have met just sighted students' needs. Thus, she did not believe that she would be able to engage with students with low vision by using a smart board.

Another participant, Emel, said that she used a smart board in every geometry lesson. She explained that she preferred showing geometry questions by using smart board software by projecting onto the board instead of sketching on the board. She emphasized that in this way, she could answer many questions for sighted students. She said, "I did not know whether there were adapted implications for blind students. I did not think so; I made an extra effort for Ahmet [her VI student] by using technology."

Kerem mentioned that his VI student needed an opportunity to understand what his classmates were doing in sketching a graph. For this reason, after the research, Kerem tried to adapt a tactile material that represented the coordinate plane. He explained that he used cheap and accessible equipment supplied by his school

carpenter studio. Although his material was constructed simply, he highlighted that careful planning and extra time were required for the teacher to determine insufficient aspects.

In addition, Nur said that she tried to design a material for her VI students, but she was not able to achieve this because she did not have sufficient knowledge of VI students' needs. In my opinion, a limited number of mathematics teachers might have adequate knowledge to transfer their pedagogical content knowledge into a material design.

Theme 4: Assessment practices

Assessment is an integral part of teaching mathematics to determine what students have learned about the following: the problem-solving process, connecting conceptual mathematical knowledge with real-life examples, exploring mathematical concepts, etc. Assessment helps teachers to understand students' development over time. Although it is an ongoing process in teaching, some teachers might think that assessment refers to exams administered by teachers two or three times a semester to determine students' grades. For example, five of the eight teachers did not care about the role of assessment in teaching. They believed that they administered exams for VI students due to an obligation of the MoNE. Because they did not pay enough attention to the VI students' assessment process, they could not provide much information when I asked them what kinds of concerns they had. They gave answers so as not to leave the interview question unanswered. In contrast to these teachers, the other teachers (three of the eight teachers) were aware of the importance of ongoing assessment to check VI students' progress. Two of them, who gave tutoring

lessons to VI students, shared possible challenges in assessing VI students. In addition, they gave suggestions for minimizing these challenges. For this reason, I focused on all the teachers' assessment practices, concerns, and alternative applications.

All five teachers who had experience with VI students in the state school described almost the same assessment practices. According to their explanations, the VI students' exams were usually different from those of the sighted students. Emel, Seda, and Burak said that before the exam, they prepared the exam questions for the VI students. They highlighted that they selected the questions from definitions or basic knowledge questions that did not contain visual representations. Example questions that might have been on the VI students' exams include "What is the sum of the interior angles in a triangle?" "How can you find the area of square?" and "What is the common factor of 8 and 12?" Seda asserted that not only did the teachers prefer asking simple questions, but also the VI students preferred answering simple questions. She explained teachers preferred this approach because evaluating VI students' exams was easier.

Other participants, Erkan and Nur, explained that they solved similar exam questions the day before the exam. They said that they changed just the numbers of the questions. Although they believed that selecting simple questions and solving similar questions before exams were necessary to VI students, sighted students did not have the same idea. For instance, Seda explained her concern: sighted students' complaints. She mentioned sighted students' complaints about the inequality between VI students and them. She said that her sighted students asked her many

times why they needed to answer hard questions. Seda noted that she always listened to her sighted students' complaints. Burak shared a similar experience with me. He said that one of his VI students insisted on taking the same exam as the sighted students. He thought that the VI student was fed up with sighted students' complaints and feeling isolated from her peers.

These teachers explained that the VI students took the exams at a different time and place from those of the sighted students. In addition, they said that there were readers who selected from sighted students to help the VI students in reading and writing. According to two of the five teachers, a reader had to read the questions and write the VI students' answers directly without making any changes. These teachers highlighted their concern of finding reliable readers among sighted students. In contrast, the other three teachers did not have concerns in finding readers because they regarded VI students' assessment as unimportant. They said that they tried to select readers from successful students. For example, Erkan, who was one of these three teachers, explained that he especially selected successful readers so that they could help the VI students by answering the questions instead of the VI students. Moreover, he said that the school administration did not allow the failure of VI students.

"In inclusive education, the students with special educational needs cannot be given low marks" (Item 84) (MoNE, 2006, p.29). All five teachers believed that this condition in the MoNE regulation was the main reason why they did not care for the VI students' assessment. For instance, Erkan commented on this condition as follows: "We [His colleagues and he] provided exams for VI students, but they were

just formality." Nur claimed that the school principal forced her to fulfill the condition. She explained her school application thusly: "We modified the averages of the exams so that we did not prepare an exam again. We changed the average from 20 points to 50 points. In this way, all students would succeed in the mathematics subject in a minute." Similar to Nur, Emel claimed that her school administration always reminded her of the condition. "My school administration said to us that all VI students had to obtain their graduation diplomas because they were special students. They should have not suffered from their exam grades," she stated.

Kerem gave an explicit explanation of his experiences. One of his concerns was the application of readers in examinations for VI students. He believed that readers might have affected VI students' assessment. For example, he stated that the readers may have read and written missing or incorrect parts; in contrast, they may have directed VI students through giving the correct answer. Therefore, VI students' exam results could be unintentionally affected.

In addition, he stated that his VI student was not comfortable in answering questions together with another mathematics teacher or someone else. Because he believed that a teacher required a comfortable atmosphere for teaching, learning, and assessment, he tried to find another way to provide exams for the VI student. He thought that VI students would be able to answer the exam questions on their own if they were given enough opportunities.

Themes 5: Beliefs regarding inclusive education and VI students

According to some participants, their first mathematics lessons with VI student were full of emotions, such as anxiety and helplessness. For example, Seda was terrified of the possibility that a VI student was going to be in her class throughout the entire year. “How can I help her? Is she able to learn mathematics?” she thought. She tried to overcome those negative feelings by ignoring her VI student, but in my opinion, this was a great mistake because her attitude was contrary to the equity required in education. Furthermore, her defense mechanism was justifying her ignorance. For this reason, she started to accuse students of being disinterested and even the educational system by overgeneralizing. For example, she described one of her lessons as follows:

> My students were listening as usual. I did not need to confront them unless they were disturbing the ongoing lesson. I did not know whether I was helping them or not. The purpose of the education was not to make them bored, but it was making them bored.

She wanted approval from me as the listener. I noticed that she felt uncomfortable in her class with a VI student, but she did not want to discuss her negative feelings because she felt guilty about making little effort to teach mathematics to her VI students.

Kerem told me that his VI student was determined to enter the best university in Turkey. He set high goals for his VI student, Mert (a pseudonym) by considering his needs. Over two years, they worked together after mathematics class regularly. Kerem guided his student during that time and motivated him to increase his

mathematics achievements. He said that their efforts led to great happiness in the end through Mert's success. Kerem shared an experience he considered the most unforgettable moment in his teaching career. He said that that day's topic had been the continuity of the function. He had prepared a tactile exercise sheet for Mert by using silicon. It included a graph of the function. He gave the exercise sheet to him, and then he sketched the graph on the board for his sighted students. He gave them time to find the points at which the function was continuous. While his sighted students complained about the difficulty of the question, Mert gave the correct answer without any hesitation. When he affirmed his answer, he had a big smile on his face, and the other students were shocked. The rest of the class had not expected the correct answer to come from him. At that moment, Mert and he felt great happiness from his achievement. Until that experience, Kerem had believed that he had created false hope by attending to Mert's needs. He admitted that this idea scared him and affected his teaching motivation negatively. After that experience, he thought that a student's achievement could influence both a student's attitudes and a teacher's motivation.

Similarly, Seda said that her motivation was increased by seeing her VI student's positive dispositions for mathematics. After six months of tutoring, her VI student entered university as a Turkish teaching candidate. Seda mentioned that if she had benefited any VI students, she would like to study with a new VI student again. The participants agreed that learning environment was restructured according to students' thoughts, feelings, and biases during their learning experiences. For example, all of the participants who worked in state schools highlighted that their VI students were usually unwilling to engage in mathematics lessons. Burak stated that

his VI students just sat in the class without even listening. He explained that his VI students had the preconception that they could not succeed in mathematics. Emel agreed regarding the existence of VI students' preconceptions and expanded her ideas by stating that VI students had a fear of mathematics when they started high school. Seda also believed that VI students' motivation and confidence played a crucial role in their mathematics performance. Seda continued with the following explanation:

> Mathematics was seen as the most difficult subject at school by many students. A major barrier in teaching mathematics was students' biases regarding how mathematics was a challenge for them. They really believed that they would always be unsuccessful in mathematics class. In time, they lost their motivation due to their biases.

Although Seda's VI students had negative attitudes toward learning mathematics, she thought that she could encourage them to have a much more positive approach toward mathematics in some way and motivate them to improve their mathematics performance.

Nur asserted that there was no way for her partially sighted learner to understand mathematics because her VI student hated mathematics class. According to her, he had "math-phobia." She explained that the attitudinal barriers of the blind or sighted learners were due to growing up with a phenomenon called mathematical anxiety. Moreover, Ceren pointed out a different factor of VI students' negative dispositions toward mathematics: students' resistance. She emphasized that the VI students did not trust the school system and the teacher:

They [the VI students] developed a resistance to change when they encountered the inclusive education in high school. It was an expected situation because they were not accustomed to the inclusive education system. In contrast, they were accustomed to the special education in VI middle schools. Moreover, their prejudice against mathematics increased.

CHAPTER 5: DISCUSSION

Introduction

The findings of the study showed that there were two groups of teachers with different ideas. One group was defined as reluctant to teach visually impaired (VI) students, while the other group of teachers was willing to implement effective inclusive practices. In this chapter, the main findings will be discussed in reference to literature by considering studies on teachers' preparedness for inclusive education, perspectives, and beliefs regarding inclusive education.

Overview of the study

The main purpose of this study was to explore the challenges and actions of mathematics teachers who teach high school mathematics to VI students. The study focused on teachers' experiences in inclusive education and their perspectives on teaching mathematics to VI students. Purposive sampling was used to select eight mathematics teachers who had experience of teaching mathematics to VI students. The data of the present study was derived mostly from prolonged interviews, the observation of participants during and after the interviews, and relevant documents. Data were analyzed by using the constant comparative method, which included coding data, recognizing patterns, and categorizing and identifying themes. As a result of the analysis, five themes emerged: teaching mathematics practices, mathematics curriculum, the preparation of materials, assessment practices, and beliefs regarding inclusive education and VI students. As a result of the study,

teachers' preparedness to implement inclusive practices and beliefs regarding inclusive education were explored.

Summary of the findings

According to participants' evaluations, the teachers can be divided into two groups. The first group can be described as being not fully committed to inclusive practices in their classrooms, while the other group of teachers is willing to implement effective inclusive practices. The first group (Erkan, Seda, Emel, Burak, and Nur), who were state school teachers, gave me the impression that they were reluctant to teach VI students due to the challenges they faced in teaching mathematics. However, the second group of teachers (Kerem, Gizem, and Ceren) were willing to teach mathematics to VI students. For this reason, the first and second findings given below correspond to the first group of teachers, and the third finding is associated with the second group of teachers.

First finding: Mathematics teachers are not adequately prepared for the implementation of inclusive education.

Second finding: Some teachers' beliefs regarding including/placing VI students in their classrooms are negative, although many of them think that inclusive education is required.

Third finding: Teachers who expand their perspectives with broad teaching experiences indicate a willingness to teach mathematics to VI students effectively.

Discussion of the main findings

Mathematics teachers are not adequately prepared for the implementation of inclusive education.

It is evident from the current study that mathematics teachers' inadequate preparedness for inclusion can be explained by teachers' limited competencies (Thawala, 2015). Teachers' accumulation of knowledge, skills, and attitudes that they apply in certain situations in classrooms indicate their competencies (Crick, 2008). Although having particular skills to determine students' learning needs and meet them by deploying teaching strategies are vital components of teachers' competencies (European Parliament, 2007), many teachers in inclusive classrooms may not have core teaching competencies. Teachers may not know how to identify the learning needs of VI students (Mwakyeja, 2013). Informants' evaluations support previous findings in the literature showing that teachers may have limited knowledge of instructional strategies to respond to VI students' diverse needs (Bayram et al., 2015; Forlin & Chambers, 2011; Kesiktaş & Akçamete, 2011). Furthermore, mathematics teachers do not necessarily have the required knowledge of differentiated activities to maintain VI students' engagement in their learning environments (Stefanich & Norman, 1996), since they do not have deep knowledge of VI students' cognitive processes (Dick & Kubiak, 1997). Mathematics teachers may focus on teaching procedural understanding more than conceptual understanding (Hiebert, 2013). Nevertheless, VI students who have just learned to understand information procedurally might have difficulties in following long steps and often forget information very easily (Küçüközyiğit & Özdemir, 2017; Spindler, 2006). Therefore, teachers need to repeat instructions many times to explain how the procedures continue (Dick & Kubiak, 1997). It may be speculated that mathematics

teachers who work with VI students have low pedagogical content knowledge (Bayram et al., 2015). Pedagogical content knowledge, which is one of the key components of teacher competence (Kleickmann et al., 2013) is expressed as a deep understanding of students' ways of thinking, alternative modes of representations, implementations of activities, and clarification of concepts (Shulman, 1986). It would seem that teachers might need to increase their pedagogical content knowledge for effective inclusive practices (Williamson McDiarmid & Clevenger-Bright, 2008).

The provision of teaching resources is essential for developing mathematical proficiency for all students (NCTM, 2000). In particular, VI students may access the curriculum providing that teachers facilitate the use of large prints, braille materials, voice recorders, and tactile graphs (Ives & Pringle, 2013). Teachers often complained of restricted commercially designed materials for teaching. Although this may give teachers the opportunity to design and produce their own materials, they might be unwilling to meet these demands (Buhagiari & Tanti, 2011). Teachers may think that they have limited time and knowledge for the preparation of such teaching materials (Bishop, 1996; Mastropieri & Scruggs, 1996). In addition, they might have difficulty in identifying and adapting materials to the needs of learners (Avramidis, Bayliss, & Burden, 2000; Rosenblum & Herzberg, 2011). Moreover, teachers may not be fully aware of adaptive technologies and internet resources for overcoming existing barriers in teaching VI students (Kohanova, 2007). Studies have reported that teachers have difficulty in using technological materials in their courses because of flawed and inadequate information (Çakıroğlu, Güven, & Akkan, 2008). Thus, they may not give due importance to adapting materials to meet students' individual

needs (Whitburn, 2014). Instead, they may avoid using technology (Borko & Putnam, 1996).

Restricted knowledge about assessment might be another reason for teachers' inadequate preparedness for inclusion regarding the present study. Assessment can be defined as an ongoing process that includes gathering and analyzing information about the teaching process to develop students' progress (MoNE, 2010). The roles of teachers in assessment are designing and implementing appropriate differentiated assessment tools to enable all students to demonstrate what they can do and know (Wolniak, Davis, Woo, & Simic, 2014). However, in practice, teachers may tend to just use accustomed written examination tools that provide limited information about student performance (Gelbal & Kelecioğlu, 2007). Knowledge, skills, and time are required to accommodate differentiated assessment practices (Gelbal & Kelecioğlu, 2007). Moreover, teachers need to check the appropriateness of the visual parts of assessment tools (European Agency for Development in Special Needs Education, 2010). However, teachers can be unwilling to evaluate VI students' mathematics performance (Durna, 2012) owing to their busyness. Teachers cannot know or experience how to organize the examination process, including the selection of experienced readers, time length, and location order (Bayram et al., 2015). Furthermore, teachers might tend to ask simple exam questions with a limited scope. This can result from the segregationist idea that "VI students cannot study mathematics because of their disability" (Moreira & Manrique, 2014).

Another explanation for the lack of preparedness of mathematics teachers is the lack of training in the implementation of inclusions. Inclusive education requires intensive

training (Thawala, 2015). Through specific in-service training, teachers can raise their awareness and empower themselves with required knowledge, skills, and competencies for inclusive classes (Oswald, 2007). However, teachers may not be adequately trained to teach an inclusive class (Gün & Gürbüz, 2016). Therefore, they may not have experience of teaching learners with a range of diverse needs (Engelbrecht, Oswald, & Forlin, 2006).

Some teachers' beliefs regarding including/placing VI students in their classrooms are negative, although many of them think that inclusive education is required.

Not all teachers may sympathize with the implementation of inclusive education (Florian & Linklater, 2010). Teachers often believe that "Inclusion provides some socialization benefits but no real educational benefits" (DeSimone & Parmar, 2006).

A lack of time might have been one of the factors that made teachers worried about including VI students in their classrooms (Westwood & Graham, 2000). Teachers might agree that they have to take time to prepare their lessons, assess, and evaluate their students' performance according to objectives included in the curriculum (European Agency for Development in Special Needs Education, 2010). Their regular duties require plenty of time, so they might not want to cater for learners who need extra support (Han, Kohara, Yano, & Aoki, 2013). However, many educators might feel pressure to manage their time in planning their work appropriately in inclusive classrooms (Winter, 2006). In addition, teachers might agree that in an inclusive classroom, they need to devote the majority of their time to learners who have special educational needs (Naicker, 2008). Some teachers may be concerned

that allocated time for VI students, especially those in large classes, might be limited (Westwood & Graham 2000). Therefore, they may not reserve time for them, and some learners may be neglected in this learning period (Thawala, 2015). Thus, it may be concluded that many teachers do not take responsibility for teaching their students in inclusive classrooms (Maguvhe, 2015).

Difficulties in the implementation of the curriculum and poor performance of students might have been factors that established teachers' negative attitudes toward inclusive education (Parasuram, 2006). Teachers may agree that a rigid curriculum can cause difficulties, such as completing the syllabus for all learners (Duru & Korkmaz, 2010; Van Reusen, 2001). Finishing syllabi on time can place pressure on teachers to use inappropriate methods for VI students (Lewis & Little, 2007). Teachers may also feel pressure not to cover all concepts in the curriculum (Lewis & Little, 2007) because of visually based concepts (Bülbül, Garip, Cansu, & Demirtaş, 2012). In addition, teachers may think that the curriculum content is overly intensive for implementation in inclusive classrooms (Gün & Gürbüz, 2016) because the majority of teachers may assert that VI students' competencies are not sufficient for proficiency in mathematics (Scleppenbach, 1997). They may suppose that VI students might not have the same cognitive capacity as sighted learners (Kumar, Ramasamy, & Stefanich, 2001). Therefore, they might believe that VI students have difficulty in comprehending the abstract nature of mathematical concepts (Agrawal, 2004). However, studies show that VI students can successfully study mathematics through providing thinking systematically, using appropriate materials, and instruction (Agrawal, 2004; Buhagiari & Tanti, 2011; Jackson, 2002).

Inadequate teacher preparation might have been another factor causing teachers' concerns about inclusive education (Jung, 2007). Teachers may become less receptive to the idea of including a VI student in their classroom since they do not have specialized knowledge and skills to cater for diversity (Jordan, Schwartz, & McGhie-Richmond, 2009). Having limited knowledge and experience can be further compounded by the fact that mathematics teachers have not received education to teach in inclusive classrooms (Van Zyl, 2002). Teachers who have never taught math to VI students may feel anxiety and less confidence (Thawala, 2015) once they encounter a VI student in their classroom. Teachers' lack of training in teaching in inclusive classrooms is an obstacle that might make teachers feel more stressed and incompetent (Hay, Smit, & Paulsen, 2001; Yada & Savolainen, 2017). Therefore, teachers may tend to reject VI students more often in their classrooms (De Boer, Pijil, & Minnaert, 2011).

Another reason that explains this finding is teachers' confidence in applying inclusive education practices (Yada & Savolainen, 2017). If teachers have low confidence in teaching inclusive students, they might exhibit more negative attitudes (Yada & Savolainen, 2017). Conversely, if teachers believe themselves to be more capable of practicing inclusive education, they might be less worried about including inclusive students in their classrooms (Malinen, Savolainen, & Xu, 2012). Teachers' low confidence can result from teachers' inadequate training in inclusive practices (Yada & Savolainen, 2017) and teachers' feelings of preparedness (Darling-Hammond, Chung, & Frelow, 2002). Untrained teachers know that they have imperfect knowledge about the implementation of inclusion; however, they might not make an individual effort to prepare themselves (Gün & Gürbüz, 2016). Therefore,

this situation might indicate teachers' unawareness of inclusive education practices (Babaoğlan & Yılmaz, 2010; Moreira & Manrique, 2014).

The finding with respect to teachers' concerns about placing VI students in their classrooms can be explained by a lack of emotional readiness (Moreira & Manrique, 2014). Teachers who lack personal experience with disabled students can be less receptive of the presence of VI students in their classes (Croll & Moses, 2000) because dealing with students with impairments can oblige teachers to confront their fears of such students (Forlin, 2001). Thus, teachers' concerns about interacting with impaired students might be triggered (Croll & Moses, 2000). Limited knowledge about disabilities may make teachers feel insecure (Frankel, 2004). Teachers may agree that being held responsible for students' lack of adaptation is a distressing predicament (Margolis & McCabe, 2003). Therefore, teachers may refuse to take responsibility for the demands of inclusive practices (Berry, 2010).

Teachers who expand their perspectives with broad teaching experiences indicate a willingness to teach mathematics to VI students effectively.

The finding related to these teachers' willingness to teach mathematics to VI students effectively can be explained by their confidence (Yada & Savolainen, 2017) because they have high confidence in mastering the implementation of effective teaching practices (Gibson & Dembo, 1984; Hoy, 2000). Through direct and indirect experience, teachers can persuade themselves to believe that they have the capability to succeed (Gibson & Dembo, 1984); thus, teachers may change their perspective with the idea "if others can do it, I can too" and reflect this in their implementations. Teachers who believe in their own capability may show a desire to acquire

knowledge and gain experience under new circumstances. They can take on their teaching responsibilities by showing patience and persist longer when dealing with challenges (Gibson & Dembo, 1984). It is evident that Kerem, Gizem, and Ceren were willing to invest effort in their teaching practices for VI students to provide a rich learning environment.

Another explanation of the teachers' willingness to teach mathematics to VI students is their perception of teaching as a profession. Teachers who have a professional approach to teaching might offer students high-quality mathematics education (NCTM, 2000). They might believe that a major role of teachers is taking responsibility for all students so that they can obtain access to mathematics. As in the cases of Kerem and Ceren, the teachers' views show that student diversity is an opportunity for them to learn how to develop their academic and social skills for the benefit of all learners (Lakkala, Uusiautti, & Määttä, 2016).

Implications for practice

Based on the results of this study, I believe that Turkish high school mathematics teachers who teach VI students need to improve their pedagogical and pedagogical content knowledge and skills to create and maintain positive attitudes toward inclusive education. I believe that teachers should pay attention to widening their perspectives by opening themselves up to working with students with diverse needs. There is a need to internalize the equity principle, which requires that teachers support all students. Therefore, teachers should increase their awareness, teaching enthusiasm, and confidence in teaching mathematics. Therefore, it is necessary for mathematics teachers to take responsibility for their own professional growth.

Instructional need-specific professional development activities might help the teachers to become more receptive to the idea that "Mathematics can be learned by all students."

I believe that changing teachers' beliefs about VI students in inclusive classrooms from negative to positive cannot happen on its own. Policymakers should provide sufficient teaching and learning resources, guidance, and in-service education for teachers. However, I have realized that there might be a gap between the policy concerning how inclusive education should be implemented in schools and what schools are actually implementing. I believe that policymakers should encourage teachers to collaborate with special education teachers to decrease challenges in teaching VI students mathematics.

Implications for future research

I suggest that future researchers should focus on resources regarding teaching and learning mathematics for VI students. These researchers could analyze the existence of challenges about the adaptation of materials. The impact of collaboration with special education teachers and special education professionals' perceptions also need to be investigated.

Limitations

First, few teachers agreed to participate in the research study. I had difficulties reaching these teachers because there are few VI students in high schools. Therefore, the data was derived from just eight mathematics teachers who have teaching experience with VI students. I formed a better understanding of the situation by

meeting with different mathematics teachers who had two and three hours of tutoring experience. Such a small sample might limit the generalizability of the results.

Second, I could observe just one class to understand a regular school environment. Because of the sensitivity of the subject, the school administrators did not give me permission to observe teachers and VI students in their regular classroom environment.

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APPENDICES

APPENDIX A: Informed consent form

The study, conducted by Gamze Baykaldı; a graduate student in Bilkent University, is about exploring the challenges of mathematics teachers while teaching high school mathematics for visually impaired students. The interviews are the major part of this study and I accept to be one of the participants to be conducted these interviews. I will help the researcher to collect information, to complete the requirements, and respond the interview questions for her thesis voluntarily. I understand that there will be no sanctions for my answers positively or negatively. The researcher will reserve my rights including my name, my answers, and my suggestions by keeping the content confidential. The interviews will be conducted face-to-face. A tape recorder will be used during the interviews for a recall for the interview information, and only the researcher will have a right to access this information. I have a choice to stop the interviews, to ask questions during and after interviews, refuse to answer questions, and there will be no sanction in the end.

I give my permission to be quoted in Gamze Baykaldı's research publication.

_____ _____

Signature of subject **Date**

_____ _____

Gamze Baykaldı **Date**

Bilkent University

APPENDIX B: Interview questions

Interviewee Background

How long have you been working as a mathematics teacher?

How many visually impaired students have you had during your career? How many year did you work with each one?

What is your education background? Briefly explain.

Have you ever taken a course regarding inclusive education during your university education?

Did you attend in-service educations for inclusive education? Could you mention about aspects of this in-service education, and strong and weak sides?

Teaching and Learning Principle

What sort of preperations do you make before a lesson in the class including visually impaired student/s?

Is the any exclusive methods, sources, materials you use?

What do you think about your teaching experiences with visually impaired sudents?

According to your knowledge and teaching, what should be done? Do you feel that you are qualified enough in special teaching methods to satisfy visually impaired students' needs about this special situation?

Have you ever had difficulty in teaching with visually impaired students? What are the challenges that you face with as a result?

How do you prepare materials for your visually impaired students' understanding? Do these materials helpful for you? Which activities do you chose and how they are helpful for your teaching?

What do you think about reading and teaching the mathematical symbols? How do you encourage your visually impaired students to solve the mathematical problems?

Do you use technology during teaching mathematics in your classroom? If you do so, do you evaluate the appropriateness of these technologies for visually impaired students?

Evaluation and Assessment

What kind of requirements do your students and you need in your examinations? Do you consider these as difficulties you confront?

Do you easily examine you visually impaired students' mathematics level?

Do you adress hard questions in order to enhance their analytical thinking and problem solving abilities up to their potential?

Inclusive Education

How do you evaluate inclusive education practices? Are they benefit for students with special educational needs?

Do you think that you are sufficientknowledge and ability to teach mathematics for visually impaired students in inclusive classrooms?

Do you think that equal conditions are provided between visually impaired students and sighted students? Would you like to evaluate your opinions by telling some incident you experienced or observed?

How does inclusive education affect visually impaired students academical success and their social progress?

Do you compare your communication wiyh visually impaired students against others?

Can you explain there are points you notice or have difficulty in?

APPENDIX C: A Photo of A3 paper