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ATTITUDES, BELIEFS AND CHALLENGES OF TURKISH
MATHEMATICS TEACHERS WHILE TEACHING
MATHEMATICS IN A SECOND LANGUAGE

A MASTER'S THESIS

BY

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THE PROGRAM OF CURRICULUM AND INSTRUCTION
İHSAN DOĐRAMACI BILKENT UNIVERSITY
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To My Mother



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A SECOND LANGUAGE

The Graduate School of Education

of

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Merve Yeşilkaya

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İHSAN DOĞRAMACI BILKENT UNIVERSITY
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May 2018

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.

Prof. Dr. Alipaşa AYAS (Supervisor)

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ABSTRACT

ATTITUDES, BELIEFS AND CHALLENGES OF TURKISH MATHEMATICS TEACHERS WHILE TEACHING MATHEMATICS IN A SECOND LANGUAGE

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Some high schools in Turkey provide medium of instruction in English. Mathematics, science and social science courses are taught in English in these schools. This study explored attitudes, beliefs and challenges of high school mathematics teachers who work in institutions where medium of instruction is in English. Furthermore, this study investigated difficulties students face with when they learn Math from Turkish teachers from these teachers' perspective. Eight private high schools located in Ankara, İstanbul and Erzurum where the medium of instruction is in English were selected as sample and 50 out of 72 teachers participated in the questionnaire from these schools. Of these, five teachers from three private schools located in Ankara were chosen in order to conduct the interview and lesson observations by purposeful sampling method in regards to their questionnaire results. This study utilized mixed-methods approaches. Results of this study were analyzed using descriptive statistics and qualitative data analysis methods. According to the findings of this study, a majority of Turkish mathematics

teachers have negative attitudes towards teaching mathematics lessons in English. According to the general results, some of the factors leading these teachers to have negative attitudes and beliefs are University Exam reality in Turkey, English background and proficiency of teachers, English proficiency of students, mathematics lessons being abstract in nature, students' lack of mathematical terminology knowledge and participation of the students in the lessons. According to the interview results, it was found out if the teachers have issues while teaching the lesson in English and the fact that teachers' preference of medium of instruction differed depending on the teachers' own English levels.

Key Words: Native or mother tongue, second language, education in a second language, immersion

ÖZET

TÜRK MATEMATİK ÖĞRETMENLERİNİN MATEMATİK DERSİNİN İKİNCİ DİLLE İŞLENMESİNE DAİR GÖRÜŞLERİ, TUTUMLARI VE DERSİ İKİNCİ BİR DİLLE ANLATIRKEN KARŞILAŞTIKLARI ZORLUKLAR

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Türkiye’de bulunan bazı liseler eğitimlerini ikinci bir dil kullanarak vermektedirler. Bu okullarda matematik, fen ve sosyal bilimler dersleri İngilizce olarak işlenmektedir. Bu çalışmada ikinci dilde eğitim veren liselerde çalışan matematik öğretmenlerinin matematik dersinin İngilizce işlenmesine karşı tutum ve görüşleri aynı zamanda matematik dersini İngilizce anlatırken karşılaştıkları sorunlar saptanmaya çalışılmıştır. Ayrıca, ders verdikleri öğrencilerin matematik dersi İngilizce işlenirken yaşadıkları zorluklar öğretmenlerin perspektifinden tespit edilmeye çalışılmıştır. Örneklem olarak Ankara, İstanbul ve Erzurum’da İngilizce dilde eğitim veren sekiz özel okul seçilmiştir. Araştırmada karma yöntem kullanılmıştır. Çalışmada uygulanan anket 72 öğretmene yöneltilmiş bunlar arasından 50 öğretmen ankete yanıt vermiştir. Uygulanan anketin sonuçlarına göre 5 tane matematik öğretmeni Ankara’da bulunan üç özel okuldaki amaçlı örnekleme

metodu kullanılarak ders gözlemlerine ve mülakatlara katılmak üzere seçilmiştir. Verilerin analizi betimsel istatistik ve nitel veri analizi yöntemleri ile yapılmıştır. Sonuçlara göre, öğretmenlerin çoğunluğunun matematik derslerinin ikinci bir dilde anlatılmasına karşı negatif bir tutuma sahip oldukları görülmüştür. Araştırmanın genel sonuçlarına göre, öğretmenlerin negatif tutuma sahip olmalarının başında gelen faktörler: Türkiye’de Üniversite Sınavı gerçeği, öğretmenin kendi İngilizce seviyesi, öğrencinin İngilizce seviyesi, matematiğin soyut bir ders olması, öğrencilerin matematiksel yeterli matematiksel terminolojiye sahip olmamaları ve öğrencinin derse katılımı ve motivasyonudur. Ayrıca mülakat sonuçlarına göre öğretmenlerin dersi İngilizce anlatırken sorun yaşayıp yaşamadıkları ve dersi hangi dilde anlatmayı tercih ettiklerinin kendi İngilizce seviyelerine bağlı olarak değiştiği görülmüştür.

Anahtar Kelimeler: Anadil, ikinci dil, ikinci dilde eğitim, daldırma

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CHAPTER I: INTRODUCTION

Introduction

Education is the upward changes in knowledge, skills and understanding of individuals to survive and to take part in society. In other words, education is the social processes that influence people's standards, beliefs and ways to fulfill requirements of society to be part of social life. Briefly, education can be defined as the process of developing and reinforcing desired behavior (Ergün, 2009). Education provides information to people on specific topics, teaches the system of values and influences individuals' beliefs. Education determines individuals' view of life from different aspects. Most importantly, education determines the profession and status of the individual in the community (Güleç, Çelik & Demirhan, 2013).

The importance of education and knowledge is rapidly increasing (Güleç, Çelik & Demirhan, 2013). If the level of education of a community is high, it is highly likely that it will contribute to that community's level of development. From this point of view, mathematics has a substantial importance in order to reach latest technological developments and desired living standards. Since without mathematics education, it is difficult to see improvements in science, economy and technology in a country (Ersoy, 2003). People encounter and need mathematics in every aspect of their daily lives. Counting, reading time, paying for shopping, measuring and weighing, making arithmetical calculations, understanding simple graphs and diagrams are among the basic concepts of mathematics. In order to keep pace with the new era, it is important to bring up individuals who are capable of high level thinking abilities, using

technology effectively and knowing one or more foreign languages (Işık, Çiltaş & Bekdemir, 2008).

The purpose of language learning differs from person to person, and sometimes language learning is regarded as a goal itself. Indeed, learning language is one of the main goals of the 21st century, and whole plan and program are trying to adapt to it. At this point, the problem related to education is how learning and achievement are affected if the subject is taught in another language. While learning a second language is more difficult, learning one's mother tongue occurs more naturally. According to Parlak's (2008) findings, some people think that learning a subject in a different language has many advantages, while others think it has some drawbacks. Among the 21st century skills, learning a second language has become an important issue for everyone including parents and children (Çelebi, 2006). Some parents think that their children will become better educated when they know another language. On the other hand, teachers may experience difficulties when teaching a subject in a second language. The purpose of this study is to further investigate the challenges and benefits of teaching and learning a subject, in particular mathematics, in a different language.

This chapter provides an overview of the study by presenting its background, the problem, the purpose, research questions and the significance.

Background

Lessons that are conducted in a second language are not a new concept in Turkey. In fact, the history of Turkey's promotion of second language education goes back to the Ottoman Empire.

Before the “Tanzimat” and “Islahat” movements, religious education was given in Arabic and Persian languages in order to use common language with neighbors of Ottoman Empire. After “Tanzimat” and “Islahat” movements in the 19th century, developments began related to education in a second language (Akyüz, 2001, p. 361). Robert College became the first school which was established by the Americans to instruct lessons in English in Istanbul in 1863. Thereafter, Galatasaray Lisesi was established in 1868 to provide education in a second language, which is French. Other than Turkish children going to foreign schools to learn a foreign language, Turkish Education Association (TED) was founded on January 31, 1928. Thereafter, this institution was called as TED College. TED started providing education in a second language, namely English in 1952 (Demircan, 1988). Teachers from abroad were hired to teach in these schools (Ozbay, 2008).

Educational Colleges (Maarif Kolejleri) were established in 1955. Educational Colleges provided foreign language education and also teachers started to teach mathematics and science lessons in English (Gok, 2009). Maarif Colleges constituted the foundation of Anatolian High Schools. Then, Anatolian high schools were opened in 1975 in order to provide quality education in English within state schools. Mathematics and science lessons were taught in English in these schools as in Maarif Colleges (Ozbay, 2008).

Students in such schools were studying only English in preparatory class throughout a year before starting the 9th grade in high school (Ozbay, 2008). When analyzing Anatolian high schools in terms of the second language education they provide, one important question can be highlighted. In preparatory classes, students are prepared to study in schools where the subject is taught in a language other than their native

tongue. Are preparatory classes sufficient for such kind of high schools, which necessarily teach lessons in a foreign language? According to Özbay (2008), lack of quality English teachers that could teach English in preparatory classes as well as complete or partial usage of mother-tongue in science and mathematics classes affected foreign language education in a negative way in the early 2000s.

Lack of proficient English teachers is, in fact, is a large obstacle for foreign language education. Based on their English levels, most mathematics teachers may encounter difficulties while teaching mathematics and explaining mathematical terms. Teachers' English proficiency is not sufficient for teaching Math and science lessons in a second language (Erdem & Morgil, 1992).

Teachers are not the only group that has difficulty while teaching the subject in a foreign language. In addition to teachers, most students have problems learning Mathematics in English due to language constraints. Karabulut (2001) states that according to the results of a survey conducted in some Anatolian high schools, 82.4% of the students in Anatolian High Schools prefer to study science courses in Turkish instead of English. Moreover, 89% of the students said that the main subjects were not understood well in English and 81.91% of participants claimed English instructions in science courses were directed towards memorization. That is why starting from 1990-1991 education year, due to the lack of well-equipped subject teachers who could teach mathematics, science and other courses in English, these lessons started to be instructed in Turkish (Ozbay, 2008). He also states that in 1997, Ministry of National Education abolished the requirement of teaching Mathematics, Physics, Chemistry and Biology courses a in second language in Anatolian High Schools.

Lately, there has been a growing concern regarding language use in general while teaching mathematics among mathematics teachers and educators (Muda et al., 2012). This concern stems mostly from teachers and students who are not proficient enough in English to teach and learn required terms and instructions in English. In order for a mathematics teacher to be qualified to provide classes in English, they should have professional development experiences in English and mathematics during their teacher preparation. In other words, a qualified mathematics teacher in foreign language education should know English and Mathematics well enough to combine them and instruct the course without having language problems (Köksal, 2007).

Problem

Students in Turkey placed in a qualified high schools according to their exam scores obtained from a nationwide exam. Oftentimes, students with higher scores are placed in better high schools where the lessons are conducted in a second language, most often in English. Most of the schools are starting to provide subject courses in English to students in Turkey. Therefore, students are starting to learn subject courses in English in 9th grade and they have difficulties about understanding of the lessons (Güneyli, 2012). When teachers are providing Mathematics in a second language, student learning may be compromised by their language levels or English background (Erdem & Morgil, 1992). Some difficulties about understanding mathematics terminology may cause students to develop negative attitudes toward Mathematics lesson. Moreover, teachers may encounter difficulties describing mathematics and mathematical terms depending on their English background (Köksal, 2002). Since Mathematics is a language of its own, teachers' lack of

proficiency may cause misconceptions in Mathematics lesson. Teachers' English proficiency is not sufficient for teaching Mathematics and Science lessons in a second language (Wilkinson, 2015).

Purpose

The purpose of this study is to investigate high school mathematics teachers' beliefs and attitudes towards teaching mathematics in a second language. Another consideration of this study is that examine challenges of the teachers when teaching mathematics courses in a foreign language. In addition to language barriers, they must also consider the learning needs of their students in this unique situation. Also, students who earn high scores in their lessons during their middle school years are often placed in high schools where the lessons are conducted in a foreign language, most often in English. For some students, this may be the first time they receive instruction in a language that is not their native tongue. The language that is used to convey mathematical ideas to students has become a topic of concern in recent years (Cuevas, 1984). Therefore, another purpose of this study is to investigate difficulties students face when they learn Math in English from Turkish teachers from their teachers' point of view.

Research questions

This study addressed the following research questions:

- What are the attitudes and beliefs of high school Turkish mathematics teachers towards teaching mathematics lessons in English?
- What type of challenges do Turkish Math teachers experience when they teach their courses in English?

- What type of challenges do students face when learning math in English from Turkish teachers based on teachers' perspective?

Significance

This study aims to understand and categorize the challenges encountered by teachers who teach Math in a second language. Explicitly, understanding the role of second language between students' language proficiency and teachers' language background is especially valuable for research and education. If these relationships are known, we can understand is the education in a second language supply to the expected qualifications for the students? Also, does this type of education reaches the educational goals in these schools where the lessons are conducted in English? This study will hopefully help to see advantages and disadvantages of teaching Math in English or the problematic areas in mathematics. Furthermore, investigating teachers in Math classes can help student-teachers like me and new teachers gain a different perspective in approaching students. If challenges are known better, necessary training can be provided for teachers who teach their lessons in second language.

Definition of key terms

Native or mother language: A type of language people speak from their birth and the language that is spoken predominantly in their birth country (Halliday, 1964).

Second language: A type of language people adopt alongside their native language (Mundsh, 2015).

Education in a second language: Providing courses in a foreign language completely or partially in a school. The purpose of it is having students learn to better the targeted foreign language. (Parlak, 2008).

Immersion: In the international literature, children from the same language and cultural environment are brought together in a classroom environment to teach their mother tongue and at the same time teaching lessons in a second language (Cummins, 1992).



CHAPTER 2: REVIEW OF RELATED LITERATURE

Introduction

In the 21st century, the importance of knowing at least one foreign language is a significant advantage for students (Çelebi, 2006). Thanks to this education, students will be trained according to the 21st century abilities and skills and they will have a valid profession. Parents and students prefer education in a second language because English has become the lingua franca of the world. Therefore, math, science and other courses are taught by Turkish teachers in English at some prestigious high schools in Turkey. However, two problematic issues arise regarding the medium of instruction being in English in institutions where predominantly Turkish teachers teach courses to Turkish students. The first problem is related to teacher competence. Do the teachers working in these schools have sufficient English proficiency to teach Math in English? Second problem is related to student competence. Can students understand these teachers' lessons properly? There are other questions that arise while teaching mathematics courses in English. Do students develop themselves during this process? If students are successful, what are the underlying reasons of students' achievement?

This chapter firstly includes a definition of second language education and education in a second language. Secondly, advantages and obstacles of education in a second language are presented. Finally, attitudes of students and teachers towards education in a second language from teachers' perspective are provided in relation to other studies.

Second language education vs. Education in a second language

Second language education is defined as learning a language which is different from native language. Thanks to second language education, individuals can experience the process of understanding, speaking and writing in another language fluently. The ability to communicate in a second language is becoming an essential skill in today's world (Mundsh, 2015, Singhal & Neas, 2011). Second language education gives opportunities to individuals to compare their own culture with another culture, and help individuals recognize other cultures (Dalkız, 2002).

Education in a second language is teaching some of the other courses in the curriculum (e.g. physics, chemistry, biology and mathematics) using foreign languages. All over the world, some high schools teach mathematics and science lessons wholly or partially in second languages. Similarly, in Turkey some high schools still continue teaching science and mathematics lessons in a second language (Tarhan, 2003).

Most of the researchers in Turkey state that, second language education and education in a second language are complementary elements to each other. However, researchers also report that these two concepts are different from each other, and they should not be confused (Akdoğan, 2005; Parlak, 2008).

Advantages of education in a second language

Since education in a second language is being rapidly combined into the educational field, its advantages are discussed among educators. When the advantages of education in a second language are taken into consideration, it is clear

that, advantages should be evaluated from different perspectives. It is reported that education in a second language enhances pedagogical development of students, provides easier access to foreign resources, increases success in international language exams, provides more job opportunities, enables acceptance from graduate programs from high quality universities and students can work abroad (Güneyli, 2012; Kolaç, 2008). According to Kilimci (1998), positive outcomes of the contributions of education in a second language provide interactions among nations. In literature, most of the studies report that education in a second language provides better quality of instruction than native language education (Casal, 2006; Ibrahim, 2009; Wode, 1999).

Obstacles to education in a second language

Although positive views about education in a second language are more likely to be highlighted, there are a lot of problems that occur during the lessons when Turkish teachers teach their lessons in English. One of the common problems related to education in a second language is that students cannot learn science lessons such as physics, chemistry, mathematics, biology when these lessons are taught in English at an anticipated or expected level (Köksal, 2002).

According to Güneyli (2012), instead of teaching lessons in a second language, it is necessary to make foreign language education qualified. Similarly, Dalkız (2002) states that, instead of teaching lessons in a second language, in English lessons English teachers can teach the course on a subject-area basis and teach terms related to mathematics, science or social science according to English curriculum.

According to Kilimci's (1998) and Büyükduman's (2001) findings, it is impossible to conduct quality education in a second language in our country due to limited

conditions, insufficient resources and inadequate English background of teachers. Kilimci and Büyükduman's findings are supported by other researchers in that teachers do not have enough English level in Turkey in order to teach math and science courses in English (Büyükduman, 2001; Çelebi, 2006; Erdem & Morgil, 1992; Güneyli, 2012). As a result, high schools which teach lessons in a second language must be rigorous while selecting their teachers (Erdem & Morgil, 1992). Another problem is that preparatory classes are not sufficient in high schools, which necessarily teach lessons in a foreign language (Özbay, 2008; Ülper, 2006). Since there are important exams which determine students' future, students generally focus on exams. Most of the researchers state that, in Turkey students are not interested in foreign language at high school because of their preparation for university entrance exams (Çetintaş & Genç, 2001; Mirici, 2000; Parlak, 2008).

Attitudes, beliefs and challenges of teachers towards education in a second language

Kilickaya (2006) examined the instructors' attitudes towards English-medium instruction in Turkey. According to the results of this attitude questionnaire, Turkish instructors tended to teach lessons in Turkish. Moreover, instructors stated that students were learning better when they were taught lessons in Turkish.

Köksal (2002) claims, according to teachers, education in English is not possible unless students are proficient in English. Even students who had high level of English proficiency quit listening when they encountered different technical terms related to the topic. Students who passed the preparatory class did not understand the course in English if there was a lack of technical terms related to subject areas. At the end of the course, these students wanted the teacher to summarize the whole

subject in Turkish (Erkan & Baloğlu, 1998). Besides, due to the fact that foreign language is not well learned in middle school or preparatory class, it is difficult to learn science and mathematics courses in English (Erkan & Baloğlu, 1998).

According to Cuevas' (1984) findings, mathematics teachers could not convey knowledge properly by using important key terms to students and this situation paved the way to misconceptions in students' mind. Also, teachers believe that students should learn technical terms related to their lessons in the preparatory class. Otherwise, students do not understand the subjects and they fall behind compared to the other students who receive their education in Turkish (Ozbay, 2008).

Attitudes, beliefs and challenges of students towards education in a second language

In literature, researchers have investigated the attitudes, beliefs and challenges of students towards education in a second language in classes. According to questionnaire results implemented on high school students who are instructed in French, English or German, these students could not understand science and mathematics lessons in a second language compared to their native language (Erdem & Morgil 1992).

Karabulut (2001) states that according to the results of a survey conducted in some Anatolian high schools, 82.4% of the students in Anatolian High Schools prefer to study science courses in Turkish instead of English. Moreover, 83.9% of the students said that the main subjects were not understood well in English and 81.91% of participants claimed English instructions in science courses were directed towards memorization. Because of education in a second language, students lean towards memorization (Güneyli, 2012; Karabulut, 2001; Köksal, 2002).

Dalkız (2002) conducted research in order to learn what type of challenges students face when learning from Turkish teachers who teach Chemistry in English at high schools. According to Dalkız (2002), teaching in a foreign language caused inefficient learning. The achievement tests conducted showed that students who were taught in a second language had lower success than the students who were taught in their native language.

Sert (2000) claims that, students cannot think critically, which means that they cannot ask questions to teachers, or they do not want to participate in the lessons because of their English proficiency and they have difficulty when taking notes.

In Turkey most of the students prefer education in English in order to have a better profession in the future (Aktuna & Dogancay, 1998; Sebüktekin, 1981). However, some research suggests that students want to learn lessons in their mother tongue and also when the mother tongue was used in teaching, learning became easier and the expected efficiency was increased (Güneyli, 2012; Ozbay, 2008).

Mathematics teaching in a second language

Some students do not have sufficient English background. Therefore, students do not understand the Math problems because of their English inadequacy (Cuevas,1984). Also, Çelebi (2006) claims that when teachers teach Mathematics in English, students listen in a passive manner. When the same topic is repeated in Turkish, students understand the topic clearly and they participate in the lesson more. Students who do not know the language properly cannot ask questions, cannot argue and they do not want to participate in the lesson.

According to Aiken (1972), verbal factors are very important for Mathematics teaching and learning. Since Math is a language of its own, teachers' lack of

proficiency may cause misconceptions in Math (Cuevas, 1984).

The study of Cuevas and Llabre (1981) demonstrates that when mathematics exams are not prepared in students' mother tongue, this situation can lead to some problems related to validity and reliability. Some students are not able to solve questions because they do not understand the questions in a second language rather than students' lack of mathematics knowledge (Erdem & Morgil, 1992).

Summary

This literature review provided definitions of education in a second language and its possible effects in relation to integrating second language into education. Previous studies in literature show that second language in education has both advantages and disadvantages in many perspectives. According to the results of the studies, some of them show that learning a subject in a language other than native one has a lot of advantages, others demonstrate that this type of education has a lot of drawbacks. Some of them claim that, students cannot understand science and mathematics lessons in a second language compared to their native language. Some researchers claim that, preparatory classes have substantial importance for students. During this process, teachers should teach terminology related to mathematics and science as well as English. According to research results, even students who have high level English proficiency, when they encounter different technical terms related to mathematics and science, they will stop listening. This situation can cause misconceptions related to mathematical terms in students' mind. At the end of the course students want the teacher summarize the whole subject in Turkish.

Education in English would not be possible unless students were proficient in English. Students should have English background from high school or middle school. They should have sufficient English level in order to understand math and

science lessons in English. Students who earn high scores in mathematics during their middle school years are often placed in high schools where the lessons are conducted in a foreign language, most often English. According to research results, these high schools do not give sufficient education for these students. However, most of the students demonstrate same performance in University Entrance Exam and they placed at better qualified universities. In this situation, we should examine the underlying reasons of these students' achievement. These high schools which given lessons in second language do not behave rigorous in selecting their teachers. Teachers are not well equipped to teach math and science lessons in English. Teachers face difficulties describing mathematics and mathematical terms depending on their English background. Teachers are not well-equip with language skill to raise their students' achievement. Similarly, resources which used in these schools are not enough to raise the students' achievements in terms of quality and quantity. According to results of other researches, teachers experience problems related to their English background. This study will examine difficulties when Turkish Math teachers describing mathematics and mathematical terms depending on their English background. Also, this research will examine what type of challenges do Turkish Math teachers experience when they teach their courses in English.

CHAPTER 3: METHOD

Introduction

This chapter starts with an explanation of the research design. Thereafter, it provides information about context, participants and instrumentation. At the end of this part, data analysis procedures and data collection technique is presented.

This study addressed the following research questions:

- What are the attitudes and beliefs of high school Turkish mathematics teachers towards teaching mathematics lessons in English?
- What type of challenges do Turkish Math teachers experience when they teach their courses in English?
- What type of challenges do students face when learning math in English from Turkish teachers based on teachers' perspective?

Research design

One purpose of this study is to explore high school mathematics teachers' beliefs, attitudes and challenges of mathematics teachers towards teaching mathematics in a second language. Another purpose of this study is to investigate difficulties students face when they learn Math as presented by their teachers' perspective. In this research, mixed- methods approach used with an embedded design.

Mixed methods research

According to Creswell (1999), mixed methods research integrates essential features of quantitative and qualitative research in order to increase the width and depth of understanding and confirmation. Fundamentally, mixed methods research provides

more detailed evidence for studying a research problem and helps answer questions that cannot be answered by qualitative or quantitative approaches alone (Creswell & Clark, 2007; Sert, 2008).

About the study

Firstly, the attitudes, beliefs and challenges of the high school Turkish mathematics teachers towards mathematics education in English were measured with an attitude questionnaire. This questionnaire consisted of items which were composed to determine teachers' English language background and most challenging situations these teachers encountered during mathematics lessons when they teach the course in a second language. This quantitative data were complemented by qualitative data involving classroom observations and interviews with Turkish mathematics teachers who are teaching in selected private schools where the medium of instruction is in English. Observations were used to explore what type of challenges Turkish Math teachers experience during mathematics lessons when they teach their courses in English compared to when they do not. Interviews with Turkish mathematics teachers were conducted to explore additional information about beliefs, opinions, attitudes and challenges of teachers towards mathematics teaching in English. Also, interviews investigated the most challenging situations for teachers and students during mathematics lessons when the lessons were instructed in English.

Context

In order to conduct this research, the particular content was chosen in which participants had detailed opinions about the research questions. Therefore, the study was carried out in eight private high schools located in Ankara, İstanbul and Erzurum where medium of instruction is in English. Each letter represents the name of the

schools (A, B, C, D, E, F, G, H). The main point about context is that, these eight private high schools conduct mathematics lessons in a second language.

Participants

This study was implemented on mathematics teachers from eight private high schools located in Ankara, İstanbul and Erzurum. Teachers who participated in this study were purposively selected from the mathematics departments and chosen according to the willingness of the teachers. Five teachers from three private schools located in Ankara were chosen in regards to their questionnaire results. In this way, participants who have detailed information about the research questions were selected. According to Creswell and Clark (2007), thanks to purposeful sampling it is possible to select participants who have sufficient information related to fundamental facts and major issues.

Since this study was limited by the number of private high schools in Ankara, İstanbul and Erzurum, mathematics teachers from each of the eight high schools were chosen. The number of teachers who completed the questionnaire is 50. Questionnaires were sent to the totally 72 mathematics teachers but only 50 of them completed the questionnaire. This means 69.4% of the teachers participated in the research. Questionnaires were sent to teachers in different cities via Google docs. In order to supply additional intuition, interviews were conducted with five of mathematics teachers from selected schools. Quantitative data were complemented by interviews and also classroom observations of the mathematics classrooms from different schools in Ankara. One lesson of each mathematics teacher was observed in different schools. The number of classes that were observed is five. Both observations and interviews were conducted with the same five teachers. The

distributions of the teachers who participated in the study according to schools are summarized in Table 1.



Table 1
The total number of participants in different schools

Name of the school	Cities	Questionnaire Sample	Interview-Observation Sample
A	Ankara	13	1
B	İstanbul	1	-
C	Ankara	8	3
D	Erzurum	1	-
E	Ankara	9	1
F	Ankara	4	-
G	Ankara	8	-
H	İstanbul	6	-
Total	-	50	5

Demographic data

The demographic data about the teachers were collected from the personal information part of the interviews. It was categorized for the following demographic features: school, teaching experience, language background, teaching language and preferred teaching language.

Table 2
Background information of teachers

	School	Experience	E.I.	H.L.	U.L.	W.L.	P.L
T1	C	13 years	13 years	English	English	English	English
T2	C	18 years	3 years	Turkish	English	English	Turkish+English
T3	A	10 years	7 years	Turkish	Turkish	Turkish+English	Turkish
T4	C	11 years	11 years	English	English	English	English
T5	E	12 years	10 years	Turkish	Turkish	Turkish+English	Turkish

E.I: Years of experience at the school in which the teacher works

H.L: In which language the teacher learned maths in high school

U.L: In which language the teacher learned maths in university

W.L: In which language the teacher teaches the lesson at the institution they work

P.L: Preferred teaching language of the teacher

Three of the teachers (T1, T2 and T4) who participated in the interviews work in School C, one of them (T3) works in School A and the other one (T5) is from School E. Generally, participants' teaching experience is over 10 years. Their experience at the institution they are currently working at varies between at least 3 years and at most 13 years. Three of the participants learned mathematics in high school in Turkish while others learned in English. Also, while three of the participants completed their university level mathematics education in English, others studied Math in Turkish. At the institution they are currently working at, three of the teachers teach mathematics lessons in English whereas the other two teach the lessons in Turkish.

Instrumentation

The instruments for this study consisted of:

- Questionnaire
- Interview
- Observation

Questionnaire

In this study, an attitude questionnaire was used in order to analyze high school teachers' attitudes and challenges towards mathematics education in English. Kılıçkaya (2006) developed the original questionnaire "Instructors' attitudes towards English-medium instruction in Turkey" to explore attitudes, beliefs and challenges of instructors as regards the English-medium of instruction in Turkey. The original questionnaire was adapted by the researcher, making necessary pronoun changes according to mathematics teachers.

The questionnaire (see Appendix B) includes 25 items with five point Likert-scales: always (5), frequently (4), half the time (3), sometimes (2), never (1) and an open-

ended question. The questionnaire consisted of items which were chosen to determine teachers' English language background and the most challenging situations for teachers during mathematics lessons when they teach the course in a second language. Questionnaires were sent to teachers who work in selected private high schools in scope of the research in different cities via Google docs.

There are 26 items in total in the questionnaire which consists of six sub-sections: positive attitudes towards teaching mathematics lessons in Turkish (4 items), attitudes in terms of resources, government support, status of the Turkish language in society (5 items), the impact of the parents on the students' language choice (1 item), attitudes towards teaching mathematics lesson by mixing English and Turkish (3 items), negative attitudes towards teaching mathematics in English in different context (5 items), from teachers' perspective type of challenges students face when learning from Turkish teachers who teach Math in English (7 items). There is an open-ended question in the questionnaire about beliefs, attitudes and challenges teaching mathematics in English in Turkey. Suggestions, alternatives and beliefs of math teachers provided in the open-ended question were examined separately from other questions in the questionnaire.

Below, Table 3 shows the distribution of the questionnaire's items and their dimensions.

Table 3
Questionnaire items and dimensions

Dimensions	Questionnaire Items
Teachers' positive attitudes towards teaching mathematics lessons in Turkish	2, 3, 4, 5
Teachers' attitudes in terms of resources, government support, status of the Turkish language in society	10, 11, 12, 13, 22
The impact of the parents on the students' language choice	15
Teachers' attitudes towards teaching mathematics lesson by mixing English and Turkish	23, 24, 25
Teachers' negative attitudes towards teaching mathematics in English in different context	6, 7, 8, 9, 17
From teachers' perspective type of challenges do students face when learning from Turkish teachers who teach Math in English	1, 14, 16, 18, 19, 20, 21

Interview

Interviews with Turkish mathematics teachers were implemented to investigate teachers' beliefs, opinions, challenges and attitudes towards conducting mathematics education in English. Structured interview protocol was used in order to supply additional intuition (see Appendix C). Also, interviews were used to investigate the most challenging situations for teachers during mathematics lessons when they teach mathematics in English. In order to allow teachers to express their opinions freely, open ended questions were used. The interview consists of 14 questions in total, exploring teachers' opinions about teaching mathematics lessons in English, the most common problems when they teach their lessons in English and general background information about the teachers. Interview questions were developed by the researcher by taking the experts opinions. Interviews were conducted with five of the mathematics teachers from selected schools. Questions were directed to participants in Turkish and participants answered all questions in Turkish. During the interviews, responses of the participants were recorded with a voice recorder. Thereafter, responses of the participants were translated into English by the researcher.

Observations

In addition to the interview questions, thanks to classroom observations quantitative data was complemented with the five mathematics classrooms from selected schools. Observations were used in order to explore what type of challenges Turkish mathematics teachers experience during mathematics class when they teach their courses in English or when they teach the course in Turkish. In line with this purpose, researcher developed a semi-structured observation form by taking expert opinions and a wide spread literature review (see Appendix D). Researcher made

observations according to items in observation chart. In total, five different mathematics teachers and five mathematics lessons were observed by the researcher. The questions in the chart basically focused on the teachers' common challenges, behaviors and problems which are related to teaching mathematics in a second language.

Method of data collection

The data collection process consisted of three steps.

The first step began with the preparation of the instruments to be used collection of the data. This step took place in June and July of 2017. Interview questions and observation chart were prepared at the end of the detailed literature review and also taking by expert opinions.

The second step was to obtain permission from the Ministry of National Education. The process of obtain permission from the MoNE took place in September 2017. Ministry of National Education sent an official letter to the schools that indicated their permission of my study.

The last step started in the September 2017 with data collection. The researcher visited all of the participating schools in Ankara. In these schools, data were collected via face to face interactions. However, questionnaires were sent to teachers in different cities via Google docs. In order to examine high school teachers' beliefs, challenges and attitudes towards mathematics education in a second language, a questionnaire was administered to 50 mathematics teachers who are teaching in selected private high schools in September 2017.

Interviews conducted with voluntary teachers who are teaching mathematics in a second language. The researcher conducted interviews with five mathematics

teachers from different high schools in scope of research in Ankara in November 2017. Interviews with each teacher took approximately 15-30 minutes. Participants' responses were recorded on a voice recorder. Teachers' consent was asked for recording the interviews.

Classroom observations started in December 2017 with observations of the mathematics classrooms from selected schools in Ankara. One lesson of five mathematics teachers was observed in different schools. Therefore, in total, five different teachers and five different mathematics lessons were observed. Both observations and interviews were conducted with the same five teachers.

Method of data analysis

The collected data is both quantitative and qualitative in its nature. Thus, data analyses were conducted in regards to the steps of both quantitative and qualitative research methods.

Quantitative data analysis

Quantitative data in this research came from the questionnaire. Statistical Package for the Social Sciences (SPSS) was used to analyse the data with descriptive statistics. All the Likert-scale items consisted of a 5-point scale: always (5), frequently (4), half the time (3), sometimes (2) and never (1). Means and standard deviations of each question were calculated separately. SPSS enabled the researcher to derive proportions which represent the data.

Qualitative data analysis

Qualitative data was derived using structured interviews and semis-structured observations. According to Miles, Huberman and Saldana (2013), observation or interview analysis consists of two steps. Firstly, collected data is transcribed, and

then preliminary analysis of the data takes place. Thereafter, according to common responses, research questions and key concepts are collected and the data is grouped. Miles, Huberman and Saldana (2013) call this procedure as coding.

In this research, firstly, interviews and classroom observations were transcribed. Then interviews were analyzed after classifying the mutual answers of the participants. In accordance with the principle of confidentiality, the teachers who participated in the interviews and observations were coded as T1, T2, T3, T4 and T5.

A checklist was used in order to analyze classroom observations. According to behaviors and attitudes of the teachers during the lesson, the data were grouped.

CHAPTER 4: RESULTS

Introduction

This chapter presents the findings of the data analysis which were obtained from questionnaires, interviews and classroom observations. The findings of the questionnaire, interviews and observations were analysed by dividing research questions into sub-sections. Then the analysis of interviews and observations are respectively presented so as to complete this quantitative data.

Findings of the study

The results were obtained from the analysis of collected data according to three research questions, which were related to attitudes, beliefs and challenges of math teachers towards teaching math in a second language. At the beginning of the study, questionnaires were shared with all of the participants via Google docs. These quantitative data were complemented with the interviews in the second part of the study. For the third part, classroom observations were conducted in order to support teachers' attitudes, beliefs and challenges.

Research Question 1: Attitudes and challenges of high school Turkish mathematics teachers towards teaching mathematics lessons in English

According to the answers of the teachers given to the questionnaire, attitudes and beliefs of these teachers towards teaching mathematics in English were categorized under four sub-sections.

- Teachers' attitudes and beliefs towards teaching mathematics lessons in Turkish instead of English
- Teachers' attitudes and beliefs in terms of resources, government support, status of the Turkish language in society and the language policy
- From teachers' perspective, the impact of the parents on the students' language choice
- Teachers' attitudes and beliefs towards teaching mathematics lessons by mixing English and Turkish

There is an open-ended question in the questionnaire about beliefs, suggestions and alternatives of teaching mathematics in English in Turkey. 50 mathematics teachers participated in the questionnaire, but only 41 of those responded to the open-ended question in the questionnaire. Answers of the teachers were examined into four sub-sections.

- Math lessons should be taught in mother-tongue, namely in Turkish
- Math lessons should be taught in second language, namely in English
- Math lessons should be taught by mixing English and Turkish
- Both languages have the same effect on mathematics education

Below, Table 4 shows the distribution of preferred teaching language of the participants according to answers given to the open-ended question.

Table 4

Distribution of preferred teaching language of the participants according to the answers given to the open-ended question

Preferred Teaching Language					
Codes of Schools	Turkish	English	Turkish and English	Both are the same	Unanswered
A	5	-	6	1	1
B	-	-	1	-	-
C	-	5	1	-	2
D	-	-	1	-	-
E	3	-	3	-	3
F	3	1	-	-	-
G	3	-	2	-	3
H	-	4	1	1	-
TOTAL	14	10	15	2	9

Teachers' attitudes towards teaching mathematics lessons in Turkish instead of English

Teachers' attitudes towards teaching mathematics lessons in Turkish on the ground of being more useful than teaching mathematics lessons in English were investigated with four of the questions (2, 3, 4 and 5) in the questionnaire. Table 5 shows the results for this point.

Table 5
Teachers' attitudes towards teaching mathematics lessons in Turkish instead of English

		N	S	HTT	F	A	Mean	SD
Q2	f	3	8	7	11	21	3.78	1.31
	%	6.0	16.0	14.0	22.0	42.0		
Q3	f	8	10	4	15	13	3.30	1.46
	%	16.0	20.0	8.0	30.0	26.0		
Q4	f	11	5	6	13	15	3.32	1.54
	%	22.0	10.0	12.0	26.0	30.0		
Q5	f	10	8	11	6	15	3.16	1.51
	%	20.0	16.0	22.0	12.0	30.0		

Note: f: Frequency N: Never (1) S: Sometimes (2) HTT: Half the time (3) F: Frequently (4) A: Always (5)
SD: Standard Deviation

Q2: Lecturing in Turkish allows the lesson to progress faster than lecturing in English.

Q3: Lecturing in Turkish produces a better classroom atmosphere than lecturing in English.

Q4: Lecturing in Turkish allows a teacher to go deeper into the content of the lesson than lecturing in English.

Q5: I support adopting mother tongue education at the high school where I teach.

As seen from the Table 5, the highest mean score belongs to the question two ($M=3.78$), approximately 64% ($N=32$) of the teachers who are above the HTT think that, lecturing mathematics lessons in Turkish allows the lesson to progress faster than lecturing in English. For the same question, 22% ($N=11$) of the teachers who are below the HTT claim that, there is hardly any effect of teaching mathematics lessons in Turkish in terms of speed of the lesson. The second highest mean score belongs to the question four ($M=3.32$), 56% ($N=28$) of the teachers who are above the HTT think that lecturing in Turkish allows a teacher to go deeper into the content of the lesson than lecturing in English. For the same question, 32% ($N=16$) of the teachers who are below the HTT state that lecturing in Turkish does not lead to more detailed lesson content compared to lecturing in English. For the third question ($M=3.30$), 56% ($N=28$) of the teachers who are above the HTT reveal that lecturing in Turkish produces a better classroom atmosphere than lecturing in English. For the same question, 36% ($N=18$) of the teachers who are below the HTT state that this situation has almost any effect on establishing a better classroom environment. The fifth question has the lowest mean score in this category ($M=3.16$). While 42% ($N=21$) of the teachers who are above the HTT support adopting mother tongue education at the high school where they teach, other 36% ($N=18$) teachers who are below the HTT do not support this statement.

Supporting evidence was derived for the results above from the open-ended question in the questionnaire which is related to suggestion, alternatives and beliefs of mathematics teachers about teaching mathematics in English in Turkey. According the results of open-ended question which is related to beliefs, alternatives and suggestions of mathematics teachers, 34.14% ($N=14$) of the teachers state that math lessons should be taught in mother-tongue, namely in Turkish. Responses of the

teachers who support math education in Turkish vary depending on different factors such as university entrance exam in Turkey, classroom management, participation and motivation of students and verbal topics in math lessons. Out of the fourteen teachers who advocate for conducting math lessons in Turkish, seven of them reveal that teaching math lessons in English negatively affects dynamics and fluency of the lesson, classroom management, participation and motivation of the students. Six of these fourteen teachers state that owing to the mandatory centralized exam students must take in order to be placed in a university, students should learn maths lessons in Turkish. Otherwise, they cannot get desired high scores from the exam and stay behind their competitors. Three out of fourteen teachers state that in order to understand the logic and content of the topic, students should learn it in their mother-tongue. According to the common responses of the teachers given for the open-ended question, mathematics is an abstract lesson and students already have difficulty in understanding this lesson in Turkish. Some topics are based on verbal comprehension and learning these topics in English becomes too complex for the students.

On the other hand, according to results of the open-ended question in the questionnaire, 24.39% ($N=10$) of the teachers state that math lessons should be taught in a second language, namely in English. Out of the ten teachers who opt for teaching math lessons in English, nine of them state that if students learn mathematics in English, they can access to and understand English sources. In other words, they can keep up with universal mathematics. Seven of the teachers out of ten state that if both students and teachers have necessary English proficiency and background, learning math lesson will be useful for students' improvement. Three teachers out of ten state that learning mathematics in English provides more job

opportunities and enables acceptance from high quality universities. Out of ten teachers, only one of them states that English resources are more reliable and consistent than Turkish sources.

Another finding derived from open-ended question is that both languages have the same effect on mathematics education. 4.87% ($N=2$) of the teachers support this statement. These teachers state that success of the students in mathematics lesson does not depend on the language of the math lesson. Besides, even if students do not know English properly, they can still solve mathematics questions with their math background and knowledge.

Teachers' attitudes in terms of resources, government support, status of the Turkish language in society and the language policy

Teachers' attitudes which were related to resources, government support, status of the Turkish language and the language policy were investigated with questions (10, 11, 12, 13 and 22) in the questionnaire. Table 6 below shows the results obtained for this point.

Table 6

Teachers' attitudes in terms of resources, government support, status of the Turkish language in society and the language policy

		N	S	HTT	F	A	Mean	SD
Q10	f	3	11	8	7	21	3.64	1.38
	%	6.0	22.0	16.0	14.0	42.0		
Q11	f	4	10	14	9	13	3.34	1.28
	%	8.0	20.0	28.0	18.0	26.0		
Q12	f	1	2	7	14	26	4.24	.98
	%	2.0	4.0	14.0	28.0	52.0		
Q13	f	2	3	14	12	19	3.86	1.12
	%	4.0	6.0	28.0	24.0	38.0		
Q22	f	2	0	6	16	26	4.28	.97
	%	4.0	0	12.0	32.0	52.0		

Note: f: Frequency N: Never (1) S: Sometimes (2) HTT: Half the time (3) F: Frequently (4) A: Always (5)

SD: Standard Deviation

Q10: Resources for teaching, e.g., textbooks and reference books, are more plentiful in English than in Turkish.

Q11: The Education Department should provide high schools that adopt mother tongue education with more resources for teaching.

Q12: The Turkish government should raise the status of the Turkish language in society.

Q13: Learning Turkish well will benefit the learning of English.

Q22: I have a good understanding of the language policy of the high school where I teach.

According to the mean scores given in Table 6, participant teachers agree with most of the statements in this category. The highest mean score belongs to question 22 ($M=4.28$). 84% ($N=42$) of the teachers who are above the HTT state that they have a good understanding of the language policy of the high school where they teach. There are only two participants who disagreed with question 22. The second highest mean score belongs to question 12 ($M=4.24$). 80% ($N=40$) of the teachers who are above the HTT think that Turkish government should raise the status of the Turkish language in the society while others who are below the HTT 6% ($N=3$) state that it is not necessary in terms of status of the Turkish language. Considering the responses to the thirteenth question in this section ($M=3.86$), 62% ($N=31$) of the teachers who are above the HTT support that learning Turkish well will benefit the learning of English, but 10% ($N=5$) of the teachers who are below the HTT disagree with this statement. The result of the tenth question ($M=3.64$) reveals that 56% ($N=28$) of the teachers who are above the HTT agreed that resources for teaching, e.g., textbooks and reference books, are more plentiful in English than in Turkish. However, there are 14 participants who disagreed with question 10. The eleventh question has the lowest mean score in this section ($M=3.34$). 44% ($N=22$) of the teachers who are above the HTT state that the Education Department should provide high schools that adopt mother tongue education with more resources for teaching, but 28% ($N=14$) of the teachers who are below the HTT do not agree with this statement.

In relation to the quantitative data gathered from the questionnaire in terms of sources used in math lessons, there is also qualitative data that backs up teachers' preferences of the language of the material as instructing the lesson. According to the findings from classroom observations of five teachers, T1, T2 and T4 teach the lesson using English sources, but T5 uses only Turkish sources while teaching the

lesson. T3 teaches the lesson using both Turkish and English sources. However, during the classroom observations, teachers did not distribute any worksheets or hand-outs to the students.

From teachers’ perspective, the impact of the parents on the students’ education language choice

Teacher views related to the impact of the parents on the students’ education language choice were investigated with question 15. Table 7 shows the results for this point.

Table 7
From teachers’ perspective, the impact of the parents on the students’ education language choice

		N	S	HTT	F	A	Mean	SD
Q15	f	12	13	18	5	2	2.44	1.09
	%	24.0	26.0	36.0	10.0	4.0		

Note: f: Frequency N: Never (1) S: Sometimes (2) HTT: Half the time (3) F: Frequently (4) A: Always (5)

SD: Standard Deviation

Q15: Parents are the major obstacle in the promotion of mother tongue education.

Looking at the responses given for the fifteenth question in Table 7, 14% ($N=7$) of the teachers who are above the HTT state that parents are the major obstacle in the promotion of mother tongue education. However, 50% ($N=25$) of the teachers who are below the HTT do not agree with this statement.

Teachers' attitudes about teaching mathematics lessons by mixing English and Turkish

Attitudes of teachers about teaching mathematics lessons by mixing English and Turkish were investigated with questions 23, 24 and 25 in the questionnaire. Table 8 shows the results for this point.

Table 8
Teachers' attitudes about teaching mathematics lessons by mixing English and Turkish

		N	S	HTT	F	A	Mean	SD
Q23	f	18	16	9	1	6	2.22	1.29
	%	36.0	32.0	18.0	2.0	12.0		
Q24	f	5	4	9	13	19	3.74	1.32
	%	10.0	8.0	18.0	26.0	38.0		
Q25	f	18	7	8	9	8	2.64	1.52
	%	36.0	14.0	16.0	18.0	16.0		

Note: f: Frequency N: Never (1) S: Sometimes (2) HTT: Half the time (3) F: Frequently (4) A: Always (5)

SD: Standard Deviation

Q23: It is inappropriate for instructors to teach the same lesson mixing English and Turkish.

Q24: I support teaching some courses in English and some courses in Turkish at the high school where I teach.

Q25: I want the education language in the school to be in Turkish, but students to take one or two classes to take in English to keep up with the developments in their field.

According to scores in Table 8, the results of the twenty-fourth question ($M=3.74$) reveals that 64% ($N=32$) of the teachers who are above the HTT support teaching some courses in English and some courses in Turkish at the high school where they teach. For the same question, 18% ($N=9$) of the teachers who are below the HTT do not agree with this statement. Responses given to the twenty-fifth question ($M=2.64$) points out that 50% ($N=25$) of the teachers who are below the HTT disagreed with this statement whereas 34% ($N=17$) of the teachers who are above the HTT condone

education language in the school to be in Turkish, but students can take one or two classes in English to keep up with the developments in their field. Regarding the results of twenty-third question ($M=2.22$), 68% ($N=34$) of the teachers who are below the HTT state that it is appropriate for instructors to teach the same lesson mixing English and Turkish. However, 14% ($N=7$) of the teachers who are above the HTT agree that it is inappropriate for instructors to teach the same lesson by mixing English and Turkish.

Supporting evidence was derived for the results above from the open-ended question in the questionnaire. According the results of open-ended question, 36.58% ($N=15$) of the teachers state that math lessons should be taught by mixing English and Turkish. Out of the fifteen teachers who answered the open-ended question, six of them state that especially the 9th grade students do not have command in mathematical terminology in English. Therefore, most of the time Turkish explanations are compulsory for these students. Five out of fifteen teachers state that if students study in the IB programme, they should learn mathematics lessons in English. Otherwise, they do not need to learn mathematics in English. Four out of ten teachers state that math lessons should be taught in Turkish, but during the lesson teachers should give definition of the mathematical terms in English.

Interviews (See Appendix C) were carried out with five teachers. A part of the interview focused on beliefs and attitudes of teachers toward teaching math lessons in English. In particular, five questions (6, 8, 11, 13 and 14) were asked related to teacher's beliefs and attitudes (see Appendix C). Interview question 6 investigates the attitudes and beliefs of mathematics teachers whether using English in mathematics lessons affects the quality of teaching or not. Four of the views which were recorded during interviews are given below:

Teacher 1 states that:

If students learn mathematics in English, they can reach more resources. In this way, they can gain different perspectives.

Teacher 2 states that:

Knowing mathematical terminology in English is very important to the students since these terms are translated from English to Turkish. Sometimes, their English meaning does not make sense for the students. Schools should provide preparatory class for students to be instructed in mathematical terminology.

Teacher 4 states that:

If the students' and teachers' English proficiency is enough for the mathematics lessons, this situation will affect students' progress in a positive way owing to the fact that they can access more examples and resources in English.

Another view is stated by teacher 5:

If students study in the IB programme, they should learn mathematics lessons in English. Otherwise, they do not need to learn mathematics in English.

Interview question 8 investigates the attitudes and beliefs of mathematics teachers whether using English in mathematics lessons has an effect on the context and comprehensive level of the mathematics lessons or not. The attitudes and beliefs of the teachers who gave responses to the interview question 8 are given below:

Teacher 1 states that:

Mathematics has its own language; it is not like a Biology lesson. If students know some basic mathematical terms in English, they can solve all questions easily. I do not think that success of the students in mathematics lessons depends on the language of math lesson.

Teacher 2 states that:

Even if the students are successful in math lessons, they want to ask questions in their own language. When they do not understand the topic, they require Turkish explanations.

Another view is stated by teacher 5:

Teaching mathematics in English attracts students' attention at the beginning. However, after a while it has the same effect as teaching lessons in Turkish.

Interview question 11 was related to teachers' attitudes and beliefs about preferred language of the source. Only one out of five teachers preferred English sources during instruction. Two of them preferred Turkish sources and others preferred both Turkish and English sources. Three of the teachers' views which were recorded during interviews are given below:

Teacher 1 states that:

I definitely prefer English sources if I need to teach a topic because Turkish sources are inconsistent and unreliable.

Teacher 2 states that:

I cover IGCSE students' mathematics lessons and I think there is limited number of sources about IGCSE mathematics. Therefore, I prefer Turkish sources.

Another view is stated by teacher 3:

I prefer Ministry of National Education books lately because there are too many activities to explore the topic. However, I prefer English sources if I need to prepare materials about the IB.

Interview question 13 was related to the beliefs and attitudes of teachers about their preferred teaching language. Out of five teachers who are interviewed with, only one of them preferred teaching mathematics lessons by mixing Turkish and English. Two of them preferred to teach math lessons in Turkish, and others preferred teaching mathematics in English.

Teacher 1 states that:

I work in an international school, so I prefer teaching lessons in English. Besides, English is a global language.

Teacher 2 states that:

I taught mathematics 20 years in Turkish and 10 years both in Turkish and English. Both of them are the same for me.

Another view is stated by teacher 5:

I prefer teaching math lessons in Turkish. I feel more comfortable when I teach lessons in Turkish.

Interview question 14 investigated the attitudes and beliefs of mathematics teachers whether using English in mathematics lessons affects the classroom management or not. Three of the teachers' views which were recorded during interviews are given below:

Teacher 1 states that:

Students always tend to ask questions in their own language and speak Turkish with their friends.

Teacher 3 states that:

If you do not have fluency in English and correct pronunciation, students make fun of you.

Another view is stated by teacher 5:

Teaching mathematics in English attracts students' attention at the beginning. Besides, it increases students' motivation. However, after a while it has the same impact as teaching the lessons in Turkish. Also, classroom dialogues must be in Turkish because it creates more sincere classroom environment.

According to findings from classroom observations, except from T3 and T5, other teachers teach the lesson using fluent English. However, T3 and T5 teach the lesson in Turkish. Except from T3 and T5, other teachers speak English with their students before starting the lesson. During T1's lessons, students generally speak in English. The teacher has strict rules about speaking English in the classroom. During the observation, a student answered one question in Turkish. T1 warned the student: 'Don't talk in Turkish during my lesson! During T2's lesson, most of the students asked questions in Turkish, but the teacher did not warn the students. However, T2 generally answered questions in English. After T4 gave information about the quiz that would be performed on the following week, one student asked a question in Turkish about the content of the quiz. Thereafter, T4 warned the students: 'Why do you speak Turkish with me? On the other hand, except from T3 and T5, teacher use English for in-class dialogues and praises. Generally, they use "well done" or "very good" as praise.

Research Question 2: Type of challenges for the Turkish Math teachers experience when they teach their lessons in English

Teachers' negative attitudes towards teaching mathematics in English in a different context

Negative attitudes of teachers about teaching mathematics lessons in English in a different context were investigated with questions 6, 7, 8, 9 and 17 in the questionnaire. Table 9 below shows the results as a whole.



Table 9
Teachers' negative attitudes towards teaching mathematics in English in a different context

		N	S	HTT	F	A	Mean	SD
Q6	f	12	12	15	4	7	2.64	1.32
	%	24.0	24.0	30.0	8.0	14.0		
Q7	f	7	15	18	3	7	2.76	1.20
	%	14.0	30.0	36.0	6.0	14.0		
Q8	f	12	11	10	9	8	2.80	1.41
	%	24.0	22.0	20.0	18.0	16.0		
Q9	f	11	21	12	4	2	2.30	1.03
	%	22.0	42.0	24.0	8.0	4.0		
Q17	f	25	18	3	4	0	1.72	.90
	%	50.0	36.0	6.0	8.0	0		

Note: f: Frequency N: Never (1) S: Sometimes (2) HTT: Half the time (3) F: Frequently (4) A: Always (5)

SD: Standard Deviation

Q6: I feel it is easier to set examination questions using English than using Turkish.

Q7: I feel I can write better in English than in Turkish.

Q8: The greatest problem in using Turkish as the medium of instruction is the need to translate a lot of special terms.

Q9: It is easier to teach Mathematics in English than in Turkish.

Q17: Teaching a class in Turkish encourages students to speak uninhibitedly, thereby disrupting the order of the class.

Based on the results given in Table 9, teachers generally gave negative responses for the items in this section. The seventeenth question has the lowest mean score in this section ($M=1.72$). 86% ($N=43$) of the teachers who are below the HTT reveal that teaching a class in Turkish does not encourage students to speak uninhibitedly and does not disrupt the order of the class while 8% ($N=4$) of the teachers who are above the HTT indicate that teaching a class in Turkish creates classroom management problems. Regarding the results of the ninth question ($M=2.30$), 64% ($N=32$) of the teachers who are below the HTT state that it is not easier to teach Mathematics in English than in Turkish, while only 12% ($N=6$) of the teachers who are above the HTT agree that it is easier to teach Mathematics in English than in Turkish. The responses which are given for question 6 ($M=2.64$) indicate that 48% ($N=24$) of the teachers who are below the HTT disagreed with the statement that they feel it is easier to set examination questions using English than using Turkish, while 22% ($N=11$) of the participant teachers who are above the HTT agreed with the statement. In respect to the responses provided to the seventh question ($M=2.76$), 44% ($N=22$) of the teachers who are below the HTT stated that they do not think they write better in English than in Turkish while others who are above the HTT 20% ($N=10$) agreed with the statement. The eight question has the highest mean score in this part ($M=2.80$). 46% ($N=23$) of the teachers who are below the HTT disagreed with the statement that the greatest problem in using Turkish as the medium of instruction is the need to translate a lot of special terms. Only 34% ($N=17$) of the teachers who are above the HTT agreed with this statement.

To support the quantitative data results provided above, a part of the interview, particularly two of the questions (9 and 10), were implicitly related to challenges Turkish mathematics teachers experience when they teach their lessons in English

(see Appendix C). Interview question 9 was about the most encountered challenges while teaching math in English. Four of the teachers' views which were recorded during interviews are given below:

Teacher 1 states that:

Students do not express themselves easily while they prepare projects. In order to prevent this situation, I make students explain questions in some lessons.

Teacher 2 states that:

Students have a problem in understanding and interpreting Word Problems.

Teacher 4 states that:

Generally in class dialogues I prefer Turkish, especially when I want to warn students. I do not like calling students 'guys' when I need to warn them. Rather, I use Turkish phrases like "Oğlum" or "Kızım" because I think they are more effective. Turkish words are more effective for me.

Another view is stated by teacher 5:

Teaching mathematics lesson in English entirely depends on teachers' English proficiency level.

Interview question 10 was related to challenges of teachers about the need of Turkish explanations for topics and grades. Four of the teachers' views which were recorded during interviews with Teacher 1, Teacher 2 and Teacher 3 and Teacher 4 are given below:

Teacher 1 states that:

Students face challenges when they analyse and interpret graphics during my lesson.

Teacher 2 states that:

Students have a problem in understanding and interpreting Word Problems. They have a difficulty converting long texts into algebraic expressions.

Teacher 3 states that:

Especially, the 9th grade students have problems with English since their English knowledge is more limited than other graders. Students should learn basic definitions and mathematical terms in preparatory class. On the other hand, some mathematical terms such as ‘or’, and ‘if and only if’ in English create misconceptions in students’ mind.

Another view is stated by Teacher 4:

Understanding of Permutation, Combination and Probability in Turkish is already hard for students. Since it is more based on verbal comprehension, it becomes too complex for students.

According to the findings from classroom observations of five teachers, during the T2’s lesson, one student does not understand the solution of the question and teacher briefly made explanation in Turkish. T1, T2 and T4 have clear and understandable pronunciation. They provide clear and explanatory answers to students’ questions in English. Also, T1, T2 and T4 use mathematical terminology and terms correctly in English. Despite the fact that T3 teaches the lesson in Turkish, she uses mathematical terminology and terms in English. T1, T2 and T4 write and speak only in English throughout the lesson. T3 write on the board in English, but teach the lesson in Turkish. T5 write and speak only in Turkish.

Research Question 3: From teachers' perspective, type of challenges students face when learning math in English from Turkish teachers

Common challenges for the students when they are learning mathematics in English

Common challenges for the students when learning mathematics in English were investigated with questions 1, 14, 16, 18, 19, 20 and 21. Table 10 below shows the results as a whole.



Table 10
Common challenges for the students when they learning mathematics in English

		N	S	HTT	F	A	Mean	SD
Q1	f	6	9	10	10	15	3.38	1.39
	%	12.0	18.0	20.0	20.0	30.0		
Q14	f	19	10	11	9	1	2.26	1.20
	%	38.0	20.0	22.0	18.0	2.0		
Q16	f	32	14	4	0	0	1.44	.64
	%	64.0	28.0	8.0	0	0		
Q18	f	18	16	8	4	4	2.20	1.24
	%	36.0	32.0	16.0	8.0	8.0		
Q19	f	22	10	7	7	4	2.22	1.36
	%	44.0	20.0	14.0	14.0	8.0		
Q20	f	20	12	11	4	3	2.16	1.21
	%	40.0	24.0	22.0	8.0	6.0		
Q21	f	16	21	4	4	5	2.22	1.26
	%	32.0	42.0	8.0	8.0	10.0		

Note: f: Frequency N: Never (1) S: Sometimes (2) HTT: Half the time (3) F: Frequently (4) A: Always (5)

SD: Standard Deviation

Q1: Lecturing in Turkish can bolster students' interest in learning more than lecturing in English.

Q14: English as the medium of instruction will certainly lead to poorer student intake.

Q16: Students tend to neglect those subjects taught in Turkish.

Q18: Even studying every subject in Turkish will not help students with poor academic performance.

Q19: Using Turkish to study Mathematics will affect students' English proficiency.

Q20: Students with good academic performance should study all subjects in English.

Q21: The English proficiency of the students I teach is not adequate for them to study Mathematics in English.

According to mean scores given in Table 10, teachers disagreed with most of the statements in the questionnaire. The highest mean score belongs to question one ($M=3.38$). According to the analysis of the responses given to the questionnaire, 50% ($N=25$) of the teachers who are above the HTT disagreed with statement that lecturing in Turkish can bolster students' interest in learning more than lecturing in English while 30% ($N=15$) of the teachers who are below the HTT agreed with this statement. The second highest mean score belongs to question fourteen ($M=2.26$). 58% ($N=29$) of the teachers who are below the HTT disagreed with the statement that English as the medium of instruction will certainly lead to poorer student intake while 20% ($N=10$) of the teachers who are above the HTT support this statement. The third highest mean score belongs to question 19 and 21 ($M=2.22$). Regarding the question nineteen, 64% ($N=32$) of the teachers who are below the HTT disagreed with the statement that using Turkish to study Mathematics will affect students' English proficiency whereas 22% ($N=11$) of the teachers who are above the HTT agreed with this statement. In terms of the responses for the twenty first question, 74% ($N=37$) of the teachers who are below the HTT disagreed with the statement the English proficiency of the students they teach is not adequate for them to study Mathematics in English while 18% ($N=9$) of the teachers who are above the HTT agree with that the statement. The fourth highest mean score belongs to question eighteen ($M=2.20$). 68% ($N=34$) of the teachers who are below the HTT disagreed with the statement that even studying every subject in Turkish will not help students with poor academic performance while 16% ($N=8$) of the teachers who are above the

HTT agree with this statement. The fifth highest mean score in this part is question 20 ($M=2.16$). 64% ($N=32$) of the teachers who are below the HTT disagreed with the statement that students with good academic performance should study all subjects in English while others 14% ($N=7$) support this statement. The sixteenth question has the lowest mean score in this category ($M=1.44$). 92% ($N=46$) of the teachers who are below the HTT disagreed with the statement that students tend to neglect those subjects taught in Turkish while others 8% ($N=4$) support this statement.

Supporting evidence was sought for the qualitative data results given above during the interviews. Two of the questions (7 and 12) in the interview were implicitly related to the common challenges for the students (see Appendix C). Interview question 7 was about success and attitudes of the students in mathematics lesson when teachers teach math in English from teachers' perspective. Three of the teachers' views which were recorded during interviews are given below:

Teacher 1 states that:

Mathematics has its own language; it is not like a Biology lesson. If students know some basic mathematical terms in English, they can solve all questions easily. I do not think that success of the students in mathematics lessons depends on the language of the math lesson.

Teacher 2 states that:

Even if the students are successful in math lessons, they want to ask questions in their own language. When they do not understand the topic, they require Turkish explanations.

Another view is stated by Teacher 5:

Teaching mathematics in English attracts students' attention at the beginning. However, after a while it has the same effect as teaching lessons in Turkish.

Interview question 12 was about English proficiency level and students' command of mathematics terminology. Four of the teachers' views which were recorded during interviews with Teacher 1, Teacher 2, Teacher 3 and Teacher 5 are given below:

Teacher 1 states that:

They do not express themselves easily when they prepare projects.

Teacher 2 states that:

Students have trouble while translating Word Problems into algebraic expressions.

Teacher 3 states that:

Most of the students still do not know the definition of odd number, even number, denominator, numerator, integer, difference between square number and square root.

Another view is stated by Teacher 5:

Especially the 9th grade students have problems with mathematical terminology.

According to the findings from classroom observations of five teachers, during T1's lessons, students generally speak in English. During T2's lesson, most of the students asked questions in Turkish. During T4' lesson, after T4 gave information about the quiz that would be performed on the following week, one student asked a question in Turkish about the context of the quiz. Throughout T3 and T5's lessons all students spoke Turkish. One student directed a question at T2 about the IB exam:

“What is the meaning of 'exactly' in the IB exam which is written at the top of the some questions in IB exam Paper 2?”

T2 gave Turkish explanation to student's question.

T2: This means that “don't use calculator, don't use decimals and solve the question by hand.”

Also, during the T2's lesson, one student did not understand the solution of the problem and teacher briefly made an explanation in Turkish.



Table 11

Codes for the teachers' attitudes, beliefs and challenges towards teaching mathematics lesson in English

Codes	Sample Responses
English proficiency of teachers	<p>If the teacher has a good command of English, this situation does not affect quality of math lesson. (T4)</p> <p>Sometimes, I have a difficulty in explaining the content of the lesson in details. I feel insufficient myself while I teach the logic of the topic. (T5)</p> <p>I have difficulty in teaching math lessons in English because if you do not have fluent English and correct pronunciation, they are making fun of you. (T3)</p> <p>The teacher can skip the topic or part of the subject if he does not believe his level of English is not sufficient to teach that topic. This will be the worst case for students. (T2)</p>
English proficiency of students	<p>If students' English proficiency is enough for the mathematics lessons, this situation will affect students' progress in a positive way because they can access to more examples and resources in English. (T1)</p>
Turkish and English instruction have the same effect	<p>Teaching mathematics in English attracts students' attention at the beginning. Besides, it increases motivation of the students. However, after a while it has the same effect as teaching lessons in Turkish. (T5)</p>

Table 11 (cont'd)

<p>Materials and sources</p>	<p>If students learn mathematics in English, they can obtain more resources. In this way, they can gain different perspectives. I definitely prefer English sources if I need to study a topic because Turkish sources are inconsistent and unreliable. (T1)</p> <p>I cover IGCSE mathematics lessons and I think there are a limited number of sources about IGCSE mathematics. Therefore, I prefer Turkish sources. (T2)</p> <p>I prefer MoNE books lately because there are too many activities to explore the topic. However, I prefer English sources if I need to prepare materials about the IB. (T3)</p>
<p>Class dialogues, warnings and jokes</p>	<p>Generally in class dialogues I prefer Turkish, especially when I want to warn students. I do not like calling students ‘guys’ when I need to warn them. Rather, I use Turkish phrases like “Oğlum” or “Kızım” because I think they are more effective. Turkish words for addressing students are more effective for me. (T4)</p> <p>Classroom dialogues must be in Turkish because it creates more sincere classroom environment. (T5)</p> <p>Students always tend to ask questions in their own language and speak Turkish with their friends. (T1)</p>
<p>Programme of the school</p>	<p>If students study in the IB programme, they should learn mathematics lessons in English. Otherwise, they do not need to learn mathematics in English. (T5)</p>

Table 12

Codes for from teachers' perspective type of challenges students face when learning math in English

Codes	Sample Responses
Word Problems	Students have a problem understanding and interpreting Word Problems. They have a difficulty converting long texts into algebraic expressions. (T2)
Graphics	Students face challenges when they analyse and interpret graphics during my lesson. (T1) Students do not analyse the graphics when they solve questions. (T4)
Permutation, Combination and Probability	Understanding this topic in Turkish is already hard for students. Since it is more based on verbal comprehension, it becomes too complex for the students. (T4)
Mathematical Logic	Some mathematical terms such as 'or' and 'if and only if' in this topic create misconceptions in students' minds when taught in English. (T3)

Table 12 (cont'd)

Mathematical terms and terminology	<p>Knowing mathematical terminology in English is very important for the students. Since these terms are translated from English to Turkish, sometimes, their English meaning does not make sense for the students. Schools should provide preparatory class for students to be instructed in mathematical terminology. (T2)</p> <p>Most of the students still do not know the definition of odd number, denominator, numerator, integer, difference between square number and square root. Especially, the 9th grade students have problems with English since their English knowledge is more limited than other graders. Students should learn basic definitions and mathematical terms in preparatory class. (T3)</p> <p>Especially, the 9th grade students have problems with mathematical terminology. (T5)</p>
Preparing assignment and projects	<p>Students do not express themselves easily when they prepare projects. In order to prevent this situation, I make students explain questions in some lessons. (T1)</p>

Classroom observations are used in order to explore what type of challenges Turkish mathematics teachers experience during mathematics lessons when they teach their courses in English. Classroom observations started in December 2017, with observations of the mathematics classrooms from selected schools in Ankara. One lesson of five mathematics teachers were observed in School A, School C and School E. Teachers' common challenges, behaviours and problems are detected using the questions in the charts. Below, Table 13 shows the findings of classroom observations.

Table 13
Findings from classroom observations

1.	The teacher teaches the lesson by using fluent English.	Except from T3 and T5, other teachers teach the lesson using fluent English. However, T3 and T5 teach the lesson in Turkish.
2.	The teachers' English pronunciation is clear and understandable.	T1, T2 and T4 have clear and understandable pronunciation.
3.	The teacher writes only in English on the board and also speaks only in English throughout the lesson.	T1, T2 and T4 write and speak only in English throughout the lesson. T3 write on the board in English, but teach the lesson in Turkish. T5 write and speak only in Turkish.
4.	Before starting the lesson, the teacher speaks English with their students.	Except from T3 and T5, other teachers speak English with their students before starting the lesson.
5.	Teacher can provide clear and explanatory answers to students' questions.	Teachers (T1, T2, T4) who teach the lesson in English can provide clear and explanatory answers to students' questions in English.

Table 13 (cont'd)

<p>6. After the teachers' explanation, students need extra help from their desk mates related to teachers' explanation.</p>	<p>I did not encounter such a situation in any of the lessons I observed.</p>
<p>7. Teacher makes explanations in Turkish while lecturing.</p>	<p>One student directed a question at T2 about the IB exam: "What is the meaning of 'exactly' in the IB exam which is written at the top of the some questions in IB exam Paper 2?"</p> <p>T2 gave Turkish explanation to student's question.</p> <p>T2: This means that "don't use calculator, don't use decimals and solve the question by hand."</p> <p>During the T2's lesson, one student did not understand the solution of the question and teacher briefly made an explanation in Turkish.</p>
<p>8. Teacher uses mathematical terminology and terms correctly.</p>	<p>T1, T2 and T4 use mathematical terminology and terms correctly in English. Despite the fact that T3 teaches the lesson in Turkish, she uses mathematical terminology and terms in English.</p>
<p>9. The students participate in the lesson and they speak only English during the lesson. The teacher warns the students about not to speak Turkish in the lesson.</p>	<p>During T1' lessons, students generally speak in English. The teacher has strict rules about speaking English in the lesson. However, a student answered one question in Turkish. T1 warned the student: 'Don't talk in Turkish during my lesson!'</p> <p>During T2' lesson, most of the students asked questions in Turkish, but the teacher did not warn the students. However, T2 generally answered questions in English.</p> <p>After T4 gave information about the quiz that would be done on the following week, one student asked a question in Turkish about the content of the quiz. Thereafter, T4 warned the students: 'Why do you speak Turkish with me?'</p> <p>Throughout T3 and T5's lessons, all students speak Turkish.</p>

Table 13 (cont'd)

10.	The teacher uses English materials and sources while teaching the lesson.	T1, T2 and T4 teach the lesson using English sources, but T5 uses only Turkish sources while teaching the lesson. T3 teaches the lesson using both Turkish and English sources.
11.	The teacher distributes only English worksheets and hand-outs.	In the lessons that I observed, teachers did not distribute worksheets or hand-outs to the students, so I do not have an opinion about this issue.
12.	The teacher uses in class dialogues and praises in English.	Except from T3 and T5, teacher use in-class dialogues and praises in English. Generally, they use “well done” or “very good” as praise.

As seen from the Table 13, T3 and T5 teach mathematics lesson in Turkish. T5 write and speak in Turkish throughout the lesson. T3 write on the board and use mathematical terminology in English, but she speaks in Turkish. Also, throughout T3 and T5's lessons, all students speak in Turkish. T5 uses only Turkish sources while teaching the lesson. T3 teaches the lesson using both Turkish and English sources. Other teachers (T1, T2 and T4) work in an international school. They teach the lesson using fluent English and also they have clear and understandable pronunciation. These teachers teach the lesson using English sources. During their lessons, they provide clear and explanatory answers to students' questions in English and also they use mathematical terminology and terms correctly in English. T1, T2 and T4 speak English with their students before starting the lesson and these teachers use English while praising students and communicating with students. However, some of the students tend to speak with their friends and ask their questions in Turkish. Especially, during T2' lesson, most of the students ask questions in Turkish, but the teacher does not warn the students. However, T1 and T4 warn these students in order to speak in Turkish during their lessons.

CHAPTER 5: DISCUSSION

In this chapter, general findings of the research are discussed in detail. This chapter starts with the overview of the study which includes general explanations of the results. Secondly, the major findings of the research are introduced completely in three categories. The final part of the chapter includes suggestions and alternatives for further research and the limitations of the study.

Overview of the study

This study investigated the beliefs, attitudes and challenges of high school mathematics teachers who work in schools where the medium of instruction is in English. Both qualitative and quantitative data were collected during the research. Findings were presented in detail in Chapter 4. The general results indicated that mathematics teachers' attitudes and beliefs towards math education in a second language were mostly negative. Also, these teachers face different types of challenges when they teach math lessons in English. According to results of classroom observations and interviews, attitudes and challenges of the teachers can change depending on the English background of the teachers, policy and mission of the school where these teachers work.

In the following section, major findings and possible reasons for these results are discussed under two sub-sections:

1. Attitudes and beliefs of high school mathematics teachers towards teaching math lessons in English

2. Turkish mathematics teachers' challenges which are related to teaching mathematics in a second language

The major findings

Attitudes and beliefs of high school mathematics teachers towards teaching mathematics lessons in English

Turkish mathematics teachers' general opinions related to mathematics education in a second language were discovered with the questionnaire and interview questions. Besides, challenges faced by mathematics teachers were explored by classroom observations.

Most of the teachers who participated in the study agreed that math lessons should be taught in students' mother-tongue. Most of them stated that students can show progress only if they learn math lesson in their native language. Otherwise, they do not understand the topic properly and teachers have to switch to Turkish in the middle of the lesson. In literature, there are studies that found similar results with this current research (Erdem & Morgil,1992; Dalkız, 2002; Kılıçkaya, 2006, Köksal, 2002). However, in literature there were two studies which found opposite results with the current study (Ibrahim, 2009; Wode, 1999). According to the classroom observations, during T2's lesson in school C students asked their questions in Turkish. Also, T2 sometimes made Turkish explanations about students' questions (See Table 13, pp.63).

When teachers teach Mathematics in English, students listen in a passive manner, they cannot think critically, which means that they cannot ask questions to teachers, And they do not want to participate in the lessons (Çelebi, 2006; Güneyli, 2012; Özbay, 2008; Sert, 2000, pp.8). When the mother-tongue was used in education,

students started to participate in the lesson. Similarly, most of the participants of the current study agreed that teaching math lessons in Turkish positively affects classroom management, dynamics and the fluency of the lesson and motivation of the students. According to the classroom observations, during T2's lesson in school C when teacher made Turkish explanations about solution of the question, students asked more questions related to the solution. However, when the teacher switched to English, students gave up asking questions.

Another finding of the current study was related to English proficiency of students. Regarding the teachers' responses which were collected by a questionnaire and interviews, participants agreed that if the students do not have sufficient English background, they do not understand the Math problems due to their limited English proficiency. They want to ask questions in their mother-tongue and also they need Turkish explanations from teachers. Therefore, most of the time teachers switch to Turkish. In literature, there are studies that found similar results (Cuevas, 1984; Köksal, 2000; Sert, 2000). However, according to classroom observations in an international school, students generally have necessary English proficiency. Therefore, students participate in the lesson more actively. Nevertheless, students always want to ask questions and talk with their friends in Turkish even though they are educated in an international school. According to the classroom observations, during T2's lesson in school C one student directed a question at T2 about the IB exam. Firstly, T2 made an English explanation about student's question, but T2's answer in English did not make sense for the student. Thereafter, T2 made an explanation in Turkish (See Table 13, pp.63).

Distributions of the participants bring another approach to this study. Out of the teachers who participated in interviews and classroom observations, three of them

work in an international school and two of them work in non-international, but IB school. Teachers who work in an international school do not have difficulties conveying mathematical knowledge to their students in a second language. However, according to the classroom observations, other teachers who work in non-international schools (T3 and T5) face difficulties and they have to switch to Turkish or teach math in Turkish throughout the lesson (See Table 13, pp.63). Previous research on the tendency of teaching math lessons in English state that it is hard to conduct quality education in a second language in our country because some teachers do not have enough English level in Turkey in order to teach mathematics lesson in Turkish (Büyükduman, 2001; Çelebi, 2006; Erdem & Morgil, 1992; Güneyli, 2012; Kilimci, 1998). However, according to small part of the results of the current study, in some schools especially in international schools, some teachers can teach mathematics lesson properly in a second language (See Table 13, pp.63).

Demographic features of the participants bring another approach to this study. Preferred teaching language varies depending on the English background of the teachers (See Table 2, pp.22). If the teachers learned mathematics lesson at high school or university in English, they prefer teaching math lesson in English. However, if the teachers learned mathematics lessons in Turkish throughout their education life, they prefer teaching mathematics lessons in Turkish. Table 2 shows that T1, T2 and T4 learned mathematics lesson in English at high school or university as students. These teachers prefer teaching mathematics lessons in English. On the other hand, according to classroom observations, while they teach mathematics in English, they do not face difficulties. However, T3 and T5 learned mathematics lesson in Turkish when they were at high school and university as students. These teachers prefer teaching mathematics lesson in Turkish at the schools

they work. According to Kilickaya (2006), instructors generally tend to teach lessons in Turkish. However, the current study results show that if the teachers have sufficient English background, they prefer teaching mathematics lessons in English. In that sense, there is a connection between teachers' own math training and their preference of language while teaching. In other words, the language in which the teachers learned math in has a substantial impact on their attitudes towards the language of the math lesson during their instruction. Similarly, if the teacher learned math in Turkish at high school or university, they are more prone to teach the lesson in Turkish.

Additionally, current study results indicated that due to the university entrance exam in Turkey, students should learn maths terminology in Turkish, as well. Otherwise, they cannot get high scores from the exam and stay behind their competitors. Previous research also has reported similar findings since university entrance exam determines students' future and students have to prepare this exam properly (Çetintaş & Genç, 2001; Erdem & Morgil, 1992; Mirici, 2000; Parlak, 2008).

According to the questionnaire results of the current research, majority of the teachers stated that resources for teaching, e.g., textbooks and reference books, are more plentiful in English than in Turkish. The result of item 10 ($M=3.64$) reveals that, 56% ($N=28$) of the teachers agreed that resources for teaching, e.g., textbooks and reference books, are more plentiful in English than in Turkish. However, there are 14 participants who disagreed with this item (Table 6, pp.38). Besides, according to results of the interviews, most of the teachers prefer English sources. However, in the literature, Kilimci (1998) and Büyükduman (2001) found contrary results. They indicated that it is impossible to conduct quality education in a second language in our country due to insufficient resources.

According to views of Aiken (1972), Dalkız (2002) and Güneyli (2012), instead of learning mathematics lessons in a second language, it is necessary to make foreign language education qualified, since mathematics itself is a specialized linguistic. According to the results of the current study, majority of the teachers agreed with this statement. Participants stated that success of the students in mathematics lessons does not depend on the language of the math lesson. Even if the students do not know English properly, they can solve mathematics questions with their math background and knowledge.

Additionally, although participants did not support mathematics education in a second language, they emphasized the importance of knowing English at this age. In the literature, previous research found similar results with the current study and the importance of knowing second language, namely English, in the 21st century is mentioned in that it provides more job opportunities and enables acceptance from higher quality universities (Aktuna & Dogancay, 1998; Çelebi, 2006; Güneyli, 2012; Kolaç, 2008; Sebüktekin, 1981).

Another finding of the current study is that when teachers teach mathematics lesson in English, this situation can lead to misconceptions in students' mind (See Table 12, pp.61). Especially in verbal topics, understanding the meaning of the terms can be difficult for students. In the literature, there were similar results with current research (Aiken, 1972; Cuevas, 1984).

On the other hand, findings of Cuves and Llabre (1981) and Köksal (2002) reported the importance of mathematical terminology. When students encountered different technical terms related to the topic, they tend to quit listening. Moreover, if they do not have sufficient command of mathematical terms, they have problem in

understanding, thus solving questions. Interview results of the current study about mathematical terminology are consistent with the results in the literature review (See Table 12, pp.61).

Final finding in this section is related to the preparatory classes. In the literature, it is reported that due to the fact that foreign language is not well learned in middle school or preparatory class, it is difficult to learn science and mathematics courses in English (Erkan & Baloğlu; 1998; Özbay, 2008; Ülper, 2006). According to the findings of this research, except from one school, other schools do not provide prep class for their students. All students start to learn mathematics in English in the 9th grade. Therefore, 9th grade students have difficulties while learning mathematics lesson in English (See Table 12, pp.61).

Turkish mathematics teachers' challenges which are related to teaching mathematics in a second language

In this section, the study focused on the challenges and common problems which were structured according to responses of Turkish mathematics teachers who participated in the interview phase.

The results of the interview questions showed that students have problems with mathematical terminology, especially 9th grade students in schools that do not provide preparatory class to their students where the interviews were held. Students start being lectured mathematics in English in the 9th grade. Therefore, they do not have sufficient command of mathematical terminology in English yet. Particularly in 'mathematical logic' topic, students face difficulties. Some mathematical terms in this topic such as 'or' and 'if and only if' in English create misconceptions in students' mind. Moreover, most of the students do not know the definition of

fundamental mathematical terms such as odd number, even number, denominator, numerator, integer, and the difference between square root and square number. Hence, they cannot solve questions. In that sense, if the students learn mathematics in a second language, they should learn these terms in preparatory class so as to create background (See Table 12, pp.61).

According to the findings of this study, one of the common reported problems was that students tend to learn mathematics in their mother-tongue. Teachers reflected that even if students are successful in math lessons, they want to ask questions in their own language. When they do not understand the topic, they require Turkish explanations. According to classroom observations of the current research, students generally tend to talk in Turkish throughout the lesson among themselves. However, in international schools because of the mission and policy of the school, teachers warned their students to talk always in English. In other schools which were observed, students always talked and asked their questions in their mother-tongue (See Table 11, pp.59).

Another problem stated by two of the teachers who participated in the interviews is English proficiency of these teachers. These teachers explicitly stated that sometimes they have a difficulty in explaining the content of the lesson in details. They feel themselves insufficient while teaching the logic of the topic. They reported that when they teach the lesson in Turkish, they feel more comfortable with themselves, so they prefer teaching mathematics in Turkish. Besides, if the teacher does not have fluent English and correct pronunciation, students tend to fun of them (See Table 11, pp.59).

Another common problem of mathematics teachers is that, students have a problem understanding and interpreting ‘Word Problems’. They have trouble while translating word problems into algebraic expressions. Similarly, they do not understand ‘Permutation, Combination and Probability’. Since it is more based on verbal comprehension, it becomes too complex for the students. Also, students face challenges when they analyse and interpret graphics. (See Table 12, pp.61).

As a final point, most of the teachers who participated in the interviews wish to use Turkish dialogues during their lessons. Especially, when they want to warn their students, they prefer Turkish. They reported that Turkish words are more effective while restoring order in the class. On the other hand, teachers stated that classroom dialogues must be in Turkish because it creates more sincere classroom environment (See Table 11, pp.59).

Lastly, findings from questionnaire, interviews and classroom observations give significant answers to research questions of this study. In terms of the first research question related to attitudes and beliefs of high school mathematics teachers towards teaching mathematics lessons in English, results show that attitudes and beliefs of teachers vary depending on different factors such as English background of teachers and students, programme of the school, University Entrance Exam in Turkey, providing materials and sources, using mathematical terms and terminology, classroom management, motivation, success and participation of the students. Questionnaire results reveal that, most of teachers have positive attitude towards teaching mathematics lesson in Turkish instead of English or mixing English and Turkish (See Table 4, pp.32 and Table 5, pp.34).

In terms of the second research question related to type of challenges for the Turkish Math teachers experience when they teach their lessons in English, findings reveal that this situation mostly depends on English background of teachers. According to the policy of institution where these teachers work, they should teach mathematics lessons in English. However, as seen from Table 13, T3 and T5 teach math lessons in Turkish. Also, findings from interviews show that they have difficulty in explaining the content of the lesson in details. They feel insufficient themselves while they teach the logic of the topic. Also, they have difficulties because of their pronunciation (See Table 11, pp.59).

In terms of the third research question related to from teachers' perspective, type of challenges students face when learning math in English from Turkish teachers, answers of the teachers reveal that students face difficulties learning especially some topics such as Permutation, Combination and Probability, Word Problems, Graphics, Mathematical Logic (See Table 12, pp.61). Since these topics are more based on verbal comprehension, it becomes too complex for the students. Students have difficulty converting long texts into algebraic expressions. Also, answers of the teachers reveal that most of the students do not know mathematical terms and terminology properly. Especially, 9th grade students have problems with mathematical terminology since their English knowledge is not as sufficient as other graders.

Summary

The findings of this study are summarized as follows:

- A majority of Turkish mathematics teachers have negative attitudes towards teaching mathematics lesson in English.

- A majority of the teachers prefer teaching mathematics lesson in Turkish or by mixing English and Turkish.
- According to demographic data which were collected from interviewed participants revealed that preferred teaching language of teachers varies depending on the English background of them. If the teachers learned mathematics lesson at high school or university in English, these teachers prefer teaching math lessons in English. However, if the teachers learned mathematics lesson in Turkish as students, they prefer teaching mathematics lessons in Turkish.
- A majority of the teachers stated that when they use Turkish in their in-class dialogues, it creates more sincere classroom environment
- The findings of the study revealed that teaching mathematics lesson in English negatively affects motivation and participation of the students.
- A majority of the mathematics teachers reported that, they have difficulties when they convey verbal topics such as ‘word problems’, ‘mathematical logic’ and ‘permutation, combination and probability’.
- Some of the teachers face difficulties because of their English proficiency and background.
- Most of the teachers reported that because of the University Entrance Exam in Turkey, students should learn maths lessons in Turkish. Otherwise, they cannot get high scores from the exam and stay behind of their competitors.
- On contrary to the findings in the literature, the current study indicated that English resources are sufficient, reliable and plentiful in order to provide quality mathematics education in English.

- Teachers stated that if the students learn mathematics in a second language, they should learn these terms in preparatory class.
- Most of the teachers reported that especially the 9th grade students have trouble with their English proficiency. Most of them do not have command of mathematical terminology in English.

Implications for practice

- According to school mission and vision some schools claim that they provide education in English, but in reality the education is given in Turkish instead of English in some schools in Turkey. Therefore, these schools should be inspected by authorized institutions and people.
- Schools which provide education in English should provide preparatory class to students before they started 9th grade. During this prep class, terminology related to subject courses should be taught properly to students and they should have a good command to terminology.
- When school administration selecting their teachers may conduct an exam or an English interview to teachers who will teach lessons in a second language.

Implications for further research

- Interviews and classroom observations of this research were carried out in schools only in Ankara. Another research can be carried out all around Turkey in order to have more comprehensive information.
- The participants of this research were only Turkish mathematics teachers. Another research can be administered on science teachers (physics, chemistry, biology), social science teachers and students as participants for further research.

- Only high school mathematics teachers participated in this study. Another research may be conducted with middle school mathematics teachers or math instructors who teach mathematics lessons in English in universities.

Limitations

In Turkey, even in institutions that provide international education, Mathematics courses are mostly conducted in Turkish, because there are not enough teachers who are qualified to provide classes in English. Furthermore, the students' English levels are low and may not be prepared to receive lessons in another language. Some of the teachers who teach Math courses in English are either native speakers of English or international teachers who cannot speak Turkish. As a result, the sample size in this study is quite limited.

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APPENDICES

Appendix A: Timeline

Preliminary proposal Outline	February, 2017
1st thesis proposal	February, 2017
Draft of chapter 1	May, 2017
Draft of chapter 2	June, 2017
Preparation of data collection tool	June, 2017
Draft of chapter 3	July, 2017
2nd thesis proposal	July, 2017
Poster Presentation	July, 2017
Proposal to Graduate School of Education	July, 2017
Preparation of required documents for MoNE and the school permission	July, 2017
Permission from MoNE	September, 2017
Collecting data	September/ November, 2017
Analysis of data results	November, 2017
First draft of the thesis	March, 2018
Presentation and defence	April, 2018

APPENDIX B: Teacher questionnaire

Dear participant,

This study is conducted in CITE Program in Bilkent University, it aims to investigate attitudes, beliefs and challenges of teachers toward teaching mathematics lesson in a second language. Thank you in advance for your help and contributions.

Merve Yeşilkaya

merve.yesilkaya@bilkent.edu.tr

Please choose an answer according to the following criteria:

1- Never 2- Sometimes 3- Half the time 4- Frequently 5- Always

1. Lecturing in Turkish can bolster students' interest in learning more than lecturing in English.	1	2	3	4	5
2. Lecturing in Turkish allows the lesson to progress faster than lecturing in English.	1	2	3	4	5
3. Lecturing in Turkish produces a better classroom atmosphere than lecturing in English.	1	2	3	4	5
4. Lecturing in Turkish allows a teacher to go deeper into the content of the lesson than lecturing in English.	1	2	3	4	5
5. I support adopting mother-tongue education at the high school where I teach.	1	2	3	4	5
6. I feel it is easier to set examination questions using English than using Turkish.	1	2	3	4	5
7. I feel I can write better in English than in Turkish.	1	2	3	4	5
8. The greatest problem in using Turkish as the medium of instruction is the need to translate a lot of special terms.	1	2	3	4	5
9. It is easier to teach Mathematics in English than in Turkish.	1	2	3	4	5
10. Resources for teaching, e.g., textbooks and reference books, are more plentiful in English than in Turkish.	1	2	3	4	5
11. The Turkish government should raise the status of the Turkish language in society.	1	2	3	4	5

12. Learning Turkish well will benefit the learning of English.	1	2	3	4	5
13. English as the medium of instruction will certainly lead to poorer student intake.	1	2	3	4	5
14. Parents are the major obstacle in the promotion of mother-tongue education.	1	2	3	4	5
15. Students tend to neglect those subjects taught in Turkish.	1	2	3	4	5
16. Teaching a class in Turkish encourages students to speak uninhibitedly, thereby disrupting the order of the class.	1	2	3	4	5
17. Even studying every subject in Turkish will not help students with poor academic performance.	1	2	3	4	5
18. Using Turkish to study Mathematics will affect students' English proficiency.	1	2	3	4	5
19. Students with good academic performance should study all subjects in English.	1	2	3	4	5
20. The English proficiency of the students I teach is not adequate for them to study Mathematics in English.	1	2	3	4	5
21. I have a good understanding of the language policy of the high school where I teach.	1	2	3	4	5
22. It is inappropriate for instructors to teach the same lesson mixing English and Turkish.	1	2	3	4	5
23. I support teaching some courses in English and some courses in Turkish at the high school where I teach.	1	2	3	4	5
24. I want the education language in the school to be in Turkish, but students to take one or two classes to take in English to keep up with the developments in their field.	1	2	3	4	5
26. What is your opinion about teaching mathematics in English in Turkey? (Whether it is successful or not, any alternative that you suggest etc.)					

APPENDIX C: Teacher interview questions

1. How many years have you been teaching mathematics?
2. How many years have you been working in this institution?
3. In which language did you learn mathematics lesson in your high school?
4. In which language did you learn mathematics lesson in the university?
5. Do you teach mathematics in English in your institution?
6. If the language of high school mathematics education in English, does it affect the quality of education given? How?

7. If the language of mathematics education in English, how does it affect the attitude of the students towards math and success of the students?

8. How does lecturing mathematics lesson in English affect the context and comprehensive level of the lesson?

9. According to your opinion what is the most frequently encountered problem for the mathematics teachers when they teach their lessons in English? Do you have a suggestion to overcome this problem?

10. Do you need to make Turkish explanations while you are teaching mathematics lesson in English? Especially in which classes and in which topics do you need more explanations in Turkish?

11. When you prepare exams and materials, do you prefer sources in English or in Turkish? Why?

12. Do you think that the level of the students you teach is sufficient for your lesson and do they have necessary knowledge about mathematics terminology in English? Could you explain it with examples?

13. Do you prefer teaching math lesson in Turkish or English? Why?

14. How does teaching mathematics lesson in English affect classroom management?

APPENDIX D: Lesson observation form

-
1. The teacher teaches the lesson by using fluent English.

 2. The teachers' English pronunciation is clear and understandable.

 3. The teacher writes only in English on the board and also speak only in English throughout the lesson.

 4. Before starting the lesson, the teacher speaks English with their students.

 5. Teacher can provide clear and explanatory answers to students' questions.

 6. After the teachers' explanation, students need extra help from their desk mates related to teachers' explanation.

 7. Teacher makes explanations in Turkish while lecturing.

 8. The teacher uses mathematical terminology and terms correctly.

 9. The students participate in the lesson and they speak only English during the lesson.
The teacher warns the students about not to speak Turkish in the lesson.

 10. The teacher uses English materials and sources while teaching the lesson.
-

11. The teacher distributes only English worksheets and handouts.

12. The teacher uses in class dialogues and praises in English.



APPENDIX E: Permission letter

On Wed, Aug 9, 2017 at 2:17 PM, <merve.yesilkaya@bilkent.edu.tr> wrote:

Dear Kiliçkaya,

I am taking an MA course at Graduate School of Education at Bilkent University. One component of my course is to write a thesis . My research is about looking high school Mathematics teachers' beliefs and attitude towards education in an English.

Having read your study "INSTRUCTORS' ATTITUDES TOWARDS ENGLISH-MEDIUM INSTRUCTION in TURKEY", I found parts of your instrument to be a good match for use in my research. Therefore, I am writing to ask permission to use a modified version of your questionnaire.

I hope that you will be willing to share your hard work with me and look forward to hearing from you in the near future.

Best Regards,

Merve Yeşilkaya



Re: Permission

From FERIT KILIÇKAYA <ferit.kilickaya@gmail.com> Date 2017-08-09 16:39

Dear Yeşilkaya,

You can surely use and modify the questionnaire in the article entitled 'Instructors' Attitudes towards English-medium Instruction in Turkey'. I hope it will be useful for your study.

Regards,



Ferit KILIÇKAYA

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