TEACHING MATHEMATICS TO ACADEMICALLY DIVERSE LEARNERS IN MIDDLE SCHOOL CLASSROOMS: TEACHERS VIEWS AND REFLECTIONS

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ABSTRACT

TEACHING MATHEMATICS TO ACADEMICALLY DIVERSE LEARNERS IN MIDDLE SCHOOL CLASSROOMS: TEACHERS VIEWS AND REFLECTIONS

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Understanding the process that teachers go through in the classroom and identifying the challenges they face is crucial for providing inclusive mathematics education. Knowing what teachers need to deliver successful mathematics instruction is a reference point for proposing solutions. Observing teachers and gathering their opinions provides access to their behaviours and allows these behaviours to be contextualized. This thesis investigates what it means to be a mathematics teacher in a classroom with academically diverse students, from the teachers' perspective.

A qualitative-focused sequential mixed-methods design was chosen for conducting this study. A scale was developed to determine teachers' beliefs about providing inclusive mathematics in heterogeneous classrooms. Subsequently, phenomenological interviews were conducted to explore the essence of the teaching process in such classrooms in terms of knowledge and application.

It was found that teachers have no deficiency in their knowledge of teaching mathematics, but they struggle to transform this knowledge into action for inclusive teaching due to various reasons. Furthermore, findings suggest that teachers do not believe a mathematics teaching environment that can respond to academic diversity can be established under current conditions.

The findings indicate that for the improvement of the quality of mathematics teaching and the professional satisfaction of teachers, teacher education programs need to be more practical and focused on real classroom environments. Teachers need to work in cooperation to increase their capacity to respond to classroom diversity and provide student-centred mathematics education. This process requires consideration not only of teachers but also of educational policies and school administrations.

Keywords: Middle School Mathematics Teachers, Student Diversity, Inclusive Mathematics Education

ÖZ

ORTAOKUL DÜZEYİNDE AKADEMİK BAŞARI YÖNÜNDEN ÇEŞİTLİLİK GÖSTEREN ÖĞRENCİLERE MATEMATİK ÖĞRETMEK: ÖĞRETMEN GÖRÜŞ VE YANSITIMLARI

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Öğretmenlerin sınıf içerisinde geçirdikleri süreci anlamak ve yaşadıkları sorunları/zorlukları belirleyebilmek kapsayıcı matematik eğitimi sunabilmek için önemlidir. Başarılı bir matematik öğretimi sunabilmek için öğretmenlerin nelere ihtiyaç duyduklarını bilmek, çözüm önerileri sunma noktasında referans olacaktır. Öğretmenleri gözlemlemek ve onların görüşlerini almak, davranışlarına erişim imkânı sağlar ve bu davranışları bir bağlama oturtmaya izin verir. Bu tez kapsamında, akademik başarı yönünden çeşitlilik gösteren öğrencilerin olduğu bir sınıfta matematik öğretmeni olma deneyiminin öğretmenlerin bakış açısı ile ne anlama geldiği araştırılmıştır.

Çalışmanın yürütülmesi için nitel ağırlıklı sıralı karma desen tercih edilmiştir. Öğretmenlerin heterojen bir sınıfta kapsayıcı matematik sunmaya yönelik inanç düzeylerini belirlemek için bir ölçek geliştirmiştir ve takiben fenomenolojik mülakatlar yoluyla bu türlü sınıflarda gerçekleşen öğretmenlik sürecinin bilgi ve uygulama bağlamında özü ortaya konulmaya çalışılmıştır.

Öğretmenlerin matematik öğretme bilgisi açısından eksikliği olmadığı fakat kapsayıcı matematik sunma noktasında çeşitli sebeplerin bilgiyi eyleme dönüştürmekte zorlandıkları bulgusu elde edilmiştir. Ayrıca, mevcut şartlarda akademik çeşitliliğe cevap verebilecek bir matematik öğretim ortamının oluşabileceğine inanmadıklarına dair bulgular elde edilmiştir.

Elde edilen bulgular ışığında, öğretmenlerin mesleki tatmininin ve matematik öğretim sürecinin kalitesinin artırılabilmesi için, öğretmen eğitimi programlarının daha uygulamalı ve gerçek sınıf ortamlarına odaklanılması gerekmektedir. Öğretmenlerin sınıf içi çeşitliliğe yanıt verebilme kapasitelerini artırmak ve öğrenci merkezli bir matematik eğitimi sağlamak için eşgüdüm ve iş birliği içinde hareket edilmelidir. Bu, sadece öğretmenlerin değil, eğitim politikaları ve okul yönetimlerinin de dikkate alınması gereken bir süreçtir.

Anahtar Kelimeler: Ortaokul Matematik Öğretmeni, Öğrenci Çeşitliliği, Kapsayıcı Matematik Eğitimi

to My Extended Family

and

to My Nuclear Family; Göktürk Rıza, Ali Altay, Songül

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LIST OF ABBREVIATIONS

BCODP	British Council of Organizations of Disabled People
CFA	Confirmatory Factor Analysis
CTGV	Cognition and Technology Group at Vanderbilt University
DPI	Disabled Peoples' International
EFA	Exploratory Factor Analysis
ERG	Education Reform Initiative
ICIDH	International Classification of Impairments, Disabilities and Handicaps
IDEA	Individuals with Disabilities Education Improvement Act
MoNE	Ministry of National Education
MT	Mathematics Teacher
MT-SAC	Mathematics teacher employed at the Science and Art Centre
NCTM	National Council of Teachers of Mathematics
SEM	Schoolwide Enrichment Triad Model
SEN	Special education needs
SET	Special education teacher
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

Imagine a mathematics classroom where students differ in terms of various academic aspects, such as their previous mathematical learning experiences, their familiarity with school climate, their readiness to learn and ability to grasp mathematical concepts. The goals of the mathematics teacher in this classroom are to involve all students in useful learning activities, particularly helping those who may not be familiar with certain classroom procedures. The teacher wants every student to face a math challenge, achieve some success, connect it to their existing knowledge, prepare for future challenges, and join group discussions with classmates about the methods they used and the work they completed.

Despite its perceived advantages in favour of students, teaching mathematics in academically diverse classrooms is, nonetheless, a complicated task for teachers. Before discussing the complexities of teaching in academically diverse classrooms, it's important to understand the homogeneous settings.

Placing students in separate classrooms where students are grouped according to similar ability or achievement levels is defined as Ability Grouping or homogeneous grouping (Boaler, 2020). This separation can occur within a single class or extend across multiple classes. Although ability grouping is widespread in some countries (e.g., United States of America, where it is known as 'tracking', and in England, where it is referred to as 'setting.'), many European and Asian countries are moving away from the practice of ability grouping (Boaler, 2020). For example, Finland, one of the most successful countries in international exams (e.g., TIMMS and PISA), holds the view that ability grouping serves as an obstacle to the pursuit of equality (Sahlberg, 2011). Similarly, in Japan, there is robust agreement that students should not be subjected to measuring academic abilities or aptitudes during the nine years of compulsory education (Bracey, 2003). Even though students in England are put into different classes based on their abilities, a government report, known as the Primary Review found that grouping students by ability does not improve their learning but can even harm their social and personal growth. Teachers believe they can give students better-suited work in these groups; however, many students find that the work assigned to them is not appropriately challenging — "often, it is too easy". (Blatchford et al., 2008, pp. 27–28; 2010). Nunes et al. (2009) state that ability grouping prevents the progress of students. Additionally, ability grouping, a system that often overlooks some students for the benefit of others, negatively affects the academical achievement of low and middle group students and does not affect the academical achievement of high achiever students.

Proponents of tracking contend that by improving the curriculum and teaching in lower-level classes, and utilizing more equitable methods for student placement, the adverse effects of tracking on underperforming students could be lessened (Gamoran & Weinstein, 1998; Loveless, 1998). However, Heubert and Hauser (1999) undertook a study on behalf of the National Research Council and did not identify any public schools where low-track classes offered high-quality instruction. In a similar vein, the scholarly literature is replete with debates about the most effective method of grouping students (Esposito, 1973; Wyman & Watson, 2020), however, the recognized advantages of student grouping include enhanced efficiency in time management throughout the learning process, enhanced clarity in addressing student queries, improved responsiveness to student feedback, and a more effective and simpler way to monitor progress of each student within the group (Černilec et al., 2023). Additionally, from the learners' perspective, it was observed that possessing a strong individual mastery of the subject matter can serve as an impediment to effective group collaboration, as the pace of collective learning may either outstrip or lag behind their own rate of comprehension (Boaler, 1997). Moreover, students with lower performance levels are at greater risk of being undervalued and subjected to ridicule

(Ireson & Hallam, 2001), and typically display reduced self-confidence (Di Martino & Miles, 2005). Additional limitations of student grouping include polarization, the formation of elitism, reduced expectations for students in lower-level groups, and the facilitation of segregation (Di Martino & Miles, 2005). Research on ability-grouping methods has consistently highlighted its negative impact on both the formation of students' identities and their academic achievements.

On the other side of the spectrum, mixed ability grouping or heterogenous grouping is a teaching strategy in which students of diverse skills and abilities are amalgamated in the same school or class. Heterogeneous classrooms comprise a diverse array of students, varying not only in abilities but also in interests, cultural backgrounds, and learning styles. Such classrooms may encompass a spectrum of learners, ranging from those who are advanced to those who face challenges in specific subjects or in their overall academic performance. When compared to ability grouping or tracking, mixed-ability grouping promotes more inclusive education and provides opportunities for peer learning and collaborative interactions among students. Additionally, heterogeneous or mixed-ability groups are conducive to a more equitable learning environment, supporting students across all levels (Boaler, 2008; 2020). Furthermore, a review study by Gabaldón-Estevan (2020) indicates that children's experiences with exclusion and diversity significantly impact their choices regarding friendships. This implies that schools with a diverse student population foster a school society that is more embracing of inclusion. Ability grouping is less commonly practiced or is generally avoided, especially for younger students, in countries that operate under the belief that high achievement is attainable for all (Dweck, 2006) or put the principle of equality at the focus of education (Sahlberg, 2011). For example, in Finland, it is preferable for students to study in heterogeneous classroom environments throughout their school career (Sahlberg, 2021). Similarly, in Pacific Rim Asian countries, ability grouping is rare or absent because they subscribe to the philosophy that learning is a dynamic process shaped by effort and diligence, rather than by fixed and unchangeable abilities (Stigler & Hiebert, 2009).

When considered in the context of mathematics education, although Askew and Wiliam (1995) observed in their review of multiple studies that higher-level groups in mathematics demonstrated improved performance when educational materials were specifically personalized for them, therefore, it can be inferred that without the use of suitable teaching resources, the positive impacts of student grouping on their academic achievements may not be expected. Furthermore, one possible cause for the ineffectiveness of homogeneous student grouping may be a prevailing assumption among teachers that they are instructing a uniform group of students, and therefore do not need to differentiate or customize tasks within those groups. This overlooks the fact that even within these groups, student differences exist and should be taken into account (Boaler, 1997). Conversely, recent empirical evidence from Černilec et al. (2023) advocates for the adoption of heterogeneous grouping in mathematics education. This aligns with earlier comparative studies, such as that by Linchevski (1995), which found no significant advantages to homogeneous grouping in terms of mathematical achievement. In contrast, students in heterogeneous settings consistently demonstrated superior performance (Boaler, 1997; Leonard, 2001). Additional research by Burris et al. (2006) indicated that students transitioned from tracked to non-tracked settings exhibited significantly higher pass rates in advanced mathematics courses. Similarly, a study by Venkatakrishnan and Wiliam (2003) conducted in secondary school settings revealed that high-achieving students derived minimal benefits from fast-track groups. However, the amalgamation of diverse abilities within the same educational setting had a pronounced positive impact on student progress, particularly benefiting lower-performing students, while imposing minimal disadvantages on high-performing students. Additionally, Nunes et al. (2009) further corroborated these findings, indicating that students in heterogeneous classrooms outperformed their peers in tests of mathematical reasoning.

Students of various levels and categories such as mathematically highly able pupils or talented and gifted students, fast learners, moderate students who meet the class-level expectations, slow learners, children with learning difficulties in mathematics, student with special needs or student with special educational needs, and students with disabilities can exist in mixed-ability or heterogeneous classrooms. This diversity in the classroom, extends beyond heterogeneous grouping or mixed-ability classes. This diversity is actually in line with inclusive education. The Education for All trend, under the leadership of UNESCO, which began nearly three decades ago and goes beyond the mixed classroom approach (Makagiansar, 1990), seeks to ensure that students are educated in the least restrictive environment. In this context, the mainstreaming approach emerged, which provided partial participation of students with disabilities in general education institutions for certain courses or days. Later, integrated education emerged to ensure full-time participation in general education institutions. The current focus of educational discourse is the creation of inclusive educational environments where there is no segregation or exclusion, and where all students are educated together. The reason why inclusive education was not mentioned so far is that a narrower understanding of inclusive education as the inclusion of only individuals with disabilities or special educational needs in general education institutions or classes is seen in the literature and practice. The concept of inclusive education goes beyond the placement of students with disabilities in general education classes; it involves a comprehensive restructuring of education systems to make general education classes more accommodating to all forms of diversity. In this study, the broad definition of inclusive education is considered: not only individuals with disabilities or special educational needs but also other groups such as gifted students or ethnically excluded or foreign-language students are educated in the same classroom. In this study, the heterogenous classroom or mixed-ability grouping is meant to be an environment in which everyone can learn mathematics together without any limitations in terms of both ability and other aspects and, it aims to create inclusive mathematics education. Henceforth, the concepts of heterogeneous class, mixed-ability class or inclusive class mean that everyone should be educated together as much as possible by creating environments where students from various backgrounds, while providing equitable educational opportunities to all students, regardless of their abilities, backgrounds, or needs.

In the past years, there was a significant increase in research concerning mathematics teachers. This extensive body of research aims to enhance our understanding of mathematics teachers' knowledge, beliefs, and pedagogical practices. These studies offer valuable insights that guide mathematics teacher educators in aligning instructional strategies with contemporary perspectives on mathematics education (National Council of Teachers of Mathematics [NCTM] 2000; 2014). However, implementing significant changes remains a challenge for many teachers (Chapman, 2016; Tomlinson et al., 2003; Tomlinson, 2017). Specifically, the persistent challenge for teachers lies in effectively teaching mathematics in academically diverse classrooms (Gervasoni & Peter-Koop, 2020).

Although the majority of sources suggest that mathematics education is more effective in mixed-ability classrooms, as opposed to those segregated by student ability levels, teaching students in a single classroom with different thinking styles and abilities, and various learning levels requires significant expertise, attention, and skill to meet the diverse learning needs of students (Mevarech & Kramarski 1997; Rubin 2008). While teachers play a crucial role in providing an environment in which all students feel valued and not excluded, teaching a diverse group of children requires educators to possess instructional, systematic, and evaluative abilities. Collaboration between professionals is also essential (Wang & Fitch, 2010; Wolfswinkler et al. 2014). Teachers are required to establish common mathematical concepts and identify potential obstacles and conditions conducive to learning.

Moreover, one prerequisite for effective strategies in heterogeneous classrooms is an expanded perspective that transcends one's own discipline. Mixed-ability or inclusive environments necessitate an understanding of how mathematical skills are learned, knowledge of scaffolding techniques, and familiarity with specific methods for supporting children with unique needs. Moreover, teachers need to acknowledge and understand their own and their students' beliefs, as well as various emotional and motivational factors (Bock et al., 2019). Therefore, teaching mathematics to such a diverse student group and creating educational settings that feed to a wide range of academic needs is challenging. It requires specialized knowledge, experience, skills, and a positive attitude.

In this context, teachers need to make a great effort to achieve success in mathematics education in heterogeneous or inclusive classes for all students. Rouse (2008) indicates that:

> Developing effective inclusive education is about not only about extending teachers' knowledge, but it is also about encouraging them to do things differently and getting them to reconsider their attitudes and beliefs. In other words, it should be about 'knowing', 'doing', and 'believing'. (p. 12)

Florian (2008) explains this conceptual model, positing that any two elements among 'knowing,' 'believing,' and 'doing' are assumed to impact the third one (Figure 1). For example, if a teacher believes in the idea of including all students and tries it by not leaving any student out, they can learn more about how to do this well. On the other hand, a teacher might believe in including all students but not know how to do it. If they acquire more knowledge, perhaps through professional development or coursework, they may gain the confidence to implement inclusive practices. Similarly, Similarly, a teacher who believes in inclusion but lacks the confidence to apply it may gain the necessary knowledge and confidence by taking a course on the subject. On the other hand, some teachers may have the knowledge but are uncertain about their belief in inclusion. By working in an environment that practices inclusion, they may come to see its effectiveness. The key takeaway is that teachers don't need to have all three elements—knowing, believing, and doing—aligned to make progress; they can be at different stages in each (Florian & Black-Hawkins, 2011).

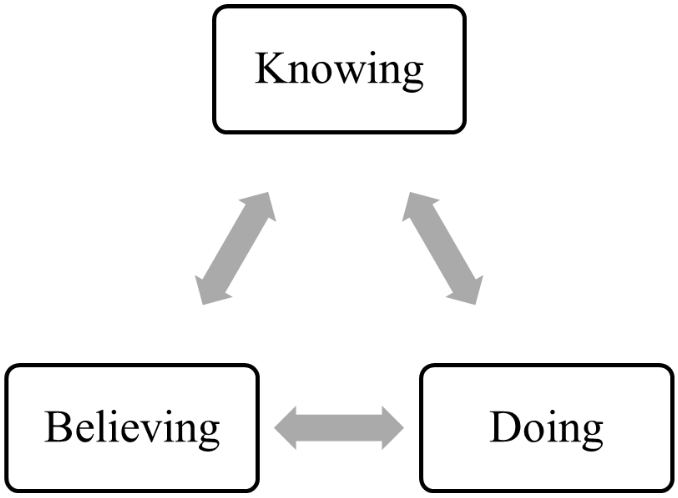


Figure 1 Reciprocal Triangular Relationship

According to these explanations, several factors are central for the development of effective teachers to teach mathematics for academically diverse learners. First, what teachers know for teaching mathematics in these classrooms is essential. This includes their knowledge of teaching strategies, how children learn, and what children need to learn, as well as methods for measurement and classroom management. Second, what teachers actually do in the classroom is equally important. This encompasses turning their knowledge into actionable teaching practices and collaborating with both colleagues and students. Finally, teachers' beliefs also play a significant role, such as whether they believe all children can learn and have the right to education. Identifying these elements—knowledge, actions, and beliefs—is fundamental for the ongoing professional development of teachers.

1.1. Purpose of the Study

The aim of this study is to investigate the knowledge, practices and beliefs of mathematics teachers regarding the teaching of mathematics in academically diverse classrooms in middle school.

In alignment with the primary objective of the research, the following research questions guided the study:

i. According to participating mathematics teachers, what is it like to teach mathematics to academically diverse learners in a middle school classroom?

ii. How do Middle School Mathematics Teachers perceive and describe their teaching experience with academically diverse learners?

iii. *What is the meaning, structure, and essence of the teaching to* academically diverse learners *for* Middle School Mathematics Teachers?

Additionally, in this study, within the framework proposed by Rouse (2006, 2008), the aim is to develop and validate "Teacher Self-Reflection Scales" composed of three different scales to elucidate middle school mathematics teachers' reflections on their 'knowledge', 'beliefs' and 'doing' in relation to teaching mathematics to students with academically diverse backgrounds. In pursuit of this aim, this research seeks answers to the following research questions:

iv. Are the scales designed to reveal teachers' reflections on their knowledge, beliefs and practices valid?

v. Are the scales designed to reveal teachers' reflections on their knowledge, beliefs and practices internally consistent?

vi. Is there empirical evidence supporting the structural validity of the scales designed to reveal teachers' reflections on their knowledge, beliefs and practices?

1.2. Significance of the Study

The existing literature underscores the critical role that teachers' opinions or reflections can play in various dimensions, including assessing the effectiveness of teacher education programs (Blake & Hanley, 1998; Barron, 2019; Rice, 2003), enhancing teachers' skill sets (Darling-Hammond, 2000; Schmidt et al., 2011), and facilitating teacher change (Chapman, 2016). In light of these information, the significance of this study can be outlined as follows:

This research contributes to the existing literature by examining the challenges faced by students with diverse academic abilities in receiving mathematics education, as well as the approaches adopted by teachers in this context (Gervasoni & Peter-Koop, 2020; Helgevold, 2016). The study holds contemporary relevance, particularly in an era where the concept of inclusive education is increasingly being adopted and mainstreamed (Dweck, 2006). The findings of the study can offer practical guidelines for teachers to more effectively instruct students of varying academic levels within a mixed-ability classroom (Wang & Fitch, 2010). It seeks to uncover insights that can serve as a foundation for professional development initiatives aimed at enhancing teachers' instructional skills for teaching in diverse settings. The findings from the study have the potential to contribute to a more inclusive educational process in the teaching of mathematics to students with diverse academic abilities (Helgevold, 2016). This research can serve as a reference for policymakers who are involved in developing curricula for middle school mathematics and education faculties (NCTM, 2014). The beneficiaries of this study include academics, educational policymakers, and particularly “mathematics teachers who deal with students of diverse academic abilities” (Tomlinson et al., 2003, p. 135). The study employs a methodology that comprehensively evaluates the interwoven and reciprocal relationship among “the knowledge, beliefs and practices of mathematics teachers” (Florian, 2008, p. 205). This research can help broaden the theoretical framework necessary for students with diverse academic abilities to receive inclusive mathematics education (Rouse, 2008). The study underscores the social importance of inclusive education and the formation of heterogeneous classrooms, examining how such educational settings could contribute to societal change or understanding (Makagiansar, 1990). This research has the potential for positive impact at local, national, and even international levels in terms of educational policies and practices (Sahlberg, 2011). Due to its design, which encompasses multiple disciplines such as teacher education and educational policy, the study has an interdisciplinary impact (Florian & Black-Hawkins, 2011). Ultimately, the study intends to contribute to the improvement of educational quality.

1.3. Definition of the Terms

Inclusive Education: Inclusive education refers to the practice of integrating all students into common classrooms within mainstream schools. This approach aims to extend equitable learning opportunities to traditionally marginalized groups, including not only children with disabilities but also those who are speakers of minority languages. In an inclusive educational system, the distinct contributions of students from diverse backgrounds are valued. This facilitates a mutual enrichment among heterogeneous groups, ultimately benefiting the entire learning community. Inclusive education stands as the most efficacious method for ensuring equitable access to educational resources, enabling all children to acquire the knowledge and skills essential for their overall development (Florian, 2008; 2013; 2014; Göransson & Nilholm, 2014).

Inclusive Classrooms: An inclusive classroom is defined as a regular education setting where students with and without (learning) differences are educated side by side. Such classrooms are comprehensive in nature, catering to the varied academic, social, emotional, and communicative requirements of all students. (DeSimone & Parmar, 2006; Tirri & Laine, 2017).

Academically Diverse Learners and Academically Diverse Classrooms: In this study, the term "academically diverse learner" is used to describe a student whose learning needs, abilities, and potential significantly differ from the expectations at their grade level. The reasons for this academic diversity may include learning capabilities, social, cultural, and linguistic backgrounds, as well as attitudes and motivations towards mathematics (Heacox, 2018; Small, 2020; Tomlinson, 2001, 2017).

Correspondingly, "academically diverse classrooms" can be defined as classes where students with various learning styles, educational histories, and learning paces are present together. Students in these classes may be at different emotional and social maturity levels. There can be substantial differences in the learning speeds of students in these classes. Students can be at different academic levels at different times. Their readiness and interests can vary (Heacox, 2018; Small, 2020; Tomlinson, 2001, 2017).

The reason for preferring the term "academically diverse classrooms" over "heterogeneous classes" in this study is that heterogeneous classes are a much broader concept related to ethnic, religious, language, and other non-academic characteristics, while academically diverse classrooms are limited to differences such as academic abilities, learning styles, and learning needs, which are deemed more manageable for the purpose of this study. Academic diversity in this study is considered as a continuum. At one end of this continuum are students with advanced understanding skills who are distinctly successful in mathematics classes. At the other end are students who genuinely struggle with learning mathematics and have specific and significant learning difficulties. Moreover, between the two ends of the continuum, there are students who meet grade-level expectations and can be described as 'regular'. It is also assumed that there are groups of slow learners as well as high-achieving student groups.

Special Education: Special education refers to “the educational programs developed to meet the educational and social needs of individuals who significantly differ from their peers in terms of individual and developmental characteristics as well as educational competencies. These programs are carried out in appropriate settings with specially trained personnel” (Çitil, 2020, p. 12).

Students with Special Educational Needs: The term ‘Special Educational Needs’ is used to “describe learning difficulties or disabilities that make it harder for children to learn than most children of the same age". Children with Special Educational Needs are "likely to need extra or different help from that given to other children their age" (Ainscow et al. 2013, p. 15; Norwich & Lewis, 2007).

Students with Disability: Types of disabilities and the term 'students with disability' are defined in Individuals with Disabilities Education Improvement Act [IDEA] (2004) as:

> "The term "child with a disability" means a child "i) with intellectual disabilities, hearing impairments (including deafness), speech or language impairments, visual impairments (including blindness), serious emotional disturbance (referred to in this title as 'emotional disturbance'), orthopaedic impairments, autism, traumatic brain injury, other health impairments, or specific learning disabilities"; and "ii) who, by reason thereof, needs special education and related services."

Gifted and Talented Students: Gifted and talented students are those who demonstrate, or have the potential to demonstrate, performance levels that are significantly above their peers in the same age group, experience or environment across one or more domains. These students necessitate adjustments in their educational experiences to fully develop and actualize their innate potential. (Özdemir & Özçakır, 2022).

The expression "students with giftedness and talents" emphasizes the individual before their characteristics or conditions, making it a person-first language and is acknowledged by the researcher as a more inclusive language choice. However, this study opts for the widely used and conventional term "gifted and talented students" in an effort to maintain consistency with the established literature.

Resource Room: The resource room is defined as an educational environment organized and staffed to provide support education services in the areas needed by students who continue their education through integrated practices, as well as for gifted students (Regulation on Special Education Services, 2018). Additionally, the resource room is a "separate, remedial classroom in a school where students with disabilities or students with significant learning difficulties, receive direct, specialized education and academic improvement on an individual or group basis, as well as assistance with homework and related assignments" (Heward, 2006, p.27).

Beliefs: Philipp (2007) defines beliefs as "the lenses through which one looks when interpreting the world" (p. 258). There are many different types of beliefs that may influence teaching, including but not limited to "beliefs about mathematics, beliefs about the teaching of mathematics, beliefs about the learning of mathematics, beliefs about students, beliefs about teachers' own ability to do mathematics, to teach mathematics, etc". (Liljedahl & Oesterle, 2020, p. 826)

Knowledge: The terms "what teachers know" or "teachers' knowledge" generally include the pedagogical and subject-specific knowledge and skills that teachers possess. This includes teaching strategies, classroom management, student assessment methods, subject matter knowledge, and the ability to understand individual student needs. Additionally, teachers' professional experiences, professional development, and their capacity for collaboration with colleagues are also other components of this concept (Mesa & Leckrone, 2020; Rowland, 2020).

Attitudes: Attitudes may be defined as "a disposition to respond favourably or unfavourably to an object, person, institution, or event" (Ajzen, 1988, p. 4). In essence, attitudes can be considered as responses to individuals' belief systems. In other words, attitudes are the expression of individuals' beliefs (Liljedahl, 2005). In this study, attitudes are considered as attitudes towards academically diverse learners and academically diverse classrooms and are seen as a part of 'doings' (Rouse, 2006), hence they are included in the definitions of the terms part.

CHAPTER 2

LITERATURE REVIEW

Although this study primarily focuses on middle school classrooms with academic diversity, it is deemed necessary to specifically address student groups with diverse academic needs. Therefore, this chapter will provide a literature review on students with special educational needs and special education, education for gifted and talented students and disadvantaged students and their education. It will also offer insights into studies concerning the mathematics education of these groups. Following this, the chapter will discuss research on inclusive education and inclusive mathematics education. Moreover, this section will include studies related to teachers' knowledge, attitudes or classroom practices and beliefs.

2.1. Education of Students with Special Educational Needs

Every child's right to education is protected in the Universal Declaration of Human Rights and the Declaration of the Rights of the Child. It is also recognized that while every child possesses distinct physical, cognitive, emotional, social, and learning characteristics, they can benefit from general education services as long as these differences remain within certain limits. In the learning environment, some students learn more quickly, recall information easily, and can apply what they learned to new situations. Others may require more repetition and experience difficulties in retaining new knowledge and skills and in generalizing them to different contexts (Heward, 2006). The differences among children are not only manageable but also visible; their similarities outweigh their differences (Meyen, 1996). However, when the magnitude of these differences is significant, focusing on these differences rather than similarities can hinder children from benefiting adequately from general education services. In such cases, providing special education services may become necessary to uphold their right to specialized education.

Special education is defined as the instructional process customized for individuals who cannot benefit sufficiently from the regular educational process. This process utilizes specialized materials, tools, methods, and techniques, and takes advantage of environments and expert personnel suited to the unique characteristics of the individual. The goal is to foster independence and maximize participation in society. The phrase "cannot benefit sufficiently from the regular educational process" refers to individuals who, due to developmental differences from their peers and age group, are unable to benefit from the educational process at the desired level. These developmental differences may stem from various developmental processes such as visual, auditory, physical, language, and cognitive growth. Depending on the source of these differences, individuals who require special education services and the disability groups they form are identified and named accordingly (Heward, 2009; Olson et al., 2008; Westling & Fox, 2004). Considering this definition, to better understand the terms ‘having special needs’ or ‘students with special educational needs’, it is beneficial to define and distinguish between the related terms ‘impairment’, ‘disability’ and ‘handicap’ as this clarification will aid in comprehending the subject more clearly. While the terms impairment, disability and handicap are often used interchangeably, they do not have the same meanings.

Impairment refers to the condition where an individual experiences difficulty in the functioning and performance of organs due to various factors that may occur prenatally, during birth, or postnatally (Ataman, 2013). Another definition characterizes impairment as “any loss or abnormality in psychological, physiological, or anatomical structure” (Heward, 2006, p.3). It denotes the loss or reduced function of a body part or organ, such as the absence of arms or a leg.

Disability is a broad term that is defined in both legal and scientific ways and encompasses physical, psychological, intellectual, and socioemotional impairments

(World Health Organization, 2001, 2011). A disability is existing when an impairment limits an individual's ability to perform certain activities (such as walking, seeing, or reading). However, a person is not considered handicapped by their disability unless it results in difficulties in educational, personal, social, vocational or other areas of life. For instance, a child who lost a leg but adapted to use a prosthetic limb and who is able to fully participate in school and other activities is not handicapped, at least in terms of their interaction with the physical environment (Heward, 2006).

Handicap is a term used to describe the barriers and challenges that were faced by individuals with disabilities or impairments when they interact with their environments. The impact of a disability varies depending on the setting; for example, a child with a prosthetic limb might be at a disadvantage in a competitive sport setting like basketball but not in an academic classroom. Handicaps can often be a result of societal barriers, such as negative attitudes or behaviours from others, which can unnecessarily limit individuals' access to and participation in educational, professional, or community activities (Heward, 2006). For example, if a school entrance lacks a ramp, a wheelchair-bound child's deficiency becomes a disabling barrier. Similarly, if a teacher believes that a child with cognitive disabilities will not progress no matter what is done, this negative attitude can become a disabling barrier to the student's development (Akçamete, 2009; Namlı & Sungur, 2022).

Based on these definitions or expiation; **children with special needs** can be described as those who exhibit significant developmental differences compared to their peers as articulated in the definition of special education (Ünlü, 2022). Depending on the nature of their differences from their peers, children requiring special education are often categorized into various subgroups. The classification of children with special needs is known to offer several benefits, including facilitating better communication among professionals, more robust advocacy for legal rights, increased visibility of individuals with special needs (Akçamete, 2019; Bogart, 2023; Houtrow et al., 2019). However, the intention here is not to stigmatize or marginalize students but rather to ensure the more efficient allocation of funds and resources, as well as the capability to plan effectively and efficiently (Bogart, 2023; Florian & Black-Hawkins, 2011; Kayama & Haight, 2018). In Türkiye, the Regulation on Special Education Services (2018) uses the term ‘**individual with special education needs’** and defines it as ‘an individual who shows significant differences in individual and developmental characteristics as well as educational competencies compared to peers.'. In the Special Education Services Regulation (2018), individuals with special education needs are categorized under 11 headings (Table 1).

Although not legally defined in the Special Education Services Regulation, individuals with learning difficulties, language and speech disorders, emotional and behavioural disorders, and multiple disabilities are also included in the category of individuals with special education needs according to national and international literature (Ataman, 2013; Kirk et al. 2022). In the United States, the Individuals with Disabilities Education Act (IDEA, 2004) is a federal law that provides free and appropriate public education to children with disabilities nationwide. This law ensures that children with disabilities receive special education and related services.

Under IDEA, disabilities are categorized into 13 distinct types: i) *Autism*, ii) *Deaf-blindness*, iii) *Deafness*, iv) *Emotional disturbance*, v) *Hearing impairment*, vi) *Intellectual disability*, vii) *Multiple disabilities*, viii) *Orthopedic impairment*, ix) *Other health impairment*, x) *Specific learning disability*, xi) *Speech or language impairment*, xii) *Traumatic brain injury*, and xiii) *Visual impairment*. When comparing the two legal documents, it is noted that unlike the regulation in Türkiye, the American document does not differentiate disability types into levels such as moderate, mild, or severe.

In addition to these, the concept of special education often conjures images of segregated classrooms or institutions; however, public education systems are mandated to facilitate the education of students receiving special education services within general classroom settings to the greatest extent feasible. Accordingly, the principle of the Least Restrictive Environment stipulates that student who receive special education services should be educated alongside their peers in mainstream classrooms whenever possible (IDEA, 2004). In this context, the educational settings available for students with special needs in Türkiye can be arranged from the least to the most restrictive as shown in Figure 2 (Ünlü, 2022).

Table 1 *Individuals with special education needs and their legal definitions*

Category	Legal Definition
Individual with severe autism	Refers to an individual who, due to significant limitations in social interaction, verbal and non-verbal communication, interests, and activities, requires intensive special education and support services.
Individual with moderate autism	Refers to an individual who, due to limitations in social interaction, verbal and non-verbal communication, interests, and activities, requires a significant amount of special education and support services.
Individual with mild autism	Refers to an individual who requires special education and support services due to mild limitations in social interaction, verbal and non-verbal communication, interests, and activities.
Individual with severe intellectual disability	Refers to an individual who, in addition to intellectual impairment, is unable to acquire self-care, daily living, and basic academic skills, and requires lifelong care and supervision.
Individual with moderate intellectual disability	Refers to a person who, due to limitations in intellectual functioning and conceptual, social, and practical adaptive skills, requires intensive special education and support services to acquire basic academic, daily living, and vocational skills.
Individual with mild intellectual disability	Refers to an individual who, due to mild limitations in intellectual functions and conceptual, social, and practical adaptive skills, requires limited special education and support services.
Individual with a physical disability	Refers to an individual who requires special education and support services due to disorders in the muscular, skeletal, and nervous systems.
Individual with a visual impairment	Refers to an individual who requires special education and support services due to a partial or total loss of vision.
Individual with hearing impairment	Refers to an individual who, due to partial or total loss of hearing sensitivity, requires specialized education and support services.
Individual with special abilities	Describes an individual who learns more rapidly compared to peers, exhibits advanced capacity in creativity, art, leadership, possesses special academic talents, comprehends abstract concepts, prefers to act independently in areas of interest, and demonstrates high-level performance.

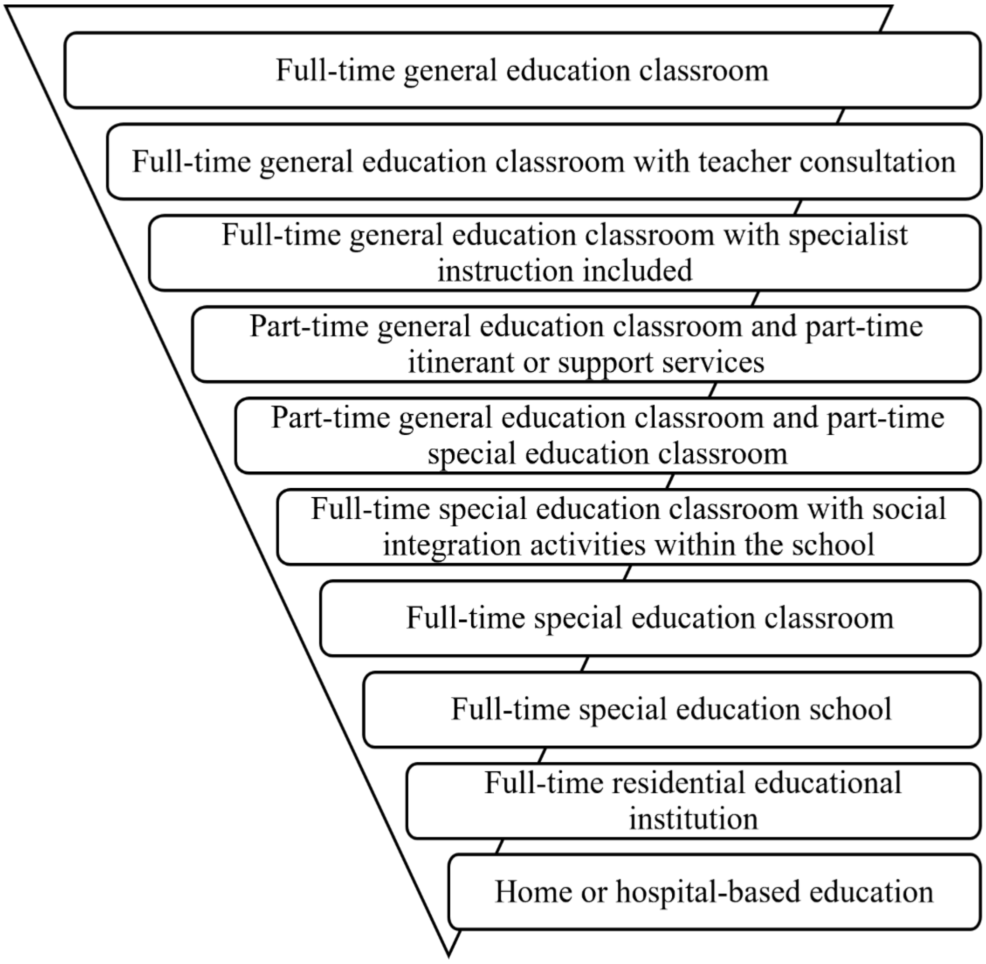


Figure 2 Educational Settings from least to the most restrictive

On the other hand, special education encompasses a vast array of topics, and it is beyond the scope of this study to address every detail. Thus far, a general overview was provided on the subject of special education. Those interested in more detailed information may read additional sources (see Ünlü, 2022; Florian, 2014; Heward, 2006; Kirk et al., 2022). Consistent with the focus of this research, the subsequent section will present information and studies concerning the mathematics education of students with special needs.

2.1.1. Mathematics Education for Students with Special Educational Needs

Shih et al. (2011) categorize some common features of effective teaching for permanent learning in mathematics classes for students with disabilities or students with learning disabilities. According to the authors, effective teaching starts with understanding students' actual mathematics knowledge, also desires and needs to determine what students will learn in mathematics courses.

Second feature is making student cantered and challenging classroom environments for students with disabilities to learn mathematics well. While some authors (i.e., Fuchs et al., 2011; Hudson, & Miller, 2006) advocate the explicit instruction and drill practices for mathematics instruction of students with disabilities, others (i.e., Babbitt, 2006; Baroody, 2011) disagree with this stand. According to Baroody (2011), the reasons that lay behind the thought of supporters of explicit instruction are the low expectations from students with disabilities, the relative unimportance of mathematical achievement, the inadequate research in mathematics education and the inadequate preservice education or professional development in mathematics education. Another reason is that knowing and understanding mathematics is more complex for special education teachers when compared to reading and writing (Babbitt, 2006).

The third feature is related to understanding the critical point that students do not all learn in the same manner and at the same rate (Badian, 1999; Fox, 1998; Keeler & Swanson 2001). Teachers essentially should start teaching based on the existing understanding levels of their students to facilitate learning of new mathematical concepts. Without this foundation, students may attempt to memorization, which is especially challenging for those with special needs, and can hinder their genuine comprehension of mathematics (Allsopp et al., 2003).

Fourth feature is that incorporating multiple representations of mathematical ideas increases the likelihood that teachers will touch every student and expand all students' understanding of core ideas. Nevertheless, Mastropieri and Scruggs (2014) states that multiple representations are reasons for ambiguity, because students think each representation as a separate concept. In fact, Ainsworth et al. (2002) found that when successful translation between multiple representations of mathematical concepts occurs, children become successful with both representations independently.

Fifth, almost every feature of problem-solving is a chance to teach mathematics for students with disabilities. Maccini and Hughes (2000) propose the STAR (Search, Translate, Answer and Review) strategy for problem-solving process of students with disabilities. They found that problem solving improve mathematical knowledge of students with disabilities at the concrete, semi concrete, and abstract levels.

Sixth, supportive and cooperative classroom learning environment where taking risks is safe and peer groups exist is a bridge for disposition to learning. However, active engagement during group or class discussion is a must to incorporate students with disabilities (Tieso, 2005).

Seventh, scaffolding, time management, homework, and assistive technology are several effective methods to adapt mathematics teaching to students with disabilities. Homework assignments extend opportunities for students with disabilities to think about mathematical concepts, and practice for automaticity when they are carefully planned (Paulu, 1995). Assistive technology services are common solutions to provide opportunities and create environments for students with disabilities. Because assistive technology increases independence and interactivity, students with special educational needs can benefit from assistive technology in anywhere by him/herself. Additionally, students use time efficiently when they engage learning stations such as computer, activity, game, etc. (Bouck & Flanagan, 2009).

Eighth, planning and resuming above mathematics teaching requires working with other colleagues, parents, principal, and so on (European Agency for Special Needs and Inclusive Education [EASNIE], 2018). Creating an inclusive ethos starts with establishing inclusive school principles. These principles motivate all personnel to accept responsibility for everybody. Teachers' consideration of the identity and background of all students to gain access and raise expectations is effective in creating a common culture (Swann et al., 2012). Students who think they are part of the school community tend to be more academically better performer and more motivated at school, so focusing on students' well-being speed up the formation of school culture (OECD, 2017).

Although Shih et al. (2011) made recommendations for effective mathematics teaching, many of students with disabilities have difficulties, especially, in learning mathematics. Students with impairments or disabilities require different methods and materials for mathematics instruction (Allsopp, et.al., 2003; Siegler et al., 2010; Shin, et.al., 2017). In this context, some studies conducted on the mathematics education of students with disabilities or special educational needs are as follows:

Maćkowski et al. (2022) posited the necessity of identifying effective teaching and learning methods for visually impaired students. Starting from the challenges these students face in managing structural information in mathematical formulas, which is crucial for their academic and vocational success, they presented an instruction that includes the use of computer-assisted mathematics learning to assess and enhance their motivation in learning mathematics. The study's results show that this alternative teaching method provided significant improvements in four of eleven assessment categories related to motivation. These categories are i) "the success in progress (adjusting the difficulty of learning)", ii) "presentation of the material", iii) "approval (both group and individual)", and iv) "alternative presentation of mathematical materials" (p. 565). The research concludes that the extended multimedia method could potentially enhance the learning experience and motivation of visually impaired students in mathematics.

In their study, Nahar et al. (2022) mention the educational challenges that are faced by blind students in Bangladesh, particularly in learning mathematics through Braille. By identifying these students' difficulties which were experienced for mathematical structures and calculations, the researchers developed an interactive math Braille learning application, which use Nemeth Codes, to facilitate and improve the learning process. The study involves a detailed needs assessment to understand the specific educational barriers and development and testing of a prototype application. This application intended to support blind students in complex calculation tasks that are difficult due to the lack of accessible tools like talking calculators. The findings emphasize the possible significance of these technological tools to improve the mathematical learning experience for blind students. Additionally, the study mention that application has a critical role in students' independence and academical success.

Similarly, the study by Brawand and Johnson (2016) emphasises the importance of developing effective mathematics instruction methods for blind students or students with visual impairments. Authors state that the abstract concepts and visual presentation of the subjects are often compelling and difficult to perceive for blind students. The study state that blind students should learn mathematical skills same as their peers without disabilities via suitable settings and materials. For achieving this goal, the authors recommend a series of various instructional tools which are abacus, braille codes, manipulatives, tactile graphics, and hands on materials. The study highlights that early usage of these tools, in conjunction with braille mathematical codes, is crucial to foster engagement. Teachers can help visually impaired students to meet academic goals and close the gap in learning experiences compared to their peers without disabilities by facilitating the usage of tactile and concrete materials.

Another study by Nazemi et al. (2012) proposes ‘MathSpeak’ which is a computer system designed to convert mathematical formula into an audio format for vision-impaired students. The researchers firstly recognized the gap in mathematical skills between students with and without disabilities, then they developed an application that is usable to transform mathematical expressions by preserving their conceptual content while excluding their visual descriptions. This method allows blind students to understand complex mathematical concepts that are typically visual. According to authors, MathSpeak facilitates a more equitable educational experience for blind students, potentially reducing the gap in mathematics education and providing them with better opportunities in school and vocational life, by transforming formula into words and making mathematics easy.

For students diagnosed with autism spectrum disorder (ASD), the review study of Siregar et al. (2020) deals with the effectiveness of various instructional strategies in teaching mathematics. Neurological challenges faced by individuals with ASD are mentioned. These are issues in social interaction, communication, and repetitive behaviours, which can affect their academic learning. Although students face these challenges, students with ASD can engage in learning when appropriate methods are employed. The research combined findings from various studies to answer specific questions related to mathematics education for students with ASD. Through a five-stage literature review process, the study evaluated interventions and their outcomes. Their findings indicate that most educators focus on improving computational procedures, knowledge of mathematical facts, and problem-solving skills. The interventions include the use of flashcards, traditional algorithms, and technology. The results imply that while there is no one-size-fits-all approach, employing a range of adjusted strategies can yield positive educational outcomes for students with ASD in the area of mathematics.

In a similar study by Chu et al. (2020) explores the integration of e-learning with adaptive educational methods for students with ASD and additionally highlights the potential benefits of e-learning to significantly improve learning outcomes. It emphasizes that students with ASD often benefit from computer-based instruction, which can lead to more rapid learning compared to traditional teacher centre methods. The research presented a case where an emotion recognition classifier was utilized to support in regulating emotions during e-learning sessions, and results show 93.34% average recognition rate. Although the effectiveness of emotion regulation interventions varied among participants, the implementation of this system results with a significant decrease in targeted negative behaviours and improvements in mathematics learning performance. The findings suggest that specific strategies, such as response modulation, attention deployment, and cognitive change, have changing levels of impact on enhancing mathematical learning rates in students with ASD, whilst response modulation shows the highest effect.

When the studies with deaf or hearing-impaired students are analysed, the study by Krause and Wille (2021) examines the role of sign languages (SL) in the mathematical thinking and learning of Deaf and Hard of Hearing students. It delves into the categorization of classifier constructions in signed expressions and their integration as linguistic or gestural elements in mathematical discourse. The study refers to a few instances in literature linking classifier handshapes with mathematical signs, suggesting a potential avenue for future research. The authors also explore the concept of embodiment in mathematics education, considering sign language as a conceptual bridge in learning, with particular attention to its metaphorical potential in representing mathematical concepts. The discussion is supplemented by examples from studies on geometry, arithmetic, and fraction concepts with Deaf learners in German and Austrian contexts, highlighting unique SL features that impact DHH learners' mathematical education. The paper also touches the observed lower mathematics achievement scores among DHH students, underscoring the need for further inquiry into the qualitative aspects of mathematics learning and assessment in this demographic.

Another research for deaf or hearing-impaired students by Thai and Yasin (2016) explores the effectiveness of the Magic Finger Teaching Method (MFTM) in teaching multiplication facts to deaf students. Recognizing the importance of mathematics in academia, career applications, and daily activities, the research underscores the need for a strong foundation in basic mathematical skills, such as multiplication facts. The study employed a quasi-experimental design to evaluate MFTM. This teaching method leverages the use of fingers, active student participation, mental reactions, and physical reflection. The study involved screening tests to determine the students' initial level of achievement and selected schools based on similar criteria such as size and urban location. The study's conclusions indicate that MFTM could be an effective instructional strategy, and it also considered students’ perceptions of this innovative approach to learning multiplication facts.

As evidenced by these research, individuals with disabilities or special educational needs require specially developed materials for mathematics instruction, as well as teachers who are capable of utilizing these materials effectively in their lessons. Teachers' deliberate planning of their lessons is crucial for enhancing mathematical achievement and learning. In this context, it is essential to provide information about the significant role of technological support in special education and the technological tools that can be utilized as resources and materials.

2.1.1.1. Technology for Special Education Students in Mathematics

There are six distinct categories of educational technologies designed for students with special educational needs. These include “teaching technology”, “instructional technology”, “medical technology”, “productivity technology”, “information technology” and “assistive technology”, as outlined by Blackhurst (2005, pp. 175-177). Examples of each technology type are provided in Table 2. While all the mentioned technology types are vital for learners with various disabilities, assistive technology became the most prevalent form of support for special education students following the enactment of the Individuals with Disabilities Education Improvement Act in 2004 (Bouck, 2012; 2015, Edyburn, 2006; Lancioni et al., 2013). Assistive technology devices are broadly defined as “any item, equipment, or system, whether off-the-shelf, modified, or custom-made, that serves to enhance, sustain, or augment the functional abilities of children with disabilities” (20 U.S.C. § 1402(1)(A)). Studies on the use of assistive technology in teaching mathematics to students with special educational needs are extensive yet open to further improvement (Wissick & Gardner, 2011). Bouck and Flanagan (2009) categorize assistive technology in mathematics education for students with disabilities or learning difficulties into three domains: i) “anchored instruction”, ii) “computer-assisted instruction” and iii) “the use of calculators” (p. 19).

Table 2 *Different types of educational technologies.*

Types	Examples
Technology of Teaching	Learning Strategies, Response Prompting
Instructional Technology	Hypermedia Instruction Programs, Electronic Books
Medical Technology	Nutritive Devices, Surveillance Devices
Technology Productivity	Database Programs, Multimedia Composing Tools
Information Technologies	Web Sites, Internet
Assistive Technology	Talking Calculator, Alternative Computer Keyboards

Calculators are extensively utilized in mathematics education and for assessment purposes (Shaftel et al., 2003). They aid students in grasping numerical concepts and operations essential for problem-solving (Bouck & Flanagan, 2009). Despite limited research specifically focusing on calculator use by students with learning disabilities or disabilities (Yakubova & Bouck, 2014), evidence suggests that using basic (four-function), scientific, and graphing calculators can positively influence the mathematical achievements of these students (Bouck & Bouck, 2008; Bouck, 2010; Yakubova & Bouck, 2014). However, some scholars, such as Kauffman et al. (2004), contend that calculators should not be employed for every mathematical problem but rather reserved for more complex and advanced calculations.

Video-based applications in special education, initiated in the early 1960s (Blackhurst, 1965; 1967), were further developed by the Cognition and Technology Group at Vanderbilt University (CTGV) to address the issue of inert knowledge in mathematics education (CTGV, 1990, 1991). This approach, known as anchored instruction or video-based instruction (Bransford et al., 1990), involves presenting mathematical problems to students via videos. A key benefit of anchored instruction is that it allows students to apply their latent knowledge to real-world problems, a skill often underutilized outside the school environment (Bouck et al., 2009). Subsequent research (e.g., Bottge & Hasselbring, 1993; Bottge, 1999) demonstrated that video-based problem presentation offers significant benefits for students with disabilities in mathematics, surpassing traditional written methods. However, these studies also identified areas for improvement, such as the limited impact of anchored instruction on individual problem-solving for some students (Bottge et al., 2010). To address these shortcomings, Brian Bottge and colleagues evolved this method into what is now known as enhanced anchored instruction (Bottge et al., 2009). This revised model incorporates computer-based technologies to better support students' comprehension of mathematical concepts and computational skills during problem-solving (Bottge et al., 2015). This integration underscores the significance of computer-assisted instruction as a complementary form of anchored instruction.

Lewis (1993, as cited in Bouck et al., 2009) noted that during the 1980s, computer-assisted mathematical software became accessible for students with disabilities. Frenzel (1980, p. 86) originally described computer-assisted instruction as "the process where computers present written and visual information in a logical sequence to students". This definition remains relevant today.

Computer-assisted instruction encompasses a range of computer programs and software, including drill-and-practice, tutorials, and simulations, which facilitate mathematics learning. These tools are designed to help both students with and without disabilities grasp mathematical concepts and apply these skills effectively (Bouck et al., 2009; Harskamp, 2015). The internet and websites also serve as platforms for computer-assisted instruction, offering resources to enhance engagement and provide diverse visual aids for mathematics learning, especially for students with disabilities

(Christle et al., 2001). Compared to anchored instruction, computer-assisted instruction is more advantageous due to its flexibility and interactivity, which are crucial for personalized educational programs (Lawal et al., 2013). Stultz (2017, p. 211) categorizes most computer-assisted instruction programs for students with specific mathematical learning disabilities as either “drill-and-practice” or “game-based”. Research generally supports the use of computer-assisted instruction in mathematics education as a supplementary aid for students with learning disabilities or disabilities (Kumar & Chaturvedi, 2014; Irish, 2002; Nordness et al., 2011). However, the effectiveness of computer-assisted instruction as the primary mode of instruction remains unclear (Ok & Bryant, 2016; Stellingwerf & Lieshout, 1999; Wilson et al., 1996).

Table 3 *Types of Assistive Technology for Mathematics*

Type	Examples
No or Light-tech	Large Number Rulers, Master Ruler, Large grid chart papers, Money Books, PieCulator
Mid-tech	Talking Calculators (Talking Desktop Calculator, Pocket Sized Talking 10-digit Calculator) Accessible Graphing Calculator, Talking Scientific Calculator, Alphasmart Neo,
High-tech	The Graph Club, Virtual Pencil, Big Keys, Software (e.g., Co:Writer, Geometer Sketchpad, GeoGebra, etc.), Edmark Touch Window, Computer, Electronic Tablets, Smart Boards, Virtual Manipulatives

Source: Adapted from “Assistive Technology Devices for Students Struggling in Mathematics by Georgia Project for Assistive Technology, 2010, retrieved from http://www.gpat.org/Georgia-Project-for-Assistive-Technology/Pages/Assistive-Technology-Devices.aspx

Furthermore, Assistive Technology can be categorized based on the complexity and technological sophistication of the devices. The first category, ‘no or light-tech’ devices, includes simple, readily available tools commonly found in classrooms. The second category, ‘mid-tech’ devices, encompasses tools with more advanced features than the ‘no or light-tech’ options. The final category, ‘high-tech’ devices, represents the most ‘sophisticated and complex’ equipment. These high-tech devices typically incorporate digital or electronic components and often require specific training for effective use (Akpan & Beard, 2013, 2014; Bouck, 2015). Examples of these devices and software are detailed in Table 3. Considering the swift advancements in mobile technology, mobile applications are increasingly favoured for the education of children with special needs (Bryant et al., 2015; Ok et al., 2016; Nirvi, 2011). Applications such as talking calculators, GeoGebra, 3D graphic calculators, and advanced scientific calculators, including Math Drills and Math Evolve, are becoming alternatives to traditional assistive technology software and devices. The trend towards app-based educational methods is on the rise (Saine, 2012). Although many mobile apps are primarily designed for entertainment, they have potential educational applications (Özdemir & Özçakır, 2018). Furthermore, 3D Augmented Reality tools are now accessible on both iOS and Android platforms. Nonetheless, there is a pressing need for more research into the educational effectiveness of these applications for students in special education. Additionally, Assistive technology can play a vital role in mathematics education, offering diverse instructional methods and supporting students with learning disabilities in acquiring essential skills for both academic success and life beyond the classroom (Etscheidt, 2016). However, more research is necessary to evaluate the effectiveness of assistive technology, particularly for middle school students with learning disabilities (Stult, 2017). On the other hand, another group of students with special educational needs mentioned in the Turkish Special Education Services Regulation includes gifted and talented students. However, in the literature on mathematics, there is a notable abundance of studies concerning especially students who are gifted and talented, distinct from those with other special educational needs. In this context, the following section will provide information on gifted students and the mathematics education that should be offered to them.

2.1.2. Education of Gifted and Talented Students

Identification, needs fulfilment and education of gifted individuals are at the forefront of many societies (Gürlen, 2021; Tannenbaum, 2000). One of the primary objectives of identifying gifted students is to facilitate the development of their potential (Jenkins-Friedman, 1982; Kuo et al., 2010; Lockhart et al., 2022). In this regard, accurate definition is necessary to establish a common language and to support individuals effectively hence several authors initially attempted to define giftedness (Simonton, 2021).

Taking this into consideration; giftedness is a result of nature and nurture. Being gifted means having the potential for rapid learning, coping with complex and abstract ideas, and developing a broad knowledge base (Feldhusen, 2005). According to Cross and Coleman (2005), giftedness is an age-based concept referring to the potential of young people who are perceived to learn faster compared to their peers. Giftedness is predominantly dispersed within the general population, and therefore only a relatively small portion of these individuals are rapid learners. In schools, the definition of giftedness differs from other definitions as it proposes varying criteria that account for the change in abilities with advancing age. The criteria become more specific as age increases. This implies that in the early stages, giftedness can manifest more broadly across general abilities and specific skill areas. However, as children progress through grades, indicators of talent and achievement tend to reveal themselves only within a specialized area of study.

In addition to these, giftedness can be defined as (a) "an exceptional capacity for interpretation; (b) the discernment needed to utilize this capacity for generating meaningful and original ideas, options, and solutions; and (c) the motivation required to apply, maintain, and enhance this interpretative capacity and discernment". In light of this understanding, giftedness necessitates creativity, but this does not imply that a child must possess all the skills necessary to produce socially impressive works. If a child who is creatively superior develops these skills, s/he can be then perceived as both creatively gifted and productive (Runco, 2005, p.303). However, the recognition of children as gifted is not solely dependent on their high potential or distinct superiority in any problem area.

The identification of giftedness depends on what is prioritized: "academic excellence for formal education, innovation for the workplace, solving pen-and-paper puzzles for an IQ club, acceptance into a summer school for the gifted and talented, or selection as a national athletic competitor." The decision-making process for identifying giftedness without testing is influenced by the observed interaction among children, how a child appears or behaves, the agreed-upon definition of giftedness, and even the representation ratios of ethnic groups demanded by authorities in the field of education (Freeman, 2005, p. 81).

Both performance-based and portfolio-inclusive approaches are popular and featured in many guides for identifying giftedness (Karnes, 2000). In this context, the most commonly used diagnostic methods are as follows (Karaduman & Davaslıgil, 2020):

Traditional:

- Intelligence Tests
- Achievement Tests
- Domain-Specific Talent Tests
- Grades
- Teacher Recommendations

Non-Traditional:

- Nonverbal Talent Tests
- Creativity Tests
- Student Portfolios and Audition Performance
- Performance-Based Assessment
- Recommendations from Parents, Peers, and Community Members

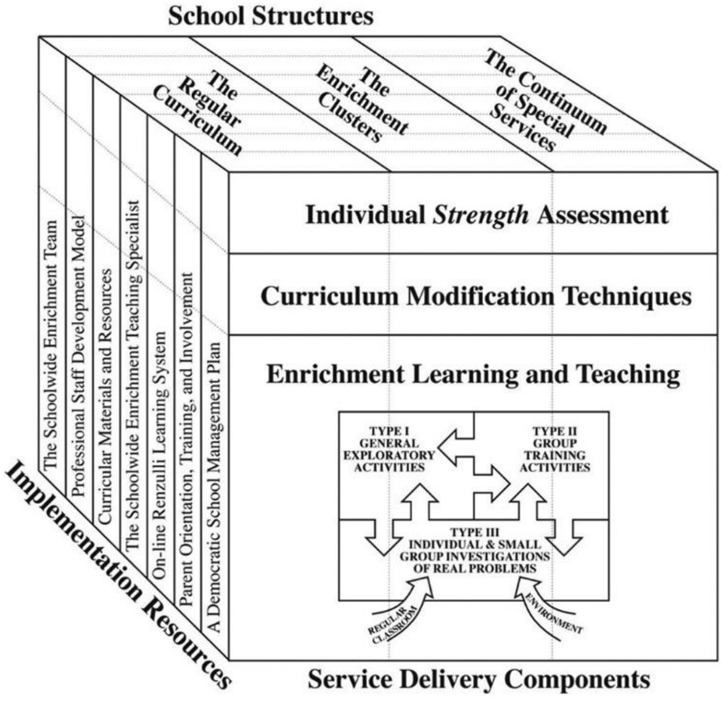
As there are different approaches in the definition and identification of these students, different suggestions and models are presented for the education they will receive.

2.1.2.1. Education Models for Gifted and Talented Individuals

The Renzulli Schoolwide Enrichment Triad Model (SEM) (Renzulli, 1988)**:** In this model, a talent pool of gifted and talented students is created using various assessment criteria such as teacher opinions, achievement tests, and creativity tests. Initially, assessments are conducted on the interests and learning styles of students selected for the talent pool. Secondly, for students who are surpassed the existing goals of the educational program, the curriculum is compacted and intensified. Enrichment activities are conducted for students with high levels of interest, talent, and motivation. The enrichment activities within this model consist of three types: Type I Enrichment

(General Exploratory Experiences), Type II Enrichment (Group Instructional Activities), and Type III Enrichment (Individual and Small Group Investigation of Real Problems) (Gürlen, 2021; Van-Tassel Baska & Brown, 2009, pp. 114-116).

SEM, depicted in Figure 3, synthesizes Renzulli's Three Ring Conception of Giftedness (1978), the Revolving Door Identification Model (1988), and the Enrichment Triad Model (1977). Developed by Renzulli and Reis, SEM emphasizes the need for academically talented and gifted students to engage in highly challenging tasks, offers additional enrichment opportunities for all students, and adopts a more inclusive method for recognizing students with high potential from diverse backgrounds.



Source: From Research on the Schoolwide Enrichment Model: Four decades of insights, innovation, and evolution (p. 112), by Reis & Peters (2021). *Gifted Education International*, 37(2), 109–141

Figure 3 Schoolwide Enrichment Triad Model

The Matrix Model (Maker, 1982)**:** This model was developed to delineate the content, process, environment, and product dimensions of an education program suitable for gifted and talented students. Recent research on the Matrix Model focus on its enhancement of the problem-solving dimension. The problem-solving matrix includes five types of problems that can be applied across different types of intelligence. These are:

i. Type I and Type II problems involve convergent thinking, leading to a single conclusion.

ii. Type III problems are structured but have multiple solution paths and acceptable answers.

iii. Type IV problems are defined, where the student determines the methods of solving the problem and the criteria for evaluating the answers.

iv. Type V problems are unstructured, requiring the student to identify the problem, discover a method for solving it, and create criteria for evaluating the solution (Gürlen, 2021; VanTassel-Baska, 2000; VanTassel-Baska & Brown, 2009, pp. 120-121).

The Autonomous Learner model (Betts & Knapp, 1980)**:** This is a model developed to meet the diverse cognitive, affective, and social needs of gifted and talented students. When their needs are met, gifted and talented students can become autonomous learners who develop their own learning, taking on the responsibility of implementation and evaluation. This model has five fundamental dimensions: "i) orientation, ii) individual development, iii) enrichment activities, iv) seminars, and v) in-depth study". Although the model can be adapted to all content areas and age levels, its limitation lies in not including acceleration activities (Gürlen, 2021; VanTassel-Baska & Brown, 2009, pp. 116-117).

Sternberg' Triarchic Componential Model (Sternberg, 1981)**:** This model, related to educational programs, is based on the theory of the information processing process of intelligence. Sternberg proposed that there are three mental processes underlying intelligent thinking: "meta-components, performance components, and knowledge-acquisition” components. Meta-components, also referred to as planning components, encompass planning what to do, monitoring the implementation of these plans, and evaluating the applied plan. Performance components are responsible for executing instructions received from the meta-components. Knowledge-acquisition components are used in actions of learning and storing acquired information. Considering these components, the Sternberg Triarchic Abilities Test (STAT) was developed. STAT is useful than traditional tests in understanding and utilizing students’ abilities (Gürlen, 2021; VanTassel-Baska & Brown, 2009, p. 123).

The Parallel Curriculum Model: The Parallel Curriculum Model is a set of four interrelated configurations that can be used independently or combined with existing curriculum units, courses, or tasks for creation or revision. “Core Curriculum, Curriculum of Connections, Curriculum of Practice and Curriculum of Identity” are the four dimensions of this model (Tomlinson et al., 2002, p.). Each of the four parallels offers a unique approach to organizing, teaching, and learning content, meticulously designed according to the specific purpose of the parallel (Tomlinson et al., 2002; Tomlinson et al., 2009). The reasons for using four parallels in the Parallel Curriculum Model are as follows (Gürlen, 2021):

- Achieving a qualitatively differentiated curriculum is not possible by merely doing something specific or random.
- Students are different from one another.
- Students have different needs at various stages of their lives.
- Students’ styles, abilities, interests, environments, and opportunities are always distinct from each other.
- Students’ levels of expertise in the same domain also vary from one another.

There are other models designed for gifted and talented students, but they fall outside the focus of this research. For a comprehensive and detailed examination of these models, it is advisable to consult the review work by VanTassel-Baska & Brown (2009).

Therefore, to maintain the focus of the study, information specific to mathematics education will be presented in the fallowing section.

2.1.2.2. Mathematics Education for Gifted and Talented Students

Singer et al. (2017, pp. 6-7) summarized the views on mathematical creativity and giftedness historically as follows:

Over a century ago, in 1905, Alfred Binet prepared the first practical intelligence test. Binet's perspective was that intelligence is adaptable and influenced by environmental factors, rather than being a fixed trait. This test was initially planned to identify students with special education needs, but the test was evolved significantly over time (Gregory, 2004). In 1916, Lewis Terman introduced the Stanford–Binet test. Terman's work included a comprehensive longitudinal study of gifted students, started in 1921 with 1500 participants. Today, intelligence tests remain a primary tool for identifying gifted students and often they rely on a single test score from an early age, without adequately distinguishing between different subject abilities or acknowledging creativity (Singer et al., 2017).

The evolution of theories and practices in mathematical creativity and giftedness is parallel the broader development of theories in creativity and giftedness. These models vary, with some linking giftedness to creative components, while others do not. Standardized tests, such as the Stanford–Binet (Thorndike et al. 1986) and Wechsler Intelligence Scales (Wechsler 1991), are central to psychometric models that aim to quantify these traits. Spearman's theory, introduced in 1923, proposed a dual-factor model of intelligence, encompassing both a general factor and task-specific factors. However, the interplay between mathematical giftedness, creativity, and these factors remains an area of ongoing exploration. Thurstone (1941) later expanded on this with his theory of seven primary mental abilities, which recent research by Paz-Baruch et al. (2014) has linked to mathematical giftedness.

In 1945, Jacques Hadamard's work on the psychology of mathematical invention highlighted the creative processes of great inventors, aligning with Wallas's (1926), four-stage model of problem-solving: preparation, incubation, illumination, and verification. These stages are still considered crucial in understanding mathematical creativity. Liljedahl's (2009) study further validated Hadamard's findings, emphasizing the 'AHA!' moment in mathematical creativity and learning.

Guilford, in 1950, defined creativity as divergent thinking, comprising fluidity, flexibility, originality and elaboration. These components, foundational to Torrance's creativity tests and Guilford's own, continue to influence contemporary assessments of mathematical creativity. This concept of creativity is adapted in school mathematics to foster problem-solving skills that enhance mathematical fluency, flexibility, and originality. Leikin (2009, 2013) later proposed models for evaluating mathematical creativity, emphasizing the importance of multiple solution tasks and mathematical insight.

The National Association for Gifted Children, established in 1954 in the U.S., gained momentum following the Soviet Union's Sputnik launch in 1957, leading to significant federal investment in gifted education under the National Defense Education Act of 1958. This act particularly focused on mathematics and science education.

In 1968, Russian psychologist Krutetskii's (1968/1976) work on mathematical abilities in schoolchildren highlighted the existence of a distinct mathematical mindset in gifted children. The Marland report to the U.S. Congress in 1972 emphasized the unique needs of gifted and talented children, leading to a federal definition that encompasses high achievement in intellectual, creative, artistic, or leadership capacities.

Julian Stanley's 1969 encounter with a young prodigy led to the Study of Mathematically Precocious Youth (SMPY), which began in 1971. This study, using the Scholastic Aptitude Test—Math, successfully identified young, high-level mathematics students, influencing gifted education globally. Stanley's later work (Stanley et al. 1976) shifted towards advocating fewer extreme forms of academic acceleration.

The National Council of Teachers of Mathematics (NCTM) in the U.S. played a pivotal role in advocating for gifted students in mathematics. NCTM (1980) highlighted the neglect of mathematically gifted students and emphasized the need for personalized educational programs. However, by the 1990s, the NCTM shifted its focus, forming a Task Force on Mathematically Promising Students, which emphasized the potential of students to become future leaders and problem solvers, contingent on maximizing their abilities, motivation, beliefs, and experiences (Sheffield et al., 1999).

2.1.2.3. Closing Words for Education of Gifted and Talented Students

To conclude, gifted and talented students require appropriate and challenging educational environments and learning opportunities to achieve their maximum performance. Similar to students with disabilities or students with significant learning difficulties, gifted and talented students also need to be educated using various methods and materials (Aygün, 2022; Gürlen, 2021).

2.1.2. Closing Words for Special Education

To summarize briefly, there are various perspectives and approaches regarding special education and the identification and education of students with special needs. A shift from the traditional special education approach to a more inclusive and holistic one is evident. Determining the least restrictive environment for students and preparing appropriate educational settings is crucial, not only for mathematics education but also for other fields. Success in mathematics for students with special needs can be achieved through instructional processes that incorporate suitable assistive technologies and materials, facilitating the creation of this encouraging and beneficial learning environment. On the other hand, despite not being explicitly addressed in the Turkish Special Education Services Regulation, classrooms inherently exhibit diversity in aspects such as race, religion, culture, and language. The subsequent section will explore the relationship between diversity and mathematics education.

2.2. Diversity and Education of Disadvantaged Students

Diversity encompasses the including and involvement of individuals from a wide range of social or ethnic backgrounds, as well as different genders, religions, and more. Because of these diversities, groups of students who face prejudice, discrimination, marginalization, and social exclusion, and as a result, struggle to receive a quality education, can be identified as 'disadvantaged students' (Atmacaoğlu; 2019; Servaes et al., 2022).

Diversity has always been and will continue to be present in classroom environments. Every education system is inherently selective based on the common values, and any system cannot completely avoid excluding some students (Barwell; 2012). However, what is unacceptable is the consistent and systematic exclusion of specific student groups (Panizzon, 2015). The inherent diversity stemming from individuals' distinct abilities and passions should be accepted. However, it's crucial to critically examine and confront the 'normative' diversity that materializes through actions like categorizing students or student groups. Such practices, intended to reduce disparities, may ironically end up reinforcing the differences they seek to mitigate (Wright, 2016). Achieving equity in mathematics education involves breaking down the bias that allows one to expect success of a student based on features such as their cultural group affiliation (Gutiérrez, 2007). The predictability of a student's mathematical achievement should not be more perceptible based on whether they are male or female, immigrant or refugee, visually impaired or not, than it is on inconsequential preferences like their choice of clothing or sports teams. The challenge in equitable mathematics education lies in ensuring that no particular group of students is privileged. In a truly equitable system, the natural variation among individuals should be mirrored in a similar spectrum of diversity within cultural groups, rather than between them, as is currently the case (Askew, 2015; Gutiérrez, 2007).

However, diversity is increasingly perceived as a strength and opportunity, rather than a weakness or threat (Krainer, 2015). Research about diversity, as noted by Healy and Powell (2013) and exemplified by studies like those of Bishop & Forgasz (2007), shifted its focus from perceiving differences among learners as deficits. Instead, it aims to comprehend mathematics learning through the lens of individuals whose identities diverge from the 'normal' as defined by prevailing social groups.

In this context, 'understanding disadvantage' is reinterpreted as recognizing the social dynamics that place certain individuals at a disadvantage. Moreover, 'overcoming disadvantage' is examined through the lens of adapting learning environments and instructional methods to better meet the unique needs of specific learner groups. This approach enables students to exceed the expectations typically set by dominant narratives.

Commonly, perceptions of disadvantage are often associated with identities that differ from the standard norms upheld by dominant social groups. These identities may encompass a range of aspects including physical attributes, racial and ethnic backgrounds, linguistic characteristics, social contexts, and gender identities. (Healy & Powell; 2013). Researchers like Gutiérrez (2008) and Martin (2009) highlight a critical issue with this viewpoint: it categorizes marginalized groups as unchanging entities and risks associating group membership with inherent intellectual capabilities. This perspective suggests that students from certain cultural backgrounds lack certain qualities, such as mathematical proficiency, which are presumed to be present in those from more dominant groups. Therefore, to bridge this inherent gap, those marginalized are expected to assimilate more closely with their "normal" peers. Identities grounded in physical, racial, ethnic, linguistic, social, and gender characteristics are not static entities. Instead, they evolve and are shaped by the interplay of social, political, and economic forces. Viewed through this lens, identity is continually in flux, constantly being shaped and reshaped, experienced and re-experienced. Thus, identity is both a product of cultural construction and transcends the limits of cultural boundaries. (Bishop & Forgasz, 2007; Healy & Powell; 2013). The next section on inclusive education, which is considered to encompass diversity, equity, and the education of disadvantaged students, will provide more detailed information.

2.3. Inclusive Education and Inclusive Mathematics Education

When the approaches towards the concept of disability are analysed, the traditional individualistic medical model is initially the basic approach adopted by the World Health Organization (WHO). Within the framework of the medical approach, WHO (1980) define impairment as a psychological, physiological unusualness/abnormality or any deprivation/loss of anatomical structure or function in *International Classification of Impairments, Disabilities and Handicaps (ICIDH).* Similarly, disability is defined as deprivation and/or limitation of, as a result of impairment, the ability to perform things accepted as normal and the ability to show required performance for expected activities (United Nations [UN], 2003; Wood & Badley, 1980). This typology is rejected by the organizations that were founded by people with disabilities (such as British Council of Organizations of Disabled People [BCODP] and Disabled Peoples' International [DPI]) (Barnes, 1998). As stated by these organizations, the definition of disability adopted by WHO is problematic in terms of the deprivations and inadequacies that individuals with disabilities are exposed to. Followers of these ideas propose the socio-medical model of disability which is the opposite of traditional medical approach. According to this new model, impairment is a biologically defect-limitation-loss in the mechanism of the body and in all or part of the arms and legs. In fact, this definition is not actually different from traditional approach. The main part which they are against is the definition of disability. Supporters of the socio-medical approach define disability, in a social sense, as the exclusion of individuals from participation for needed situations to take part and engage in social life and for pursuance their social activities. Socio-medical approach also say that by have a disadvantageous state due to activity limitations because people with disabilities are ignored or considered little remarkable by the present-day social organizations (Barnes, 1998). These definitions are accepted and replaced in ICIDH (Shakespeare, 2013).

In brief, traditional medical approach accepts the disability as a result of people's impairment, however, socio-medical approach rejects this view. According to socio-medical approach, disability is not caused by impairment of people with disability, instead the reasons for disability are based on dominant community's behaviours that exclude people with disability from social life and activities. Being disabled or disadvantaged is not a desire or the choice of people with disability; this label is given to them by the dominant ideal society which constructs normative categorizations for identities (Bishop & Forgasz, 2007; Healy & Powell, 2013). Despite what the majority says, students with disabilities are merely different from other regular students, when appropriate environments and educational opportunities are provided, they are not academically deficient from others (Healy & Powell, 2013). Puri and Abraham state the current position of students with disabilities as "Within Walls, Without Boundaries" (2004, p.1). As these authors state, disability is not an obstacle to educate disabled students. Social factors are now more foregrounded than biological or physical factors for understanding the disability (Burcu, 2015). The change in understanding and approach to disability has, naturally, an effect on the educational services and environments. Inclusive education is the most prominent example of this social turn. After the creating inclusive classes or schools, students with disabilities achieved the right to education together with their regular, peers without disability (Lerman, 2000).

Over the last 2 decades, the concept of inclusion emerged as a critical subject in educational research. Historically and in contemporary times, practices of exclusion and segregation are evident in educational systems and broader societal structures worldwide, as highlighted by Arnold et al. (2009). The evolution of inclusive education in various countries were significantly influenced by a range of international declarations that focus on diversity and education. These declarations not only heightened awareness but, in some cases, also established legal frameworks. A notable example is the Salamanca Statement on Special Needs Education by the United Nations Educational, Scientific and Cultural Organization [UNESCO] (1994). Furthermore, the United Nations Convention on the Rights of Persons with Disabilities (2006) stands out as one of the most impactful documents in this arena. International agreements emphasize educational inclusion as both a legal mandate and a method to enhance learning, as noted by Baker et al. (1994). However, at its core, inclusion represents a moral obligation to discover methods for coexisting and learning collaboratively. It involves constructively engaging with diversity and ensuring that individuals who are different are not segregated or isolated in separate settings or educational institutions (Kollosche et al., 2019).

Although inclusive education is sometimes defined as a type of special education, these two have different philosophical lenses (Hornby, 2015). Special education is considered as a discrete situation with discrete classes and, sometimes, discrete schools; hence it has an exclusion lens in contrast with inclusive education which has an inclusion lens (Sacks, 2009). According to Stubbs (2008), in special education, "special" children require 'special' teachers or "special" schools. Special education presupposes the existence of a distinct group of children with 'special educational needs.' However, any child may experience difficulties in learning. Despite many children with disability facing issues related to access rather than learning, they are still often labelled as children with special needs. Moreover, children with intellectual disabilities can learn exceptionally well in certain areas or at specific stages of their lives. There is a belief that teaching 'special children' necessitates "special methods," "special teachers," "special environments," and "special equipment." Special Education tends to view the child, not the system or the teacher, as the problem, categorizing all children according to their weaknesses/disabilities. Additionally, between these two types of education, mainstreaming is defined as a bridge between special education and inclusive education. Partial integration and full integration were used to express varying ways about placement of students with disabilities [Given the broad scope of the concept of inclusive education, the use of terms such as 'partial-inclusion' or 'fully-inclusion' was deliberately avoided.] (Rogers, 1993). Occasionally, partial integration is used interchangeably with mainstreaming (Brantlinger, 1997). In mainstreaming context, students with special education needs spend the maximum quantity of time with regular peers in general classes for part of the school day. In another view, full integration is defined as educating children with disability together with their regular peers without disability in the same mathematics classes, during the whole school day. Integration or mainstreaming means placing children with special needs in the same classrooms as their peers without disability. It can be described as the joint education of students with and without disabilities. This approach aims to integrate students with disabilities into the general student settings (MoNE General Directorate of Special Education, Guidance and Counselling Services, 2010). In a sense, while it does not view the child as a problem, it continues to see the child's problem as a problem. Conversely, inclusive education does not view the child as a problem; instead, it attempts to adapt the education system and the teacher to the child. In other words, unlike "integration" and "special education," which primarily focus on changing the student to fit the system, inclusive education changes the system to accommodate the student. It views diversity not as an "obstacle" but as an "opportunity" in education. This process is not limited to formal/official educational institutions but also involves the family and even the community (Baykara Özaydınlık, 2019).

On the other hand, the interpretation of the term ‘inclusion’ varies significantly, as explored by Ainscow et al. (2006) and Grosche (2015). Commonly, inclusion is narrowly defined as the integration of students with disabilities or those identified with special educational needs into mainstream schools. However, in its broader theoretical context, inclusion is conceptualized as a fundamental principle for both education and society. This broader perspective emphasizes ensuring optimal development and participation opportunities for all individuals and advocates for the elimination of any barriers that hinder these objectives (Kollosche et al., 2019). According to Schwartz (2015, 0:39)

> inclusion is not an instructional strategy, inclusion is not a placement option; inclusion is about belonging; it is belonging to a community, a group of friends, a school or classroom. However, it is also important to remember that inclusion is not just about being there, meaningful contact and interaction is focus of it.

Additionally, Göransson and Nilholm (2014, pp. 268-270), in their analysis, identified four distinct categories of definitions for inclusive education. They labelled these categories as follows:

A. **“Placement Definition”***:* This definition views inclusion as the practice of placing students with disabilities or those needing special support in general education classrooms.

B. **“Specified Individualized Definition”**: This approach defines inclusion as the process of addressing the social and academic needs of students with disabilities or those requiring special support.

C. **“General Individualized Definition”**: This definition broadens the scope of inclusion, considering it as the act of meeting the social and academic needs of all students, not just those with disabilities or special needs.

D. **“Community Definition”**: The most comprehensive of the four, this definition sees inclusion as the creation of communities characterized by specific, often varying, traits.

These categories are hierarchically related, with each subsequent category encompassing and building upon the previous ones. For instance, the ‘Community Definition’ (D) inherently includes the principles of the ‘General Individualized’, ‘Specified Individualized’, and ‘Placement’ definitions. Similarly, the ‘General Individualized Definition’ assumes the principles of both ‘Specified Individualized’ and ‘Placement’ definitions, and so on. This hierarchy illustrates a progression towards stricter criteria for what constitutes inclusive education, moving from definition A to D (See Figure 4).

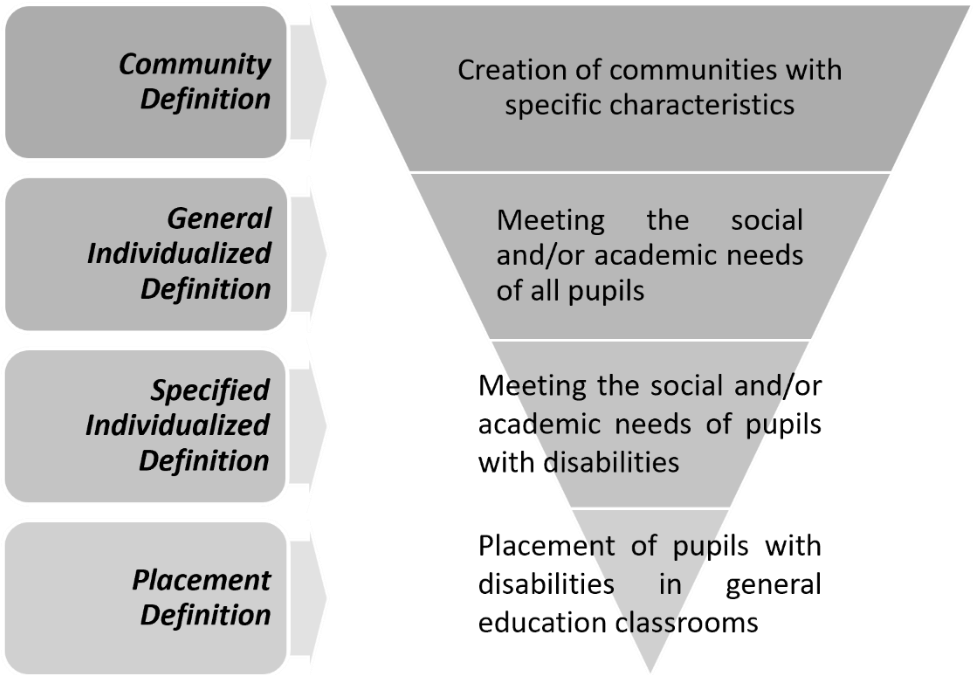


Figure 4. Different types of definition of inclusion and their hierarchical relations.

In essence, Göransson and Nilholm's framework suggests that inclusive education can be understood through increasingly complex and comprehensive definitions, starting from the basic placement of students with special needs in general classrooms to the creation of diverse and adaptive educational communities.

On the other hand, inclusive education is defined by UNICEF (2014) based on three fundamental principles: i) Educational Justification, ii) Social Justification and iii) Economic Justification.

Educational Justification: Inclusive schools should develop curricula that consider the individual characteristics of students and the benefits for all students. When an approach diversified according to students' needs and individual learning performances is preferred over standardization in education, it is more likely that all students will benefit from the learning process.

Social Justification: Inclusive schools will lay the foundation for a more equitable societal structure by creating an attitude and change. Inclusive education fosters an environment where all children can live, learn, and engage in recreational activities together. This approach offers every child the chance to understand and embrace each other's skills, abilities, individual characteristics, and requirements. Additionally, it facilitates the formation of significant relationships and friendships, contributing to the development of their social skills and competencies.

Economic Justification: Inclusive schools, by educating all students together, will be more cost-effective compared to an education system that has different types of schools for different student communities. In the long term, students with disadvantages will contribute more significantly to the economy when they reach adulthood by starting in skilled positions with higher added value, rather than only in unskilled roles.

In addition to these, inclusive education is expected to remove or minimize barriers to the learning potential of students, particularly in classroom activities. This involves structuring assessments, practices, and knowledge derived from activities conducted in the classroom to better accommodate these students' needs (Daniels, 2014).

On the other hand, segregated education has significant disadvantages as they fail to acknowledge the reality that children with special educational needs are part of families and the broader society. This oversight implies greater restrictions and social barriers for these young people and adults in their later years (Oluremi, 2015). In this context, understanding the concept of exclusion is important to understand to inclusion.

2.3.1. Exclusion

Exclusion refers to the process of isolating or marginalizing individuals or groups. It often results in reduced participation and representation in social, educational or economic activities. This can take various forms, such as physical discrimination, lack of access to resources or socialization. Understanding exclusion is critical for developing effective strategies to promote inclusion and ensure equal opportunities for all members of society (Winter, 2020). However, research show that managing diversity in inclusive classrooms poses significant challenges for educators (Meijer, 2003). Teachers frequently concentrate their teaching efforts on the middle ability level in a classroom, rather than employing differentiated instruction to cater to the entire spectrum of student abilities (Labhart et al., 2018). Additionally, there is a tendency for students with special educational needs, particularly those with intellectual disabilities, to receive instruction separately from their peers in inclusive settings (Langner, 2015; Preiß et al., 2016). This leads to exclusion within an ostensibly inclusive environment.

Furthermore, at the core of the concept of exclusion lies the state of being isolated. The process of exclusion sometimes culminates in students being expelled or dropping out of school. However, in many instances, students remain officially enrolled but become “implicitly excluded” from meaningful participation in learning. This phenomenon turns them into students who are present in name only, not actively engaged in the educational process. Teachers who do not learned or lack the skills to effectively communicate with and educate this group of students may encounter situations of exclusion or segregation similar to those experienced by the students themselves.

The issue lies neither solely with the teachers nor the students; rather, it is rooted in the challenges of communication between teachers and students. Individuals or groups are “socially excluded” when they are unable or fail to effectively participate in the key activities or benefits of the society, they live in. Exclusion occurs for both teachers and students. This interrelationship is referred to as the “*cycle of exclusion*” (see Figure 5). When teachers and students are trapped in this cycle, both parties act in ways that perpetuate feelings of exclusion towards the other (Razer & Friedman, 2017). The cycle of exclusion operates akin to a virus, extending its impact beyond the interactions between teachers and students. It adversely affects relationships among teachers themselves, between teachers and school administrators, and also between schools and the families they serve. This cycle not only disrupts the immediate educational environment but also influences the broader network of relationships essential for a supportive and effective educational community (Razer & Friedman, 2017).

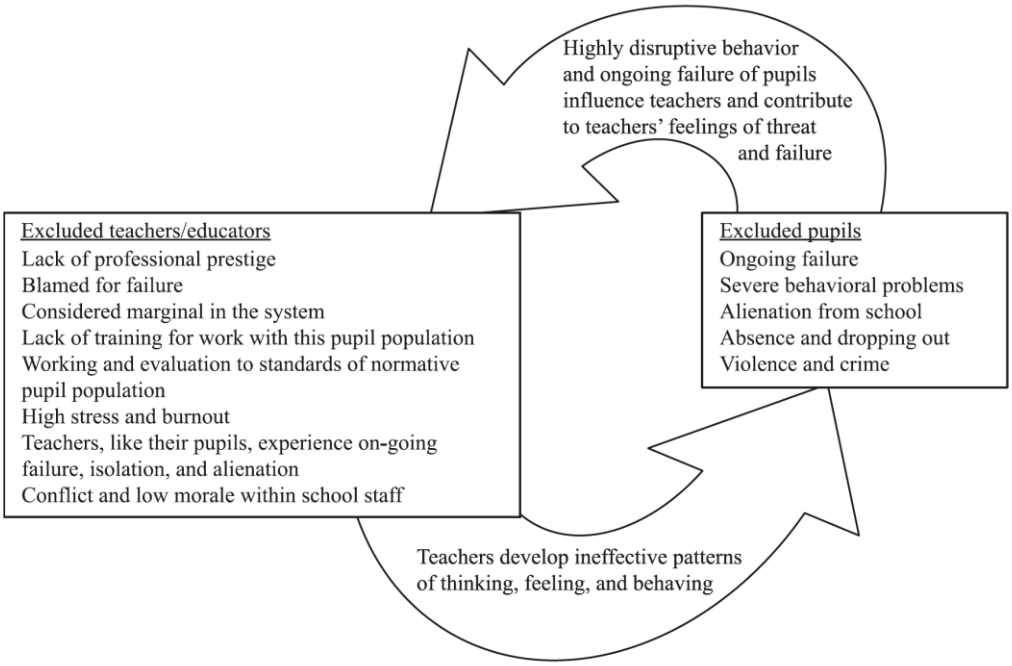


Figure 5 The cycle of exclusion in schools

Up to this point, a general outline of inclusive education has been provided. Inclusive education is much more comprehensive than the aspects discussed here. However, to maintain the focus of this study, the subsequent section will delve into the specifics of inclusive education within the context of mathematics education.

2.3.2. Inclusive Mathematics Education

In the recent decades, the concept of inclusion received growing attention in mathematics education and its research; however, universal consensus and reconciliation over the definition of inclusion among mathematics education authorities were not established. The failure to compromise stems from the different approaches towards inclusion. These approaches are ideology versus way of teaching

(Artiles et al., 2006). On the one hand, values such as diversity and equity are core elements of ideology perspective. On the other hand, teaching interventions – such as interactive groups, regulated learning strategies – are discourses of teaching way perspective. Roos (2018) analysed 76 studies related to mathematics education in inclusion settings. She stated that in the 23 of 76 studies, inclusion was referred to as an ideology and in the other 53 studies, it was referred to as a way of teaching. Furthermore, National Council of Teachers of Mathematics touches on both values – "opportunities to study mathematics"– and way of teaching –"appropriate accommodations"– in *Principles and Standards for School Mathematics* (2000, p. 12). In the relevant context, there are two means of using the term inclusion in mathematics education: (I) describing what it means to be counted in a society, as well as why to be included in a society is critical (UNESCO, 2009) and (ii) describing inclusion as a way of teaching of mathematics, in which all students are taught in a regular mathematics classroom (Cornwall & Graham-Matheson, 2012).

In a similar vein, the primary objective of mathematics education in inclusive classrooms is to enhance the learning experience for all students, either by not focusing on their differences or by striving to minimize the disparities among various student groups (Sullivan, 2015). Boaler and Staples (2008) emphasize that communication plays a crucial role in the mathematical learning process for students in inclusive settings. Furthermore, Sullivan et al. (2009) advocate for the establishment of a nurturing classroom environment. This supportive atmosphere enables all students to engage in activities that foster interactive idea connection and collaboration. Mitchell (2014) formulates inclusive education to describe what is involved in it;

$$\text{Inclusive Education} = V + P + 5As + S + R + L$$

where:

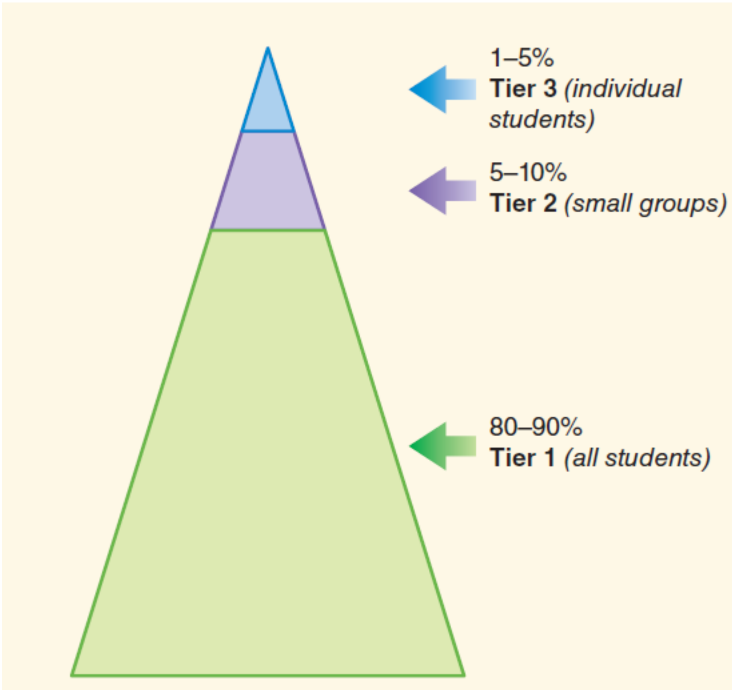
V: Vision; P: Placement;

5As: Adapted Curriculum, Adapted Assessment, Adapted Teaching, Acceptance, Access;

S: Support; R: Resources; L: Leadership.

Mitchell emphasizes that all of these elements are present in successful inclusive education. Author explains each component of formula as follows. Inclusive education requires a commitment on “its underlying philosophy and a willingness to implement it” (p. 29). To avoid segregation, the placements of students with special (educational) needs are arranged in an age-appropriate and ability-based grade level. The educational programs in an inclusive classroom are accessible to all learners, with developmentally appropriate level activities. Effective inclusion practices include formative assessment and feedback, which enable teacher to diagnose why learners do not mastered and then to re-design learning opportunities. Effective inclusion practices include cooperative group teaching. Inclusive education obliges teachers to develop a wide repertoire of teaching strategies that include peer tutoring, consideration of peer influences, creating a safe and motivating classroom climate. Furthermore, teachers take advantages of assistive technology and alternative classroom discourse with enhanced communication skills. For learners with physical disabilities to be included, adequate access to classrooms is provided. Inclusive education needs support from a team of professionals and specialists, which consist of general educator, specialist adviser, appropriate therapists, psychologists, and (if needed) hearing and seeing advisers. Parent involvement and support are critical to respect students and their families’ rights and needs. Collaborative teaching with special education teachers and other mathematics or branch teachers is a good way of constructing effective teaching team. Leadership is required at all levels, starting from government to classroom teachers to orchestrate above elements.

Additionally, an interrelated concept with mathematics education for students with special educational needs is Response to Intervention. Response to Intervention is “an early action, prevention, and support system that identifies struggling students and assists them before they fall behind” (Gersten et al., 2009, p.4). Response to Intervention is “a tiered student support system that focuses on the results of implementing instructional interventions in a model of prevention” (Van de Walle et al., 2012, p. 96). Each tier in the triangle (Figure 6) represents a different intervention. Tier 1 represents instruction that all students in a mathematics classroom receive. In tier 2, students receive extra purposeful instruction (or interventions) using more obvious systematic teaching. Additionally, tier 3 instruction is for students who need more in-depth levels of support, which may include a referral for special education services (Van de Walle et al., 2012).



Source: Based on Scott, Terence, and Lane, Holly. (2001). *Multi-Tiered Interventions in Academic and Social Contexts.* Unpublished manuscript, University of Florida, Gainesville.

Figure 6 Response to intervention

The National Council of Teachers of Mathematics in their 2011 position statement on interventions, while not specifying exact interventions, advocates for the implementation of progressively intensive and effective instructional interventions for students facing difficulties in mathematics. According to Fuchs and Fuchs (2001), such interventions are designated for conditions that are resistant to less intensive prevention levels and necessitate more substantial measures to prevent severe complications.

Moreover, studies on prevention models like Response to Intervention indicate that while the majority of students remain in the initial tier (tier 1), about 15 percent do not exhibit the expected level of progress and are thus shifted to tier 2 for more intensive instructional approaches (Fuchs & Fuchs, 2001). Subsequently, nearly 40 percent of these students respond positively to the interventions at tier 2 and revert to tier 1. Only around 13 percent of the students initially moved to tier 2 are then considered for more personalized services, typically provided by a special educator, at tier 3 (Fuchs & Fuchs, 2005; 2007). To illustrate with an example based on research data, in a group of 100 children, approximately 15 would transition to tier 2. Following intervention, 6 of these students would return to tier 1. Of the remaining 9 in tier 2, about 2 students would advance to tier 3 for more individualized services.

2.3.3. Closing Words for Inclusive Education

In summary, inclusive education can be defined at varying degrees between two perspectives: one that sees it merely as placing students with disabilities or special educational needs in general education institutions, and another that envisions a learning community where everyone can be educated together. This shift reflects changes in the definition of disability and the diversity in modern classrooms due to globalization and migration. Similarly, in the field of mathematics education, inclusivity emerges both as a teaching method and a value judgment. Therefore, it is important to view classroom diversity not as a barrier or obstacle but as an opportunity. In this context, to provide inclusive mathematics education in a classroom with academic diversity, various adaptations and adjustments are necessary. In the next section, details of modifications, accommodations and differentiated instruction will be presented.

2.4. Classroom Adaptations for Inclusive Classrooms

Inclusive education has evolved beyond being a limited concept solely focused on integrating students with special educational needs. It has transformed into an approach that advocates and strives for equal access to education for all individuals, regardless of language, religion, ethnicity, gender, income group, disability, culture, sexual orientation, age, criminal record, and other diverse characteristics (Sarı & Türkkan, 2019). From the broader perspective of inclusive education, every classroom displays a diversity in students' abilities and backgrounds. Designing and conducting lessons that encourage every student to grasp essential mathematical ideas, offering both support and challenges tailored to their learning needs is one of the most crucial responsibilities for teachers (Van de Walle et al., 2012). To achieve this, they can employ specific adaptations that provide to the diverse needs of students in the classroom. The adaptations discussed here include accommodations, modifications and differentiated instruction.

Accommodations refer to the provision of a different environment or situation, taking into account specific students' needs. These adjustments ensure equal access to instruction and assessment for all students, including those with disabilities or special educational needs. They respond to the environment or learner's needs without altering the task itself (Van de Walle et al., 2012). Salvia et al. (2010, p. 73) describe four types of accommodations**:**

- “Presentation Accommodations” allow students to access information in ways that do not require visually reading standard print. These alternative access modes include auditory, multisensory, tactile, and visual methods. Large print texts, magnification devices, talking calculators or clocks are examples.
- “Timing Accommodations” reasonably extend the time allowed to complete a test or assignment and may also alter the way the time is organized. Examples include multiple sessions, extra time for assignment submission, etc.
- “Response Accommodations” enable students to complete activities, assignments, and tests in different ways, often using some type of assistive device or organizer. Examples include voice recorders, spell-check devices, note-takers, etc.
- “Setting Accommodations” involve appropriately modifying the learning environment or assessment conditions. This could include changing a student's seating position in the classroom or allowing the use of headphones, etc.

Accommodation focuses on making the environment or materials more suitable and accessible without altering the tasks within the classroom. Changes made to the tasks or activities presented to students are referred to as modifications. Modifications will be detailed fallowing part.

Modification refers to changes made directly to the problem or task itself. Modification alters the task to make it more accessible to the student. When modifications result in a new task that is easier or less demanding, the expectations for the student are reduced. Persistently making and using low-expectation modifications can widen the gap between the success of students with special needs and the desired outcomes at the classroom level. Therefore, modifications are implemented for students who need them, through support structures or aids, aimed at solving the original task (Hunt, & Seney, 2009). Maker and Nielson offer a set of "principles" to guide teachers for modification (1996, p. 31, as cited in Hunt & Seney, 2009):

The environment and teaching process should

1. "be learner-centred rather than teacher- or content-centred",
2. "focus on independence rather than emphasizing dependence",
3. "be open rather than closed to new ideas, innovations, and exploration",
4. "promote acceptance rather than judgment",
5. "focus on complexity rather than simplicity",
6. "provide for a variety of group options rather than one grouping as a general organization",
7. "be flexible rather than having a rigid structure or chaotic lack of structure"
8. "provide for high mobility rather than low mobility".

The next section will provide information on "Differentiated Instruction," a practice often perceived as a modification typically applied to gifted individuals. However, in the context of inclusive education, it encompasses adaptations suitable for all students.

2.4.1. Differentiated Instruction

Differentiated instruction is an approach to planning programs and teaching for academically diverse students; it's a way of thinking about the classroom to meet each student's learning needs and maximize their learning capacity (Subban, 2006; Hall, 2002; Tomlinson & Eidson, 2003; Tomlinson, 2017). Some studies in the literature treat differentiated instruction within the scope of gifted or special education needs students (Broderick et al., 2005; Reis & Renzulli, 2018). However, differentiated instruction is not limited to arrangements for only gifted or special education needs students. Generally, differentiation involves meeting the needs of diverse students, promoting equity and excellence, and focusing on best practices in mixed-ability classrooms (Tomlinson, 2017). Differentiation in teaching is a comprehensive approach to instruction and ensures the successful inclusion of all students, including those with disabilities, those with significant learning difficulties and those are gifted and talented, in general education classrooms (Chamberlin & Powers, 2010).

In this context, Tomlinson (2017) suggests that to effectively differentiate instruction, it is necessary to make adjustments and changes based on a) student diversity and b) curriculum components. To differentiate instruction, three dimensions of student diversity are emphasized: i) students' readiness levels, ii) their interests, and iii) their learning profiles. It is known that students learn better when the tasks given are closely aligned with their abilities and understanding of a subject (readiness), spark passion and curiosity (interest), and allow them the freedom to work in ways that make learning more efficient or accessible for them (learning profile). In addition to students' diversity, teachers in all classrooms deal with three curriculum components on which they can differentiate:

Content — the input, what students will learn;

Process — how students begin to understand and form ideas and information; and

Product — the output, or how students demonstrate what they learned.

In a similar vein, according to Reis and Renzulli (2018), the three components most commonly linked with effective differentiation are: curriculum or content (what is taught), instruction or process (how it is taught), and student product (tangible outcomes reflecting students' interests and abilities). Consequently, Reis and Renzulli proposed a five-dimensional differentiation schema that includes Content, Instructional Strategies, The Classroom, Products, and The Teacher, which are closely interrelated.

On the other hand, Small (2020) emphasizes the impracticality for teachers to design individualized instructional strategies for each student in a classroom, such as creating 30 unique paths for 30 students or even 6 varied paths for groups of students. This daunting task often leads to hesitation in adopting differentiated instruction in mathematics, as it appears to be an overwhelming alternative to the traditional uniform teaching approach. Nonetheless, Small proposes two fundamental strategies to facilitate effective differentiation in mathematics teaching: employing open-ended questions and implementing parallel tasks.

In addition to identifying what needs to be differentiate, Heacox (2018) provides a framework consisting of 12 steps to establish differentiation as a habitual practice:

i. "Identifying learning goals based on students' needs to Know, Understand, and be able to Do".
ii. "Examining professional practices in light of students' needs".
iii. "Applying practical, doable and valid assessment strategies".
iv. "Creating differentiated learning plans".
v. "Using choice opportunities to motivate student learning".
vi. "Tiered assignments and usage flexible grouping as necessary and appropriate".
vii. "Flexibility in planning and teaching".
viii. "Developing student responsibility and independence".
ix. "Ethical grading".
x. "Differentiating instruction for gifted students with their particular and specific learning differences in mind".
xi. "Integrating differentiation strategies with academic interventions for students who struggle".
xii. "Committing to a leadership framework for differentiated classrooms in school".In light of the above explanations, a few studies specifically in the field of mathematics education that incorporate differentiated instruction will be discussed.

In their study, Bikić et al. (2016) examined the impact of differentiated instruction in geometry within a problem-based learning framework. The research employed a quasi-experimental design, contrasting a differentiated problem-solving approach with a traditional teaching method. In the experimental setup, 88 secondary school students were divided into three categories (low, average, or high achievers) based on initial testing. These groups then engaged with geometry problems, adopted to their respective levels of achievement, over 16 lessons, ending in a final assessment. The study provided an example of how each ability group received a unique, complexity-varied version of the same task. In contrast, the control group, consisting of 77 students, received conventional instruction. The results showed that students in the differentiated instruction group generally outperformed those in the control group, with a moderate positive effect size of d = +0.539. Further analysis revealed that this approach was particularly beneficial for students of average ability, while high achievers did not significantly surpass their counterparts in the control group.

In their research, Awofala and Lawani (2020, p. 9) explored the impact of differentiated instruction, that “involve pre-assessment, flexible grouping, tiered instruction, scaffolding, and assessment, on the mathematical achievement” of senior secondary school students. Researcher employed a pre-test, post-test non-equivalent control group quasi-experimental design, involving a sample of 220 students. The study divided these students into two groups: one received differentiated instruction, while the other was taught using conventional methods over an eight-week period. Three tools were utilized for data collection: a mathematics achievement test, a learning styles index, and an intelligences inventory. The findings revealed that students who received differentiated instruction exhibited significantly better performance in mathematics compared to those taught through conventional methods. The authors also concluded that differentiated instruction enhanced student engagement, reduced stress, and fostered cooperation among students.

In another research conducted by Bal (2016), sixth-grade students completed an initial assessment in algebra and completed a learning style inventory, identifying their preference for kinaesthetic, visual or affective learning styles. Researcher then adopt algebra learning resources and activities to provide to two distinct groups: lower-performing and higher-performing students. This customization also took into account the diverse learning styles of students in the experimental group. The study observed significant positive outcomes from this tiered approach after a four-week instructional period. Insights from student interviews, as reported in the study, suggest that the participants found the learning process successful and enjoyable, particularly with the materials and activities designed for the experimental setup.

2.4.2. Closing Words for Classroom Adaptations

Based on the explanations provided and the outcomes of the conducted studies, it can be concluded that when accommodations and modifications such as differentiated instruction is effectively planned and implemented for students at every educational level and for those with diverse needs, an enhancement in the quality of teaching is evident.

However, one of the major challenges in this context is the misalignment between teachers' knowledge, beliefs, and classroom practices. An example of this is a teacher who believes in their ability to effectively instruct, yet due to insufficient knowledge or other reasons, fails to reflect this in their classroom applications. In the following section, an effort will be made to provide information about teachers' beliefs, knowledge, and practices.

2.5. Teachers’ Beliefs, Knowledge and Classroom Practices or Attitudes

Approximately 30 years ago, Koehler and Grouws (1992) categorized research in mathematics education according to their complexity, arranging studies from simple to complex (see Figure 7 for highest complexity). They emphasized the complex nature of mathematics instruction, acknowledging that it is influenced by multiple factors. They argued that understanding mathematics teaching through the lens of a single component is challenging due to its multifaceted nature.

When the parts related to teachers are examined, Teacher Knowledge, Teacher belief and classroom practices are stood out. In this context, the focus of this study encompasses teachers' beliefs, knowledge, and attitudes/classroom practices. Each of these components will be examined individually, followed by an exploration of the interrelationships among them.

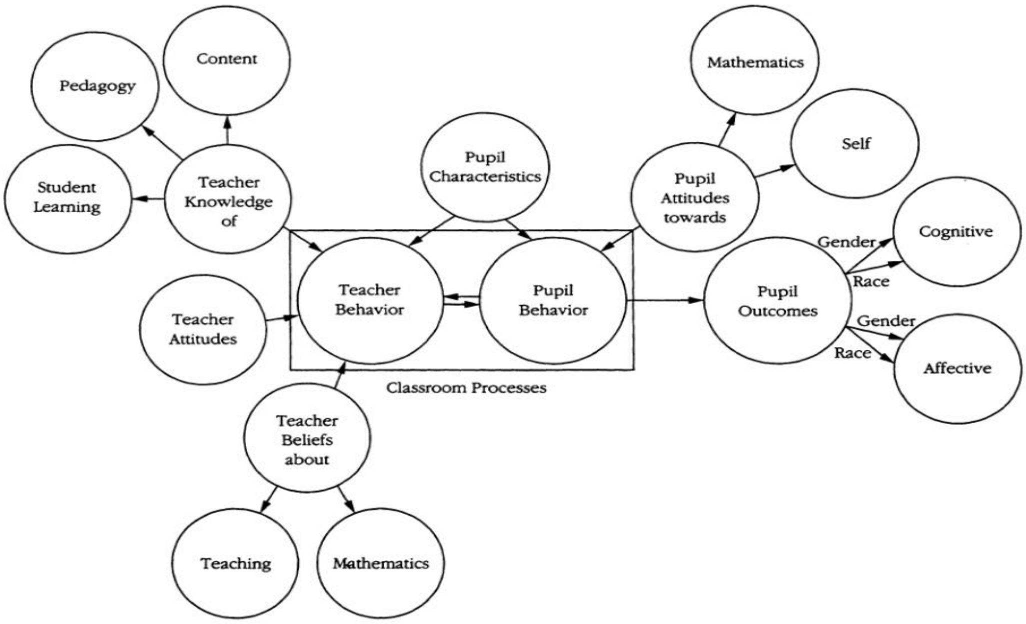


Figure 7 The network of the mathematics learning and teaching process

2.5.1. Teachers' Beliefs

Beliefs is a component of the affective domain (McLeod, 1992). According to DeBellis and Goldin (2006), affective domain can be conceptualized as an internal representational system, encompassing emotions, attitudes, beliefs, morals, values, and ethics. These elements were arranged on a continuum. At one end of this spectrum lie feelings and emotions, characterized as short-lived and intensely charged, while at the other end are beliefs, known for being more cognitive and stable (Philippou & Christou, 2002).

Specifically in the mathematics education, the affective domain was introduced to elucidate why some learners, despite having the cognitive resources necessary for mathematical tasks, still face challenges in succeeding (Di Martino & Zan, 2001).

In this context, Philipp (2007, p. 258) characterizes “beliefs as the ‘interpretive lenses’ through which individuals perceive the world”. Additionally, Voss et al. (2013, p. 249) define beliefs as “psychologically held understandings and assumptions about phenomena or objects of the world that are felt to be true, have both implicit and explicit aspects, and influence people’s interactions with the world”. Also, according to Ajzen and Fishbein (1980), beliefs represent everything that an individual considers to be true. Beliefs can be inferred from a person's words or actions (Pajares, 1992). Therefore, their existence can be attributed with greater certainty than what might be immediately apparent (Handal & Herrington, 2003). The spectrum of beliefs that can impact teaching is diverse, encompassing a range of areas. These include, but are not limited to, beliefs regarding the “nature of mathematics, approaches to mathematics teaching, perspectives on mathematics learning”, “views about students” and “beliefs about teachers' personal competence in both understanding and instructing mathematics” (Liljedahl & Oesterle, 2014, p. 584).

Table 4 *Relationships Between Beliefs*

Beliefs about the nature of mathematics (Ernest, 1989a)	Beliefs about mathematics teaching (Van Zoest et al., 1994)	Beliefs about mathematics learning (Ernest, 1989b)
Instrumentalist	Content-focused with an emphasis on performance	Skill mastery, passive reception of knowledge
Platonist	Content-focused with an emphasis on understanding	Active construction of understanding
Problem-solving	Learner-focused	Autonomous exploration of own interests

Additionally, Beswick (2005) interconnected the belief categories proposed by Ernest (1989a), Van Zoest et al. (1994), and Ernest (1989b) (see Table 4). According to this interrelation, it can be suggested that a teacher who perceives mathematics as problem-solving oriented is likely to strive for student-centred mathematics instruction. This approach is based on the belief that students construct their learning upon their previous knowledge.

On the other hand, Calderhead (1996, p. 712) identified five principal domains of teacher beliefs: beliefs concerning "teaching and learning, beliefs related to instructional methods, beliefs about the subject matter, beliefs regarding the process of learning to teach, and beliefs about the self". Voss et al. (2013, p. 250) adapted and expanded these categories specifically for mathematics education. Teachers possess beliefs about "their own teaching abilities" and "the role of the teacher". They also hold beliefs regarding "mathematical knowledge" and beliefs about the "teaching and learning of mathematics". Additionally, they maintain beliefs about "cultural diversity within the school environment".

In another study, Philipp (2007) identified beliefs about students' mathematical thinking, the curriculum, and technology as three main areas of research concerning teachers' beliefs, due to their potential in changing beliefs. Philipp also noted that beliefs related to gender among teachers is a subject of research.

When considering the explanations provided by Philip (2007) and Voss et al. (2013) together, it becomes evident that in addition to fundamental mathematics topics like curriculum, learning, and teaching, areas such as diversity and gender are also being incorporated into studies on teacher beliefs. As mentioned in previous sections, since these subjects are directly linked to inclusive education, information regarding teachers' beliefs about inclusive education will be provided below.

Kochhar et al. (2000) in their book on inclusive education, identified teachers' negative beliefs and feelings as one of the major barriers to inclusive education. Additionally, Janney et al. (1995) found that the more experience general education teachers had with including students with disabilities in their classrooms, the more positive their attitudes and beliefs became. Smith and Smith (2000) identified four key factors influencing general education teachers' perspectives and beliefs on teaching students with learning difficulties in inclusive classrooms: knowledge, class size, support, and time.

Additionally, in their meta-analytical study, Dignath et al. (2022) identified six key findings regarding teacher beliefs. Firstly, they found that teachers neither fully support nor completely reject inclusive education; rather, there are teachers who hold both supportive and opposing beliefs. Secondly, teacher candidates tend to have higher self-efficacy beliefs about teaching in inclusive settings, whereas in-service teachers often possess a lower level of self-efficacy. Thirdly, special education teachers generally have more positive beliefs and attitudes than general education teachers toward inclusive education. Fourth, they discovered that belief systems are not fixed; professional development activities can shift teachers' beliefs towards becoming more inclusive. Fifth, teaching experience in an inclusive classroom can lead to a change in beliefs about inclusive education. Lastly, the sixth key finding relates to the duration of interventions; longer interventions are not necessarily always more effective.

In conjunction with above studies, while searching mathematics teachers' beliefs about inclusive education, the researcher was able to access only two study. DeSimone and Parmer's (2006) study highlighted that although most mathematics teachers were in favour of the idea of inclusive education, they had reservations regarding its effective.

execution. In their survey involving 228 middle school mathematics teachers, nearly four fifths of participants either agreed or strongly agreed that students with special needs should be included in general education math classes. Additionally, about seventy percent of teachers felt that it was the responsibility of general education teachers to educate these students. Despite this, more than half of participants were unsure or disagreed that inclusive classrooms were the best setting for teaching mathematics to students with special needs, and merely 30% believed that middle schools were successfully implementing such practices. Follow-up interviews were conducted with a subset of participants to deepen the understanding of these perspectives. Only about one fourth of the teachers felt that they had sufficient time to prepare for inclusive mathematics classes. Less than a third were convinced that their teacher training effectively equipped them with relevant philosophies, strategies, or an understanding of the needs of students with special requirements in the context of teaching mathematics.

In another study, Larina and Markina (2020) found that mathematics teachers' attitudes towards student diversity can be seen as a spectrum, with 'Inclusive' on one end and 'Exclusive' on the other. They used four factors to define this spectrum that: a) the teacher believes or does not believe that all learners are capable of learning mathematics, b) degree of the teacher's involvement in the learning process, c) whether students are grouped and d) whether students are labelled. Teachers with 'Exclusive' beliefs tend to label and differentiate between student groups, believe not all students can learn math, and see their role as less impactful. On the other hand, 'Inclusive' teachers avoid labelling, believe all students can learn math, and see themselves playing a significant role in the learning process. The fundamental difference between the exclusive and inclusive ends of the continuum lies in whether teachers categorize and contrast groups of students.

However, for a change in teachers' beliefs, it is first necessary to increase their knowledge and ensure they receive positive feedback in the classroom (Guskey, 2002). A comprehensive explanation about the knowledge of teachers will be provided in the next section.

2.5.2. Teachers' Knowledge

For a successful teaching process, teachers need to have an in-depth knowledge of the subject they are teaching (Fernandez, 2005). Although it's necessary for a teacher to possess the knowledge required for the curriculum level they are teaching, this alone may not be enough to guarantee student progress (Petrou & Goulding, 2011). In this context, Shulman and colleagues suggested various categories of teacher knowledge essential for effective teaching. While the names of these categories are varied in different publications, one of the most comprehensive descriptions is found in Shulman's study (1987). In this work, Shulman identifies seven distinct categories of teacher knowledge (p. 8):

i. "general pedagogical knowledge";
ii. "knowledge of learners' characteristics";
iii. "knowledge of educational context";
iv. "knowledge of educational purposes and values";
v. "content knowledge";
vi. "curriculum knowledge";
vii. "pedagogical content knowledge".

In addition to Shulman's proposed model, scholars such as Tamir (1988), Grossman (1990), Marks (1990), Carlsen (1999), Cochran et al. (1993) and Gess-Newsome (1999) either expanded upon Shulman's (1987) model or proposed different models to elaborate on what teachers need to know. These efforts were aimed to further clarify the knowledge requirements for effective teaching (for more details, see Sağır, 2019).

To maintain the focus of this study, the discussion will be concentrated on research related to teacher knowledge specifically for teaching mathematics. In this context, information will be provided about some models that describe the professional knowledge and skills essential for a proficient mathematics teacher (for more details, see Şahin, 2019).

Ernest (1989a) built upon and adapted Shulman's (1987) work, creating a model specifically for mathematics instruction. In this model, he outlined the key knowledge components that a teacher should possess knowledge (p. 15):

- “of mathematics”
- “of other subject matter”
- “of teaching mathematics”
    - “Mathematics pedagogy”
    - “Mathematics curriculum”
- “classroom organisation and management for mathematics teaching of the context of teaching mathematics”
    - “The school context”
    - “The students taught”
- “of education”
    - “Educational psychology”
    - “Education”
    - “Mathematics education”

Furthermore, Fennema and Franke (1992, p. 162) synthesized previously developed models to propose a dynamic and interactive model. In this model, a teacher's knowledge is composed of four components: “knowledge of the content of mathematics, knowledge of pedagogy, knowledge of students' cognitions, and teachers' beliefs". According to this model, teacher knowledge emerges in the classroom context based on these four components (see Figure 8).

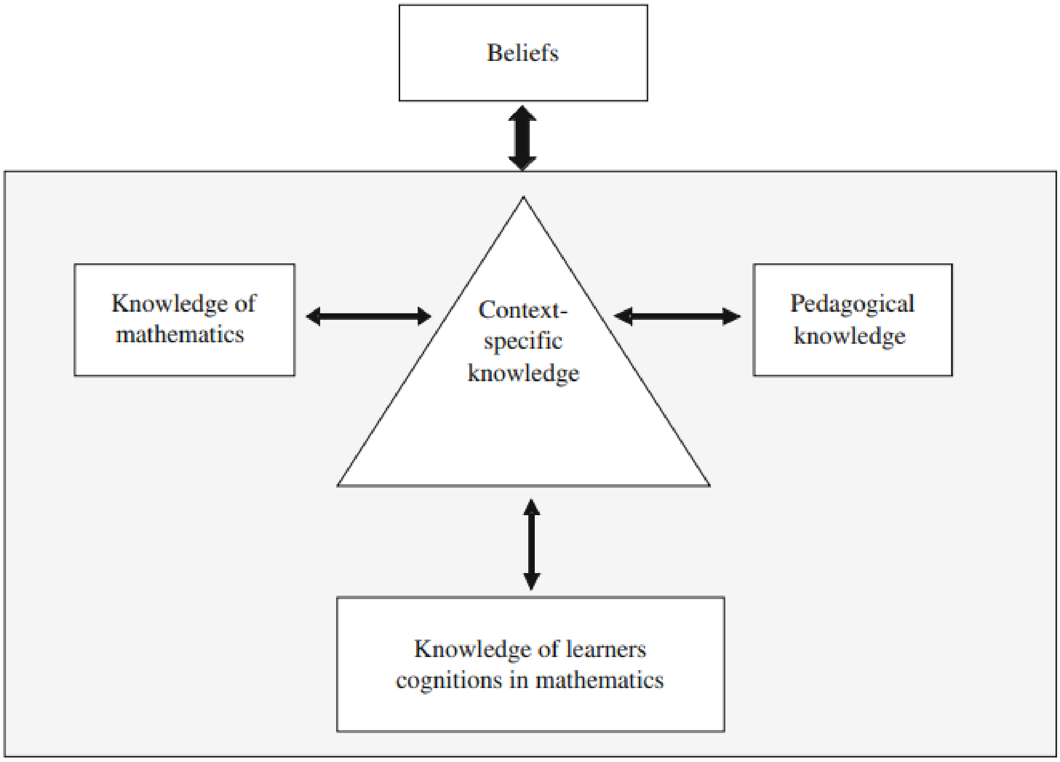


Figure 8 Teachers' Knowledge: Developing in Context

On the other hand, the most popular mathematics teaching content knowledge model is the "Mathematical Knowledge for Teaching" model proposed by Ball et al. (2008). Ball et al. (2008) developed their model based on the premise that Shulman's (1987) model of pedagogical content knowledge was too general, lacked empirical foundations, and was not clearly defined. They argued for the need for a model specific to mathematics, grounded in empirical evidence. In their model, which outlines the professional competencies required of a mathematics teacher, they introduced the concept of "mathematical knowledge for teaching" to the literature. The model developed by Ball et al. (2008) consists of two main dimensions: subject matter knowledge and pedagogical content knowledge (Figure 9).

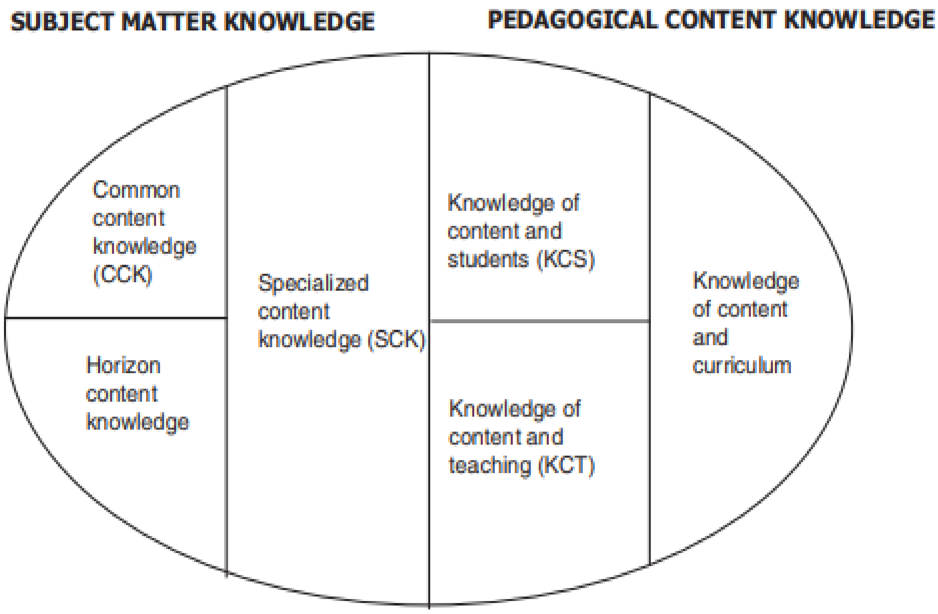


Figure 9 Domains of Mathematical Knowledge for Teaching

The distinctive feature of this model compared to other models is the subdivision of subject matter knowledge. This knowledge includes a mathematics teacher's understanding of definitions, rules, formulas, procedural algorithms, mathematical justifications of operations, relationships between concepts, and the correct use of mathematical terminology. In this model, subject matter knowledge is further divided into three sub-components: general content knowledge, specialized content knowledge, and horizon content knowledge.

The other main dimension of the Ball et al. model is pedagogical content knowledge. In this model, Ball and colleagues expanded upon Shulman's (1987) model rather than offering a completely new perspective. Pedagogical content knowledge in this model consists of three components, two of which were already present in Shulman's model. These components are knowledge of content and students, knowledge of content and teaching, and knowledge of content and curriculum. While Shulman treated knowledge of curriculum as a component separate from pedagogical content knowledge, Ball et al. incorporated it as a sub-component within pedagogical content knowledge.

On the other hand, when specifically considering inclusive education, Rouse (2006, 2008) emphasized the importance of teachers' knowledge in areas beyond their subject matter expertise, particularly for improving practices in schools. Even if many teachers do not always apply this knowledge when they return to the classroom, understanding the following aspects related to inclusive education is essential (Rouse, 2008, p. 13):

- “Teaching strategies”,
- “Disability and special needs”,
- “How children learn”,
- “What children need to learn”,
- “Classroom organization and management”
- “Where to seek help when needed”,
- “Identification and assessment of challenges”,
- “Assessment and monitoring of children's learning”,
- “The context of legislation and policy”

In a similar vein, Kuyini and Desai (2007) emphasized the necessity for teachers in inclusive education settings to be knowledgeable in Class Management, Lesson Planning/Presentation, and Adaptive Instruction, and to practically apply these concepts in their classrooms. Additionally, Kuyini and Desai demonstrated that knowledge of inclusive education is one of the predictors of effective teaching in inclusive classrooms. Furthermore, Chitiyo and Alasa (2023), while adopting Göransson and Nilholm's (2014) placement definition in understanding inclusive education, reported that teachers perceive themselves as knowledgeable about inclusive education.

Although it's crucial for teachers to be knowledgeable or to perceive themselves as knowledgeable, this knowledge becomes ineffective if it is not put into action within the classroom. Therefore, turning knowledge into action in the classroom setting is of great significance. Information about classroom practices will be provided in the following section.

2.5.3. Classroom Practices

Sullivan et al. (2006) highlighted that the essence of effective mathematics teaching is rooted in lesson planning, especially for diverse classrooms with students who may struggle or feel disconnected. He proposed a research-based framework consisting of four critical phases for such classrooms:

i. Choosing tasks that captivate and engage students at various levels, fostering active involvement in mathematical learning.
ii. Preparing targeted prompts to support students who encounter difficulties with these tasks.
iii. Developing advanced tasks for students who efficiently complete the initial tasks, aimed at further enhancing their thinking in a meaningful and engaging way.
iv. Considering a range of specific teaching methods, encompassing both teacher actions and verbal guidance, which should be clearly expressed and applied in practice.

In a similar vein, Franke et al. (2007, p. 248) highlighted three key aspects of teaching practice in mathematics classrooms: “discourse, norms and relationship-building”. They emphasize these aspects because there's a growing agreement that students should have classroom opportunities to express their mathematical thoughts, explore different problem-solving methods, and use mathematical tools in a multipurpose manner. For students to access these opportunities, teachers and students need to develop new ways of interacting about mathematical concepts, particularly through enhanced mathematical discourse. Facilitating this discourse requires careful consideration of both social norms and specific norms related to mathematics (socio-mathematical norms). The process of establishing these norms and promoting discourse involves fostering strong relationships between teachers and students. This includes recognizing students' identities, their history of participation and the norms and cultural practices from their communities. This approach ensures that assumptions about participation and mathematical literacy are constantly questioned and redefined. Within this framework, it's essential to address and highlight issues related to race, class, and gender.

However, although Franke et al. (2007) highlighted the importance of issues related to race, class and gender or other reasons for diversity, a significant difference exists between teachers' theoretical knowledge and their classroom implementation (Allsopp et al., 2006; Flores, 2007). Central to this gap is the concept of '*doing*' as a key element in professional and institutional development in the context of inclusive education. These initiatives often include action-research approaches centred on school or classroom improvement projects, and promote new methods for (Rouse, 2008, p. 14):

> "converting knowledge into action",
>
> "going beyond simple reflection",
>
> "using evidence for practice enhancement",
>
> "collaborating effectively with peers and students" and
>
> "adopting a proactive, 'activist' approach in the professional setting".

While these recommendations provided are essential for success in inclusive education, they alone are not sufficient. Teachers should believe in their ability to deliver instruction that accommodates classroom diversity. Additionally, they should hold positive beliefs that every student can learn mathematics and that every student has a right to education (Florian, 2008; Rouse, 2006; 2008). This highlights the interconnection and mutual influence of beliefs, knowledge, and classroom practices.

2.5.4. Interrelationships Among Knowledge, Classroom Practices and Beliefs

Rouse (2008) highlighted the interconnectedness of teachers' actions, knowledge, and beliefs in the context of inclusive classroom practices. He pointed out that these three key elements - what teachers do, know, and believe - mutually reinforce each other. For instance, combining practice ('doing') with belief ('believing') enhances a teacher's knowledge ('knowing'). In other words, if teachers gain new knowledge and are encouraged to apply it practically with a proactive 'just do it' mindset, their attitudes and beliefs will gradually evolve. Similarly, if teachers already possess positive beliefs and are supported in adopting new practices, they are more likely to develop new knowledge and skills. Thus, Rouse suggests that if any two of these elements (action, knowledge, belief) are effectively aligned in the process of developing inclusive practices, the third element is likely to be strengthened as a result.

Jacobson (2017), in a similar manner, defined mathematical teaching proficiency as achievable through three distinct categories: Knowledge, Disposition (which includes beliefs) and Instruction. These categories are believed to be interrelated and mutually influential in attaining fluency in mathematics. Essentially, the categories of teaching proficiency (knowledge, disposition, and instruction) are interconnected through reciprocal relationships.

To conclude, both from the perspectives of mathematics education and inclusive education, it is evident that teachers' knowledge, beliefs and instruction are interconnected.

2.6. Summary of Literature Review

To briefly summarize the information presented in the literature review: from the perspective of traditional special education, it is envisioned that students with special educational needs are removed from general education institutions and educated in separate, independent institutions. Similarly, the education of gifted and high-achieving students is envisaged to take place in separate institutions, with specially trained teachers providing instruction through uniquely developed curricula.

Additionally, today's students face cultural, linguistic, or gender-based diversities, which become integral to mathematics education. However, both the changing perspective of special education and the increasing popularity of inclusive education led to the development of a vision that general education institutions should adapt to support every student group, rather than establishing different institutions for each. Despite the various definitions and perspectives on inclusive education, its success hinges on teachers possessing necessary knowledge and actively applying it in the classroom. However, for both the translation of knowledge into practice and the success of inclusive education, it is crucial to enhance teachers' belief in their ability to be effective in inclusive settings. Knowledge, belief and classroom practices thus interact in a cyclical manner, each influencing the others.

CHAPTER 3

METHODOLOGY

The research aim of this study is to understand the meaning of the teaching experience of middle school mathematics teachers in academically diverse classrooms. Aligning with this purpose, this chapter outlines the study's design, its participants, and the context in which it was conducted. The tools used for data collection, the processes followed, and how the data was analysed are also explained. Furthermore, the chapter addresses the study's trustworthiness, its limitations, and its scope.

3.1. The Design of the Study

Mixed-method design was preferred for the conduct of this study. A mixed-method design, as defined by Creswell (2014), refers to a research approach that integrates both qualitative and quantitative techniques for data collection and analysis within a single study or project. Advocates of mixed methods research usually subscribe to a compatibility thesis and embrace the pragmatist philosophy. The compatibility thesis posits that quantitative and qualitative methods can complement each other and can be concurrently applied in one research project, allowing researchers to address a single or related set of research questions effectively. Pragmatism, as a philosophy, provides an empirical rationale for using mixed methods, asserting that their use is validated to the extent that they function in practice and yield the anticipated results (Christensen, et al., 2015, Johnson et al., 2007). The merging of methods is based on the pragmatic view that qualitative and quantitative techniques are not just compatible but also complement each other in generating knowledge that is both scientifically significant and beneficial to society (Feilzer, 2010; Morgan, 2007). Hurmerinta-Peltomaki and Nummela (2006) discovered in their review research that mixed methods enhance the study by increasing the validity of results, guiding the gathering of the subsequent data source, and aiding in generating knowledge. They propose that research employing a mixed methods strategy achieves a more comprehensive and profound insight into the subject matter compared to studies that only employ either a quantitative or qualitative approach. Another merit of mixed methods is the integration aspect. Integration strengthens the reliability of results and conclusions of the research (O'Cathain et al., 2010). Furthermore, some researchers assert that employing mixed methods research is the only method to establish definitiveness in results (Coyle & Williams, 2000; Sieber, 1973) and in data interpretation (Morse & Chung, 2003). Additionally, Maggetti (2020) state that researcher can provide stronger inferences by fuller, deeper, more complex, and more comprehensive explanation using mixed-method research.

In the light of these explanations aforementioned, and with a pragmatist view, mixed-method research design was appropriate for this study, as the intention of the research was to explore and to reveal teaching experiences, knowledge and beliefs of middle school mathematics teachers in an academically diverse classroom. The purpose of combining quantitative data (getting more numerous data) and qualitative data (getting deeper information about participants) is to investigate all aspects of the research and to achieve maximum benefit.

Mixed methods research designs can be shaped by a variety of design elements. Nevertheless, Christensen et al. (2015) proposes a basic typology that can serve as a foundational structure for constructing mixed methods design. The typology sorts Mixed-method designs into two categories. The first is time order, which can be concurrent (where the quantitative and qualitative components are executed roughly simultaneously) or sequential (where the quantitative and qualitative components are carried out one after the other). The second category is paradigm emphasis, which can be equal status (where quantitative and qualitative approaches are equally emphasized) or dominant status (where one approach has a primary focus). These two dimensions, time order and paradigm emphasis, create a 2-by-2 design matrix, as illustrated in Figure 10.

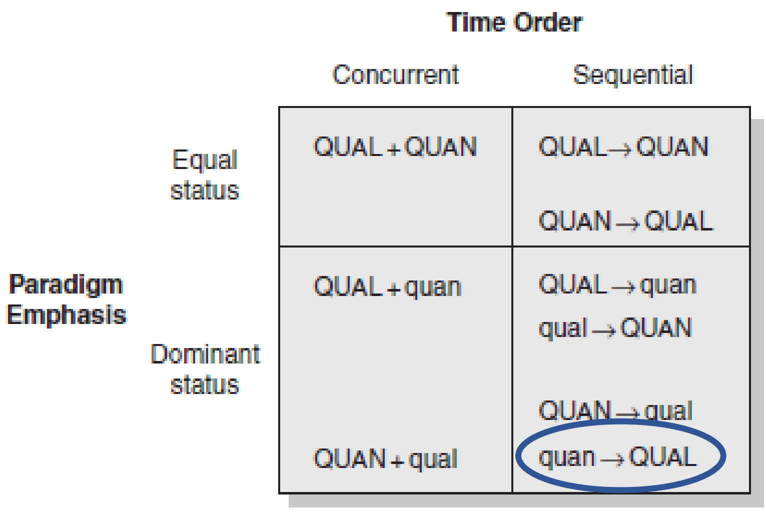


Figure 10 The Mixed Methods Design Matrix

The research process of this study simply has two components: a) developing a scale to reveal the current levels and stances of mathematics teachers and b) revealing the essence of teaching experience with academically diverse learners through phenomenological interviews.

In a classroom displaying academic diversity, the focus is not merely on what the mathematics teacher is doing, but also on understanding the underlying reasons and causes for their actions. It is believed that uncovering these underlying factors will serve as a guide for improving mathematics instruction in these and similar classrooms, which is why qualitative data is emphasized. Therefore, this study meets the structure of Sequential-QUALITATIVE dominant design (circled in Figure 10)

3.2. Data Collection Procedures

In the data collection process of the research, the researcher initially developed three different scales. Data collected through scales were utilized to conduct validity and reliability studies, which are essential phases in the scale development process. Subsequently, interviews with mathematics teachers were conducted using a semi-structured interview protocol, which was developed by the researcher to align with the scale items. Finally, classroom observations were carried out both for the purpose of data triangulation and to add depth to the data. In the continuation of this section, an attempt will be made to provide detailed information about the data collection tools and analysis processes used.

3.2.1. Data Collection Tools

In this study, 3 different tools were used to collect data. Data collection tools consist of a series of scales, an interview form and an observation form.

3.2.1.1. Teacher Self-Reflection Scales

The first tool is the scales titled 'Teacher Self-Reflection Scales' developed by the researcher. These scales are three different but related scales. The first sub-scale includes teachers' self-reflections about their beliefs regarding teaching mathematics in a classroom with diverse levels of academic achievement. The other two sub-scales are related to teachers' self-reflections about their knowledge and classroom practices, respectively.

Table 5 *Process Steps in Scale Development*

Step No	Steps
1	Need Analysis
2	Literature Review
3	Generating Item Pool
4	Expert Review
5	Designing first prototype
6	Sampling
7	Pilot Study
8	2nd expert review
9	Designing final version
10	Works on reliability and validity

In the scale development process, the steps suggested by DeVellis (2017) and Seçer (2015) were followed (Table 5). Before starting the preparation of the scale items, an extensive literature review was conducted. Since no existing scale could be used to achieve the objectives specified in the research questions, it was decided to develop a new one. After reviewing the literature, 13 different draft questions/items were created by the researcher (Appendix D). These questions/items were written considering the Triangular Relationship proposed by Rouse (2008). After an extensive discussion with a mathematics education expert holding a PhD, it was decided that some of these 13 items should be improved, some items should be removed or corrected, some items should be subdivided into sub-questions and some items should remain as they were, and thus obtaining the first expert review.

Table 6 *Sub-Dimensions for Scales*

Sub-Dimensions	Related Item Numbers
Planning /Goal-setting	D9, D10, D11, K2
Teaching strategies	D1, D15, D16, D18. K2, K3, K4, K13, K14, B10, B22
How students learn	D6, K1, B5, B6, B7, B8
What students need to learn	K8, K9, K10
What children should learn	D5, D8, B2, B13
Classroom organization and management	D27, K15, K16
Where to get help when needed	K12
Identification and assessment of challenges	K6, B16
Assessing and monitoring children's learning	D12, D13, K7
legal and policy contexts	B15
special educational needs	K17, D28
Accommodation and modification	D3, D17, D19, D23, B11, B12
Technology / assistive technology	D24, K11, B14
Putting knowledge into action	D22
Going beyond reflective practice	D21
Working with colleagues	D14
Professional development	B9, B20, B19
Creating a class culture	B18, B23, D29
to be worth educating	D2, D7, B4, B17
All children can learn	D25, D26, B1
Capacity to make a difference in children's lives	B21
Access and equality	B3
Responsibility	B4

After the first expert review, each dimension (Doing, Knowing, and Belief) suggested by Rouse was treated as a separate scale and these first draft questions were reorganized and written according to these dimensions. Indicators related to these dimensions were articulated in a more descriptive manner and written as items. Items related to each dimension were added to the different item pools. Common sub-dimensions for each dimension or scale were determined by utilizing the literature (see Table 6). During this process, multiple items were written for the same indicator to capture all aspects of the relevant quality comprehensively. After these adjustments, three different draft scales consisting of 24 questions/items for doing, 18 items for knowledge and 25 items for beliefs were formed.

Scale Name	Items	Appropriate	Needs correction	Not Suitable / Should be Removed	Explanation
	1st item				
	2nd item				

Figure 11 Expert Review Format

Expert opinions were sought initially to decide which of these items is the most ideal representation of the quality in question. The format shown in Figure 11 was used to obtain expert opinion. The questions in the item pool were initially presented to two different language experts (one is a Turkish teacher with a bachelor's degree, one is an academician with a PhD degree) to ensure linguistic validity and to ensure the questions are clearly understood. Recommendations from Turkish language experts were carefully reviewed, and revisions were made in a manner that does not disrupt the scope of the study.

After reviews by Turkish language experts, the scales were shown to a measurement and assessment expert (an academic with a PhD) to ensure there were no structural issues with the scales. The measurement and assessment expert suggested that some items measured 2 or more dimensions and that these should be separated and written as different items. Based on these correction suggestions, some questions were rewritten as two different questions, while others were rewritten to measure a single characteristic without distorting the meaning and focus.

After the opinions of the measurement and evaluation expert were obtained, the scales were shown to 6 mathematics education experts (all hold a PhD degree) and 2 middle school mathematics teachers. One of the mathematics educators specializes in the education of gifted and talented students. Another mathematics educator studies in the field of equitable mathematics. One of the middle school mathematics teachers works in a state school and the other one works in a private school. The purpose of obtaining opinions from a large number and variety of experts is to both increase the content validity as much as possible and to gain maximum benefit by incorporating contributions from individuals with different expertise and environments. In accordance with the feedback provided by experts in mathematics education and teachers, some items were revised to facilitate understanding. This was done through methods such as using different words, rewriting sentences, or adding words to reinforce the meaning. Some items were removed either because they were outside the scope of the subject matter or because they required overly detailed information. In necessary cases, new items were added in light of the experts' advice.

After receiving feedback from experts in the field of mathematics, the revised scale items were sent to a different Turkish language expert (an academic with PhD) for a re-evaluation of their linguistic appropriateness. The language expert noted that there were six different variations of the phrases 'classes where individual differences in mathematics achievement are observed' and 'students showing individual differences in terms of mathematics achievement.' The expert recommended that standardizing these phrases would be more effective. Accordingly, the necessary corrections and modifications were made to the items.

Lastly, the scale items that were sent to an assessment and evaluation expert received confirmation that there were no issues in terms of the stages of scale development.

After making the necessary changes and adjustments based on expert opinions and recommendations, the finalized scales were made ready for use. A section containing participants' personal information, such as professional experience, age, and gender, was also added. The scales were then transferred to an online platform via Google Forms in a 5-point Likert scale format. Once the scales were uploaded, the scale items were both shared with and read aloud to a middle school mathematics teacher by the researcher, and the participant was asked to mark their responses. The aim here was to observe whether there were any difficulties in reading the scale items. Subsequently, another teacher was asked to both read the questions aloud and fill out the scale. The purpose of this step was to observe how the scale items were perceived by the respondents and to identify any items that were difficult to read or could be misinterpreted. Following this process, minor changes were made to a few items that were found to be problematic or difficult to read. After these one-on-one procedures, the scale items were shared with five different middle school mathematics teachers, who were asked to both fill out the scales and share any problems they encountered while doing so. With the positive feedback received from these five different teachers, the initial prototypes of the scales were developed. In these prototype scales, there were 19 items related to the 'Belief' dimension, 15 items related to the 'Knowledge' dimension, and 19 items related to the 'Doing' dimension, all of which were structured according to the tripartite framework proposed by Rouse (2008).

3.2.1.1.1. Pilot Study

With these three prototype scales, pilot data was collected from 66 middle school mathematics teachers. The internal consistency levels and item-total correlations of the scale were examined using the SPSS 26 statistical program.

Table 7 *Cronbach's alpha coefficients of Prototype Scales*

Scale Name	# of items	Cronbach's alpha (α)
Knowledge Scale	15	.690
Doing Scale	19	.777
Belief Scale	19	.780

As a result of the analysis of the pilot data, it was found that the Cronbach's alpha coefficients were α=.690 for the 'Knowledge Scale,' α=.777 for the 'Doing Scale,' and α=.780 for the 'Belief Scale' (see Table 7).

While the internal consistency levels for the Doing and Belief scales were found to be acceptable, the Knowledge Scale had an alpha value below .70 (Seçer, 2015), indicating that internal consistency was not achieved. To identify the reason for this, item-total correlations were examined (Table 8, Table 9 and Table 10). It was observed that the item-total correlation coefficients for some items were below .30 (Seçer, 2015), and some even had negative values (bolded in Table 8, Table 9 and Table 10).

Table 8 *Item-Total Correlation coefficients of Knowledge Prototype Scale*

Number of Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
s1	0,595	0,637
s2	0,601	0,651
s3	0,574	0,644
s4	**-0,167**	**0,743**
s5	0,549	0,649
s6	0,406	0,664
s7	0,592	0,642
s8	0,414	0,664
s9	0,657	0,635
s10	0,475	0,653
s11	0,573	0,649
s12	0,346	0,672
s13	**-0,067**	**0,749**
s14	0,433	0,659
s15	**-0,255**	**0,769**

Upon examining the items with negative item-total correlation coefficients, it was found that all of them were phrased in a negative manner (e.g., 'I don't know how to set appropriate goals for students with different levels of math achievement.'). It was thought that the attempt to balance the number of positively and negatively phrased questions within the scales led to misinterpretation by the participants, especially given that the Turkish words for 'Biliyorum (I know)' and 'Bilmiyorum (I don't know)' differ by only one letter.

Table 9 *Item-Total Correlation coefficients of Doing Prototype Scale*

Number of Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
s16	**0,198**	**0,780**
s17	**-0,099**	**0,796**
s18	0,475	0,757
s19	0,594	0,749
s20	0,329	0,769
s21	0,317	0,769
s22	**0,280**	**0,772**
s23	0,418	0,762
s24	0,258	0,773
s25	0,452	0,760
s26	0,490	0,758
s27	0,507	0,758
s28	0,378	0,766
s29	0,333	0,768
s30	**0,276**	**0,774**
s31	0,364	0,767
s32	0,474	0,761
s33	0,468	0,760
s34	**0,284**	**0,775**

Another factor supporting this line of thought is that, except for one item, no negative item-total correlation coefficients were observed in the 'Belief Scale' for items starting with 'İnanıyorum (I believe)' and 'İnanmıyorum (I do not believe)'. Therefore, after consulting with an expert in mathematics education and a language expert, it was decided to rephrase the problematical items that were originally structured negatively into a positive form.

In the finalized 'Knowledge Scale', there were 15 items; in the 'Doing Scale', there were 19 items; and in the 'Belief Scale', there were 19 items (Appendix E). Thus, after the pilot study, the scales were finalized and made ready for data collection to carry out validity and reliability works. Detailed information regarding the factor analysis conducted for validity and reliability will be presented in the later sections of this chapter and in the findings chapter.

Table 10 *Item-Total Correlation coefficients of Belief Prototype Scale*

Number of Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
s35	0,257	0,780
s36	0,542	0,761
s37	0,085	0,795
s38	0,358	0,772
s39	0,520	0,763
s40	0,386	0,772
s41	**-0,151**	**0,794**
s42	0,553	0,760
s43	0,674	0,752
s44	0,336	0,775
s45	0,486	0,760
s46	0,520	0,757
s47	0,440	0,765
s48	0,382	0,769
s49	0,494	0,765
s50	**0,195**	**0,784**
s51	0,406	0,767
s52	0,334	0,772
s53	**0,226**	**0,778**

3.2.1.2. Interview Protocol

Another data collection tool used in the study is the interview protocol, which was developed utilizing Seidman's (2006) 'The Three-Interview Series' method. The interviews in this series are as follows: a) Interview One: Focused Life History, b) Interview Two: The Details of Experience, and c) Interview Three: Reflection on the Meaning. The interview questions were written with literature support and structured to move from general to specific, as recommended by Seidman.

Academically Diverse Classroom Sample Scenario

The student profile of the 7/C class in a middle school is as follows:

The story of a male student named Ahmet is as follows: 'The student's parents are divorced, and he lives with his mother. Before coming to his current school, he had to change schools three times and is frequently absent from his current school. Although he is enrolled in the 7th grade, he struggles with reading and writing and even makes mistakes in basic arithmetic. He constantly wants to wander around the classroom. When given a task or activity during class, he doesn't sit down for even a minute to complete it. Knowing his situation, teachers avoid teaching him to maintain classroom order, essentially isolating him from the lesson by saying, 'just do your own thing'. His classmates also avoid befriending him and including him in their games, excluding and ignoring him.

Information about Başak, a female student in the same class, is as follows: 'Her family's economic status and socio-cultural level are quite high. She is diagnosed as intellectually gifted and talented and is enrolled in 'Science and Art Centre'. Her family has high expectations for her. Although she is at the 7th-grade level, she has knowledge at the high school level in algebra, specifically in functions and polynomials, and in geometry, she can calculate the area of circles or quadrilaterals using the properties of integrals. She finishes tasks or activities much faster than her classmates, leading her to adopt a mocking attitude, saying, 'how can you not do such simple things,' and starts engaging in activities unrelated to the lesson (such as watching outside the window, drawing on her notebook or desk).'

Additionally, in the same class, there are also differences in terms of mathematics achievement among other students. There are students who meet the class level expectations and could be described as 'normal,' as well as slow learners and high-achieving students

Figure 12 An academically diverse classroom sample scenario

To depict what a classroom with academically diverse students looks like, a sample classroom scenario was prepared by the researcher to be used in all interviews (see Figure 12). Subsequently, a semi-structured interview protocol was developed by the researcher to be conducted in three different sessions. The interview protocol cover what needs to be done or what is done by teachers inside and outside the classroom, what teachers know or should know, and beliefs about student learning in the sample classroom, all within the framework of the three structures proposed by Rouse (2008). Like the scale development process, the final version of the interview protocol was given based on the opinions and recommendations of language experts, experts in the field of mathematics, and assessment and evaluation experts (Appendix J). A pilot interview was conducted with one middle school mathematics teacher. It was found in this pilot study that there were no issues with the interview questions, but the interview durations were problematic as each session lasted approximately one hour. It was also observed that some of the detailed information sought was redundant as it was covered in other questions. Therefore, in the main interview data collection phase, it was decided to avoid asking for excessive details.

3.2.1.3. Observation Protocol

In this study, field notes were used as another data collection tool both for the purpose of data triangulation and to gather more detailed information. During classroom observations, the Differentiated Classroom Observation Scale (DCOS), developed by Cassady et al. (2004), was utilized. DCOS is fully outlined in Appendix I, including explanations of the coding methods and techniques used. While the DCOS was originally created to study the effects of differentiated teaching methods on gifted students, it's anticipated by authors that the scale can be applied to observe the learning experiences of any specific group of children.

3.2.2. Data Analysis Procedures

The data collected from participants through each data collection tool were analysed using different methods, approaches, or software. Detailed information about the method or software used to analyse the data obtained with different measurement tools will be presented.

3.2.2.1. Data Analysis of Data Driven from Scales

The data obtained from the scales were subjected to quantitative data analysis. The SPSS and AMOS software packages was used for quantitative data analysis. Initially, validity and reliability analyses, which are part of the scale development process, were conducted (DeVellis, 2017; Seçer, 2015).

3.2.2.2. Data Analysis of Data Driven from Interviews

In phenomenological research, the investigator explores diverse responses to, or interpretations of, a specific phenomenon. The aim is to delve into the participants' experiential world and articulate their viewpoints and emotional responses. Subsequently, the researcher endeavours to meticulously delineate and characterize the facets of each participant's individual perceptions and emotional responses to their experiences. Data are predominantly gathered via comprehensive interviews (Fraenkel et al., 2023; Moustakas, 1994).

The interview data were analysed according to the two main cycles and one intermediate cycle of coding technique recommended by Saldana (2016) for the analysis of qualitative research. The first main coding cycle involves the processes that occur during the initial coding of the data. The second main coding cycle is somewhat more challenging, as it requires analytical skills such as classification, prioritization, integration, synthesis, abstraction, conceptualization, and theory-building. The intermediate coding cycle serves as a bridge between the first and second main coding cycles and is the stage where the transition of codes from the first main cycle to the second main cycle occurs.

In present study, the interviews were conducted one-on-one with teachers, varying in length from one and a half to three hours. With the consent of the participants, audio recordings were made. These recordings were transcribed into written documents with demanding considerable time and effort. The transcriptions were then analysed using the MaxQDA software, a software package for qualitative and mixed-methods data analysis.

The analysis of the interview transcripts followed these steps:

1. Initial Reading and Note-taking: The transcripts were meticulously read, marking significant statements and passages with ‘memos’.

2. Open Coding: Following the initial reading, the data were subjected to open coding. Each phrase or section in the text was labelled with short tags or 'codes' that encapsulated the meanings they conveyed.

3. Categorizing Codes: Similar codes were grouped to form categories.

4. Identifying Themes: The categories were examined to determine broader themes.

5. Interpretation and Establishing Connections: The themes identified were related to the instructional practices of the teachers and the mathematical learning approaches of students, as inferred from classroom observations.

In this context, specific codes corresponding to single words or phrases such as ‘denial of responsibility', 'competition', and 'friend' were created. Subsequently, codes like 'student's interest to the courses' and 'student's motivation' were merged due to their similarities, along with other similar consolidations. Following this, directly related codes such as ‘Individuality and Lack of Collaboration', 'Lack of Peer Assistance' and 'Lack of Peer Learning' were grouped under the sub-category 'Peer Learning'. Similarly, other sub-categories were also formed.

After the formation of these sub-categories, groups like 'Peer Learning', 'Group Dynamics', 'Student Participation' and 'Teacher's Response Level' were collectively categorized under the broader category of 'Classroom Culture'. The established categories were then re-analysed to derive key themes. Data from the interviews were categorized under eight different themes, which are as follows:

i. Teacher Approaches
ii. Curriculum
iii. Student Diversity
iv. Differentiating Instruction
v. The Nature of Mathematics

vi. Family
vii. Criticism of the Education System
viii. Beliefs

The details of these emerging themes and the reflections of the teachers will be presented in the findings chapter.

3.2.2.3. Data Analysis of Data Driven from Field Notes

For the analysis of field notes, Content Analysis was employed. This is a technique within qualitative research methods aimed at obtaining objective, measurable, and verifiable information by analysing various materials such as documents, texts, and records, following specific rules (e.g., sampling, coding, categorization) (Mayring, 2000; 2004). In this context, handwritten data were digitized for analysis. Open coding techniques were utilized to both identify underlying patterns and to conduct a comparative and contrasting analysis with the interview data. For ensuring consistency between different types of data, interview data and observation field notes were coded using the same set of codes.

3.3. Participants of the Study

Seçer (2015) stated that for validity and reliability studies in scale development, reaching approximately ten times the number of items on the scale in terms of participants is sufficient. Hence the sample of 442 responded, is sufficient to collect data to works for validity and reliability. Furthermore, in selecting teachers for this process, an appropriate sampling method was employed, as suggested by Büyüköztürk et al. (2013).

In the quantitate part of the study data was collected from a total of 442 middle school mathematics teachers using the scales employed. The professional experience of the respondent teachers ranges from 1 to 35 years, with an average of approximately 11 years. Correspondingly, the youngest respondent is 23 years old and the oldest is 58, with an average age of approximately 35. Of the 442 respondent teachers, 292 were female and 150 were male. Frequencies and descriptive statistics about experience, age, and gender of respondents are given in the Table 11.

Table 11 *Descriptive statistics of the respondents to the scales*

	Experience	Age	Gender	
			Male	Female
Frequency			150	292
Mean	10,63	34,76		
Range	34	35		

In the qualitative section of the study, interviews were conducted with a total of 6 teachers, comprising 5 middle school mathematics teachers and 1 special education teacher. To align with the research objectives of the study, one of the mathematics teachers is employed at a Science and Art Centre, an institution dedicated to educating gifted and talented students. Additionally, a special education teacher who also teaches at the middle school level was included in the study to ensure relevance to the research topic. In the study, the abbreviation "MT" is used to denote mathematics teachers, while "SET" is used for special education teachers. For the mathematics teacher employed at the Science and Art Centre, the abbreviation "MT-SAC" is utilized.

While the research design of this study is a mixed-methods approach, it is predominantly qualitative. Because the phenomenological research method was chosen for the qualitative part, providing detailed information about the participants is more useful for interpreting the findings and conclusions (Moustakas, 1994).

MT İsmail: İsmail, a 36-year-old male middle school mathematics teacher, possesses 13 years of professional experience. He is currently employed at a school located in the city centre, which caters to a socio-economically affluent student population. İsmail had previously worked in village schools in other provinces. İsmail is a graduate of an Anatolian Teacher High School and is completed his undergraduate studies in Mathematics Education. Subsequently, he earned a master's degree. His educational journey towards becoming a teacher commenced during his high school years.

MT Safiye: Safiye is a 36-year-old female mathematics teacher working in the city centre. The school where she is employed serves a socio-economically disadvantaged community and includes migrant or refugee students among its population. Safiye previously worked in schools where she indicated that the conditions were more challenging. She completed her undergraduate studies in Mathematics Education and is currently pursuing her master's degree. Additionally, Safiye participated in numerous in-service training courses offered by the Ministry of National Education and has various certifications related to education and mathematics education.

MT Niyazi: Niyazi, who is 38 years old male teacher, graduated from Elementary Mathematics Education program in a university that offers instruction in English. With 11 years of professional experience, he is currently employed at a school located outside the city centre. Niyazi tries to understand both the out-of-school and familial circumstances of his students.

MT Merve: Merve is a middle school mathematics teacher with 10 years of experience. She spent the first 6 years of her career working in a district school and have been at her current school for 4 years. The school where she currently work is socio-culturally at a normal level. Instead of pursuing a master's degree, she is currently studying for a bachelor's degree in Turkish Language Education.

MT-SAC Melek: Melek is a mathematics teacher working at a state institution known as the Science and Art Centre, which specializes in educating gifted and talented students. After teaching in public schools for 8 years, she transitioned to the Science and Art Centre through a selection exam. She is currently pursuing her master’s degree.

SET Baki: Baki, who works as a special education teacher, completed his master’s degree in the same field after finishing his undergraduate education. He is currently pursuing his doctoral education. Since there is no distinction made between primary, middle, or high school levels in special education teaching, he taught students with special education needs at all grade levels.

For classroom observation, five class periods were observed in a classroom taught by Teacher İsmail, which included both slow learner students and those identified as gifted and talented. Additionally, the classroom included various student groups characterized by slow learning, moderate academic performance, and a majority who demonstrated higher achievement levels compared to their peers. The class size varied between 22 and 25 students, depending on the attendance of the students.

3.4. Validity and Reliability of the Study

The objective of mixed-methods research is to amalgamate the strengths of both quantitative and qualitative data types to yield more comprehensive and reliable outcomes (Teddlie & Tashakkori, 2010; 2012). Therefore, it is imperative to attend to validity and reliability features that are specific to mixed-methods, as well as those that are individually pertinent to quantitative and qualitative research paradigms (Christensen et al., 2015).

Christensen et al. (2015) proposed five distinct types of validity for mixed-methods research, namely: a) Inside-Outside Validity, b) Weakness Minimization Validity, c) Sequential Validity, d) Sample Integration Validity, and e) Multiple Validities. In the present study, efforts were made to establish Inside-Outside Validity by incorporating the perspectives of both the participants involved in the research and impartial external experts. An attempt was undertaken to achieve Weakness Minimization Validity by using interviews and observations to explore the reasons behind the results obtained from quantitative data collected through scales. Although the study is a the sequential mixed-methods research, the focus on investigating the underlying causes of the findings obtained from the quantitative data serves a research purpose rather than introducing bias, thereby not compromising Sequential Validity. For Sample Integration Validity, defensible conclusions were drawn from both quantitative and qualitative data; however, these were not considered equivalent but rather complementary, as they examine different aspects of the phenomena under study. A detailed explanation for Multiple Validities, which refers to the condition where both quantitative and qualitative methods are internally valid, is provided below and the finding chapter.

For the validity of the quantitative data, face, content, and construct validity can be considered (Namlı, 2023). As previously detailed, expert opinions was rigorously obtained to enhance the face and content validity of the scale items. For construct validity, both Exploratory Factor Analysis and Confirmatory Factor Analysis was executed using the SPSS software package. The resultant findings about these analyses will be comprehensively presented in the "Findings" chapter.

3.5. Ethics

In the conceptualization and execution of research endeavours, ethical considerations pertinent to the research activities must be meticulously planned for (Creswell, 2013). To uphold ethical integrity throughout the study, the following steps were undertaken:

- After finalizing the research methodology and formulating the data collection instruments, ethical clearance was secured from the Applied Ethics Research Centre at Middle East Technical University to affirm the study's adherence to ethical norms (Appendix A for details).
- During the research process, no physical or emotional harm was inflicted on any living being.
- All necessary permissions were obtained from official authorities to conduct the study (Appendix B).
- The objectives of the study were clearly communicated to the teacher participants, and their voluntary participation was established as the foundational criterion for their involvement. Accordingly, both oral and written informed consent was obtained from each participant prior to data collection via a consent form (Appendix C).
- All participant-related information and data amassed during the study were securely stored using multiple data storage solutions. Access to this data was restricted solely to the supervisor.
- To maintain participant anonymity, pseudonyms were employed in lieu of actual names in the research documentation.
- Plans were made to disseminate the finalized research report to the study participants for their review.

3.6. Limitations and Assumptions of the Study

- It's possible that the teachers may not recounted every detail or might not remember certain aspects, and they could made biased interpretations in their favour while expressing themselves. Therefore, it was assumed that both the mathematics teachers who responded the scales and those who participated in the interviews have given honest and sincere responses.

- The theoretical framework used within the scope of the study which was offered by Rouse (2006, 2008) may have caused the data obtained to emerge only in certain aspects.
- The sample classroom scenario used during interviews to provide a clear concept and perception for teachers when referring to a 'classroom with academically diverse students' may have both limited and directed the responses given by the teachers.
- The researcher's subjective interpretations or biases may serve as a limitation, particularly when dealing with qualitative data
- Since the findings obtained in this study reflect only the perspectives of the teachers who participated voluntarily, generalisation of the results may be limited to teachers and teaching settings with similar characteristics.

CHAPTER 4

FINDINGS

The purpose of present study is to investigate the knowledge, practices (or attitudes), and beliefs of mathematics teachers regarding the teaching of mathematics in academically diverse classrooms in middle school. In this chapter, considering the research questions, the preliminary analyses of the developed Knowledge, Belief, and Doing scales will be presented initially, followed by the statistics of exploratory and confirmatory factor analysis. Subsequently, the analysis and findings of qualitative data collected through interviews with participating middle school mathematics teachers will be presented. Additionally, findings obtained from classroom observations will relate to other results.

4.1. Findings Related to Scale Development

Initially, to analyse the reliability of the Reflection Scales (Appendix E., F., and G), Cronbach's alpha coefficients were examined. Additionally, in the context of this study, the Teacher Self-Reflection Scales were being developed with a focus on establishing construct validity. Factor analysis procedures were applied for this purpose, and the findings obtained from these factor analysis procedures will be presented in this section.

4.1.1. Findings Related to Reliability for Teacher Self-Reflection Scales

With these three scales, data was collected from 442 middle school mathematics teachers. The internal consistency levels and item-total correlations of the scale were examined using the SPSS 26 statistical program. Results are presented in the Table 12. As a result of the reliability analysis of the data, it was found that the Cronbach's alpha coefficients were α=.951 for the 'Knowledge Scale,' α=.875 for the 'Doing Scale,' and α=.550 for the 'Belief Scale'.

Table 12 *Cronbach's alpha coefficients of Scales*

Scale Name	# of items	Cronbach's alpha (α)
Knowledge Scale	15	.951
Doing Scale	19	.875
Belief Scale	19	.550

Table 13 *Item-Total Correlation coefficients of Belief Scale*

Number of Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
m1	0,158	0,540
m2	0,318	0,518
m3	**-0,016**	**0,576**
m4	0,235	0,526
m5	0,224	0,530
m6	0,321	0,515
m7	0,153	0,541
m8	**-0,311**	**0,600**
m9	0,207	0,536
m10	0,323	0,518
m11	0,321	0,524
m12	0,393	0,505
m13	0,156	0,548
m14	0,371	0,511
m15	0,305	0,509
m16	0,239	0,525
m17	0,273	0,525
m18	**-0,198**	**0,603**
m19	0,365	0,513

Based on these results in Table 12., it was observed that the reliability coefficients of the Knowledge and Doing scales are sufficiently high and fall within an acceptable range (Seçer, 2015). However, for the Belief scale, the reliability coefficient appears to be low and falls outside the acceptable range. It was deemed appropriate to decide whether to remove items from the Doing and Knowledge scales after conducting an exploratory factor analysis, as the items in these scales were suitable for such analysis.

For the Belief scale, to identify the reason for the low reliability coefficient, item-total correlations were examined (Table 13). It was observed that the item-total correlation coefficients for some items were below .30 (Seçer, 2015), and some even had negative values (bolded in Table 13).

At this stage, it was considered appropriate to remove problematic items one by one from the analysis and continue this process until the alpha coefficient reached a sufficiently high level and no further removal of any item positively contributed to the alpha coefficient.

In conclusion, for the remaining eight items (2, 6, 9, 10, 11, 12, 14, and 17) of the belief scale, the Cronbach's alpha coefficient is determined to be .724. The item-total correlation coefficients and statistics for 'Cronbach's alpha coefficient if item deleted' are presented in **Hata! Yer işareti başvurusu geçersiz.**.

Table 14 *Item-Total Correlation coefficients of Revised Belief Scale*

Number of Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
m2	0,490	0,680
m6	0,417	0,698
m10	0,502	0,678
m12	0,354	0,711
m9	0,290	0,718
m11	0,448	0,693
m14	0,423	0,695
m17	0,420	0,696

4.1.2. Findings Related to Construct Validity for Teacher Self-Reflection Scales: Belief Scale

In this section, the focus will initially be on checking the normality and sample size adequacy for the Belief Scale which initially contains 19 scale items then reduced to 8 items. Subsequently, the results of the exploratory factor analysis will be presented to reveal the latent structure. Finally, information about the confirmatory factor analysis results will be provided to examine the model fit.

4.1.2.1. Suitability of Sample Size and Normality for Belief Scale

To determine the suitability of a dataset's sample size (N=442) for factor analysis and to check for multivariate normality, it is essential to first conduct the Kaiser-Meyer-Olkin (KMO) and Bartlett’s tests (Seçer, 2015; Çokluk et al., 2021). The Table 15 provides statistical information related to these tests.

Table 15 *Results of the KMO and Bartlett Tests for the Belief Scale*

	KMO	Bartlett's Test of Sphericity
Coefficient	.750	
Chi-Square		658,561
df		28
Significance		.000

The Kaiser-Meyer-Olkin (KMO) coefficient value indicates the adequacy of the sample size, presenting a value between 0 and 1. A KMO value closer to 1 suggests the sample size is sufficiently adequate. According to Pallant (2020), the KMO value should be at least 0.60 or higher. Furthermore, Hutcheson and Sofroniou (1999) state that a KMO value between 0.7 and 0.8 indicates a good level of sample size adequacy, a value between 0.8 and 0.9 indicates a very good level, and a value above 0.9 signifies an excellent level of sample size adequacy. Considering this information, a KMO value of .70 or higher is generally expected.

Upon examining the values presented in Table 15, it can be stated that the KMO value is .75, indicating that the sample size of the data set (N=442) used is adequately large for factor analysis. Additionally, to determine whether the data set exhibits multivariate normality, the significance of the 'Barlett's Test of Sphericity' value should be examined. Accordingly, considering the Barlett's value ($\chi^2(28) = 658.561$, p=.000), it can be stated that it is significant, and the data set possesses a multivariate normal distribution. Having established the necessary criteria for factor analysis, the latent structure of the scale can now be examined on this data set. The steps to determine the latent structure of the scale within the scope of exploratory factor analysis are presented in the following section.

4.1.2.2. Findings of the Exploratory Factor Analysis of the Belief Scale

For the exploratory factor analysis, SPSS 26 software was utilized. Initially, the principal components method was employed as the factor determination approach. Additionally, the Scree plot, which provides insights into the latent structure of the scale, was also used. Although the Scree plot does not offer a complete understanding of the scale's latent structure, it can be considered as an initial finding in determining the factor structure of the scale.

Table 16 *Total variance explained values for Belief Scale*

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,772	34,652	34,652	2,772	34,652	34,652
2	1,372	17,153	51,805	1,372	17,153	51,805
3	0,924	11,553	63,358			
4	0,731	9,140	72,498			
5	0,684	8,547	81,046			
6	0,581	7,261	88,307			
7	0,505	6,317	94,624			
8	0,430	5,376	100,000			

In this context, Table 16 presents the total values of the explained variances for the scale. Upon examination of the table, it is suggested that the scale under development be grouped under 2 factors for exploratory factor analysis. This is attributed to the eigenvalues being above 1. It is observed that the eigenvalue for the first factor is 2.772 with a variance percentage of 34.652, for the second factor the eigenvalue is 1.372 with a variance percentage of 17.153, The total explained variance percentage for 2 factors is 51.805. In social sciences, a total variance percentage above 30% is considered acceptable (Çokluk, et al., 2021). Additionally, before deciding on the definitive number of factors for the scale, it is necessary to examine the Scree plot.

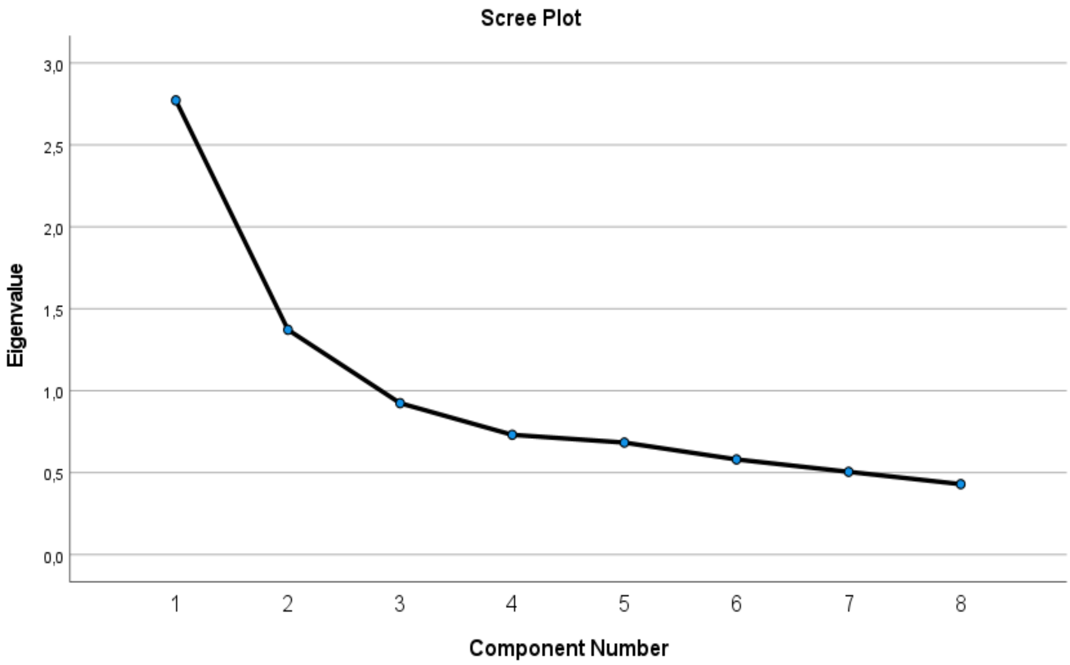


Figure 13 Scree plot For Belief Scale

According to Figure 13, the vertical axis represents the eigenvalue, while the horizontal axis indicates the number of factors (component number). As per the Figure 13, the scale starts to take eigenvalues lower than 1 after the sixth factor. This information aligns with the eigenvalue data. To support this interpretation, parallel analysis (Watkins, 2000), a method aiming to determine the number of factors using hypothetical data, was employed. The eigenvalues resulting from 100 replications using this method are presented in Table 17.

Table 17 *Results of Parallel Analysis for Belief Scale*

Number of Eigenvalue	Random Eigenvalue
1	1,2034
2	1,1279
3	1,0716
4	1,0233
5	0,9602
6	0,9178
7	0,8748
8	0,821

Parallel analysis is conducted through a three-stage procedure. Initially, a data set is created randomly, mirroring the actual data in terms of case and variable count. Subsequently, Principal Component Analysis is applied multiple times to this randomly generated data, with the eigenvalues for each component being recorded during each iteration. These eigenvalues are then averaged for each respective component. The final step involves comparing these averaged eigenvalues from the simulated data with those from the actual data set. Components from the actual data are considered significant and retained only if their eigenvalues surpass the corresponding averaged eigenvalues from the simulated data (Tabachnick & Fidell, 2013).

Considering this explanation, it is observed that all components following the second component (eigenvalue = 1,372) in the actual data set have eigenvalues lower than the second component's eigenvalue (eigenvalue = 1,1279) generated in the random data. Based on both the scree plot and the parallel analysis, it was determined that a two-factor structure for the scale would be more appropriate. Due to the identification of multiple factors in the analysis, a rotation process was performed. The item factor loadings resulting from the factor analysis, which was redone with a fixed two-factor structure and conducted using the Varimax rotation method, are presented in Table 18. Upon examining the item factor load values in Table 18, it is observed that there is no overlapping or negatively loaded items. Consequently, it was concluded that the belief scale being developed consists of two sub-dimensions. Items 9, 11, 14, and 17 are grouped under the first sub-dimension. Items 2, 6, 10 and 12 are grouped under the second sub-dimension (factor).

Table 18 *Factor Loadings of Belief Scale*

Number of Item	Component	
	1	2
m11	0,774	
m14	0,745	
m17	0,725	
m9	0,512	
m10		0,791
m12		0,765
m2		0,679
m6		0,581

On the other hand, confirmatory factor analysis, used to examine the model fit of the latent structure obtained through exploratory factor analysis, is a crucial method in the process of developing an original measurement tool. Therefore, the next section will provide information about the results of the confirmatory factor analysis.

4.1.2.3. Findings of the Confirmatory Factor Analysis of The Belief Scale

In the previous section, the latent structure of the Belief Scale was established through exploratory factor analysis. Confirmatory factor analysis, a crucial approach in the development of an original measurement tool, was conducted using the AMOS 22 software package. To facilitate comparison of the results derived from the analysis findings, it is necessary to establish the model fit indices and their acceptable ranges. In this context, reference values (Çokluk et al., 2021; Gürbüz, 2021) are presented in

Table 19. Additionally, the fit index values resulting from the confirmatory factor analysis are presented in Table 20 and the diagram showing the factor loadings is displayed in Figure 14.

Table 19 *Model Fit Indices and Recommended Range*

Fit Indices	Criterion	
	Good	Acceptable
χ^2	Non-significant	Non-significant
χ^2 / df	≤ 3	≤ 5
RMSEA	≤ .05	≤ .08
NFI	≥ .95	≥ .90
CFI	≥ .95	≥ .90
RMR	≤ .05	≤ .08
GFI	≥ .95	≥ .90
AGFI	≥ .95	≥ .90

Table 20 *Fit Index Values Obtained After CFA for Belief Scale*

Fit Indices	Obtained value
χ^2	65,816 (p=.000; significant)
df	19
χ^2 / df	3.464
RMSEA	.075
NFI	.901
CFI	.926
RMR	.033
GFI	.963
AGFI	.930

The first value to be examined in the first-level multifactor confirmatory factor analysis is the p-value, which provides information about the significance of the difference between the expected and observed covariance matrices (χ^2 value). Ideally, the p-value should be non-significant. According to Table 20, p-value is significant. However, in many confirmatory factor analyses, especially with large samples, a significant p-value is common and thus, alternative fit indices are also considered. In other words, a significant p-value is often tolerated in many studies.

Another fit index considered is the χ^2 value. However, χ^2 is not evaluated in isolation but is ratioed against the degrees of freedom (df). As seen in Table 20, χ^2 is 65,816 and df is 19. When these values are divided, the χ^2 / df ratio is 3.464 (65,816 /19=3.464). In large samples, a ratio below 3 indicates excellent fit, and below 5 indicates a moderate level of fit (Kline, 2005; Sümer, 2000). Therefore, the analysis provides an acceptable fit according to the χ^2 / df ratio.

Examining the RMSEA in Table 20, a fit index of .075 is observed. An RMSEA below .05 indicates excellent fit, and below .08 indicates good fit (Jöreskog & Sörbom, 1993). Thus, the analysis's fit index is considered acceptable.

Continuing with the examination of fit indices, the GFI is .96 and the AGFI is .93. GFI and AGFI indices above .95 indicate good fit, and above .90 indicate acceptable fit (Hooper et al., 2008). Therefore, the analysis indicates good fit for GFI and acceptable fit for AGFI.

The RMR fit index is observed to be .033. RMR and standardized RMR below .05 indicate good fit, below .08 indicate acceptable fit (Brown, 2006), and below .10 indicate weak fit. Hence, the analysis's RMR indicates good fit. Finally, examining the NFI and CFI fit indices, the NFI is .90 and the CFI is .92. NFI and CFI indices above .95 indicate good fit, and above .90 acceptable fit (Sümer, 2000). Therefore, the analysis indicates acceptable fit for both NFI and CFI.

According to these findings, model fit indices meet the required standards. In conclusion, it can be stated that the two-factor structure of the 8-item Belief Scale was confirmed as a model. Since the first-order multifactorial model was confirmed, analyses for the second-order multifactorial model were conducted. However, it was determined that the second-order multifactorial structure is not suitable as a model. Consequently, it is appropriate to use the first-order multifactorial model (Figure 14).

In the next section, information will be provided on the naming of the factors/dimensions that emerged in the Belief scale, whose first-level multifactorial model structure was confirmed through the exploratory and confirmatory factor analysis results conducted so far.

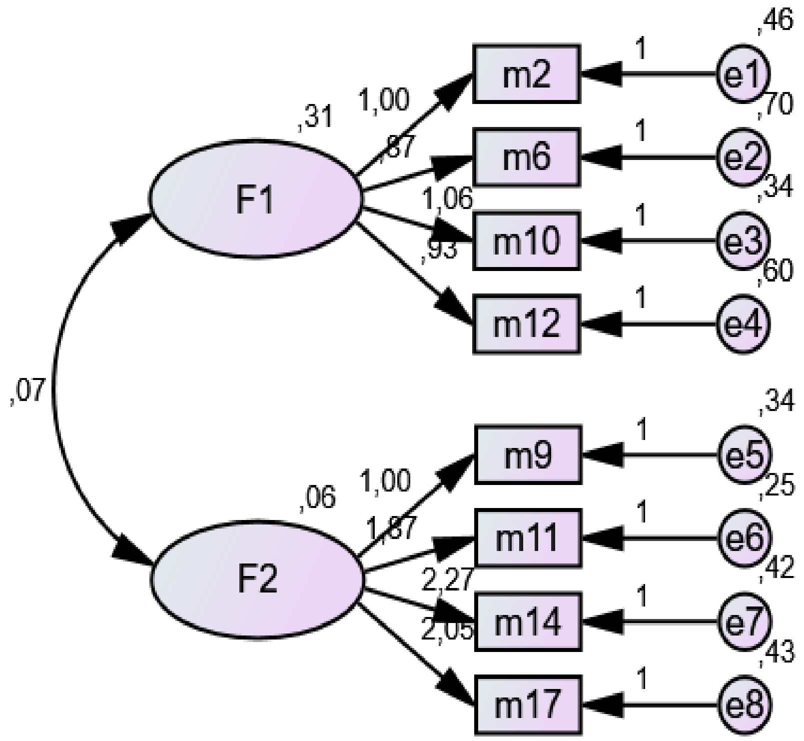


Figure 14 Diagram of Factor Loadings for Belief Scale

4.1.2.4. Naming the Emerging Factors in the Belief Scale

To name the factors that emerged in the Belief scale, whose structure was confirmed by the first-level multifactorial model through exploratory and confirmatory factor analysis results, the items grouped under each factor were examined.

The first factor, comprising items 2, 6, 10 and 12, relates to the subcategories "All children can learn" and "to be worth educating" used during the item pool creation (see Table 6). It was decided that naming this factor "Beliefs about the Right to Education" would be appropriate.

1. Item 2: I believe all students should be taught mathematics in the same way.
2. Item 6: I believe there is no need to teach extra mathematics to students with high mathematical achievement.
3. Item 10: I believe all students learn mathematics in the same way.
4. Item 12: I believe there is no need to teach mathematics to students with low mathematical achievement.

On the other hand, items 9, 11, 14, and 17, grouped under the second category, are associated with the "Accommodation and Modification" subcategory from the previously mentioned item pool subcategories. Therefore, it was determined that "Beliefs about Differentiating Instruction" would be a suitable name for this factor.

- Item 9: I believe every student learns mathematics at a different pace.
- Item 11: I believe students should be given different assignments/tasks based on their academic achievement levels.
- Item 14: I believe in differentiating instruction based on students' interests when teaching mathematics.
- Item 17: I believe in differentiating instruction based on students' readiness levels when teaching mathematics.

In conclusion, the Mathematics Teachers’ Belief Self-Reflection Scale, consisting of 8 items grouped under 2 factors, is presented in Appendix H with item and factor names.

4.1.3. Findings Related to Construct Validity for Teacher Self-Reflection Scales: Knowledge Scale

In this section, the focus will initially be on checking the normality and sample size adequacy for the Knowledge Scale which contains 15 items. Subsequently, the results of the exploratory factor analysis will be presented to reveal the latent structure. The stages of exploratory factor analysis will be explained, and with the aid of alternative methods for determining the number of factors, such as parallel analysis, the number of factors in the latent structure of the scale will be identified. Finally, information about the confirmatory factor analysis results will be provided to examine the model fit.

4.1.3.1. Suitability of Sample Size and Normality for Knowledge Scale

To assess whether a dataset's sample size is appropriate for factor analysis and to verify the presence of multivariate normality, conducting the Kaiser-Meyer-Olkin (KMO) and Bartlett's tests is a crucial initial step (Seçer, 2015; Çokluk et al., 2021). Table 21 presents the statistical details relating to these tests.

Table 21 *Results of the KMO and Bartlett Tests for the Knowledge Scale*

	KMO	Bartlett's Test of Sphericity
Coefficient	.932	
Chi-Square		5243,951
df		109
Significance		.000

Reviewing the data in Table 21 reveals that the Kaiser-Meyer-Olkin (KMO) measure is .932, suggesting that the sample size of the utilized data set is sufficiently large for conducting factor analysis. Furthermore, the 'Barlett's Test of Sphericity' value ($\chi^2(109) = 5243.951$, p=.000) is significant and this confirms the multivariate normal distribution of the data set.

With these criteria for factor analysis being met, the next step involves analysing the scale's latent structure. The process for uncovering the scale's underlying structure through exploratory factor analysis is detailed in the subsequent section.

4.1.3.2. Findings of the Exploratory Factor Analysis of the Knowledge Scale

In the initial phase of the exploratory factor analysis, the principal components method was utilized to determine the factors. Alongside this, the Scree plot was employed to gain insights into the scale's latent structure.

While the Scree plot does not provide a comprehensive understanding of the scale's underlying structure, it serves as an initial indicator in identifying the scale's factor configuration. In this context, Table 22 presents the total values of the explained variances for the scale. Upon examination of the table, it is suggested that the scale under development be grouped under 2 factors for exploratory factor analysis.

Table 22 *Total variance explained values for Knowledge Scale*

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8,950	59,664	59,664	8,950	59,664	59,664
2	1,087	7,248	66,912	1,087	7,248	66,912
3	0,836	5,574	72,487			
4	0,674	4,496	76,983			
5	0,603	4,021	81,004			
6	0,455	3,034	84,038			
7	0,430	2,864	86,902			
8	0,372	2,483	89,386			
9	0,317	2,114	91,499			
10	0,277	1,847	93,347			
11	0,254	1,696	95,042			
12	0,233	1,557	96,599			
13	0,212	1,412	98,011			
14	0,167	1,114	99,126			
15	0,131	0,874	100,000			

It is observed that the eigenvalue for the first factor is 8,950 with a variance percentage of 59.664, for the second factor the eigenvalue is 1.087 with a variance percentage of 7.248. The total explained variance percentage for 2 factors is understood to be 66.912. In social sciences, a total variance percentage above 30% is considered acceptable (Çokluk, et al., 2021). Additionally, before deciding on the final number of factors for the scale, it is necessary to examine the Scree plot.

As per the Figure 15, the scale starts to take eigenvalues lower than 1 after the second factor. This information aligns with the eigenvalue data.

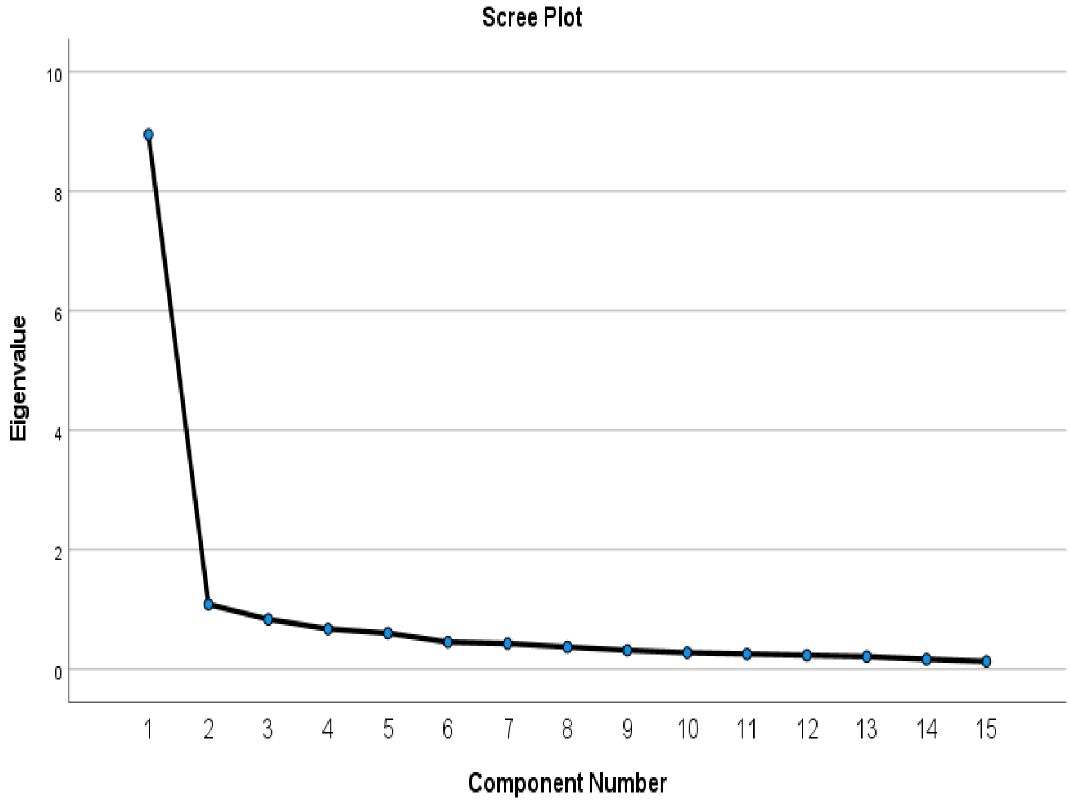


Figure 15 Scree plot For Knowledge Scale

Table 23 *Results of Parallel Analysis for Knowledge Scale*

Number of Eigenvalue	Random Eigenvalue
1	1,3182
2	1,2467
3	1,1927
4	1,1493
5	1,1068
6	1,0649
7	1,0320
8	0,9933
9	0,9598
10	0,9201
11	0,8828
12	0,8458
13	0,8070
14	0,7662
15	0,7143

In this case, it can be interpreted that instead of 2 factors,1 factor might be more appropriate. To support this interpretation, parallel analysis (Watkins, 2000), a method aiming to determine the number of factors using hypothetical data was employed. The eigenvalues resulting from 100 replications are presented in Table 23.

Considering Table 23, it is observed that all components following the first component (eigenvalue = 8.950) in the actual data set have eigenvalues lower than the fourth component's eigenvalue (eigenvalue = 1,3182) generated in the random data. Based on both the scree plot and the parallel analysis, it was determined that a one-factor structure for the scale would be more appropriate.

Table 24 *Factor Loadings of Knowledge Scale*

Number of Item	Factors
	1
k4	0,844
k9	0,813
k6	0,813
k3	0,811
k5	0,808
k15	0,798
k7	0,797
k8	0,797
k14	0,784
k10	0,762
k11	0,756
k12	0,724
k2	0,708
k1	0,681
k13	0,666

Since the scale has a unifactorial structure, a rotation process cannot be performed. The item factor loadings resulting from the factor analysis, which was redone with a fixed one-factor structure, are presented in Table 24. According to Table 24, the Knowledge Scale being developed consists of only one dimension (factor), and all the remaining 15 items are included in this factor.

Confirmatory factor analysis, used to examine the model fit of the latent structure obtained through exploratory factor analysis, is a crucial method in the process of developing an original measurement tool. Therefore, the next section will provide information about the results of the confirmatory factor analysis.

4.1.3.3. Findings of the Confirmatory Factor Analysis of The Knowledge Scale

In the previous section, the latent structure of the Knowledge Scale was established through exploratory factor analysis. Confirmatory factor analysis, a crucial approach in the development of an original measurement tool, was conducted using the AMOS 22 software package.

During the initial phase of the analysis, it was observed that many of the fit indices were outside the acceptable range. Therefore, a maximum of two recommended modifications were made before repeating the analysis. And the fit index values resulting from the repeated analysis are presented in Table 25 and the diagram showing the factor loadings is displayed in Figure 16.

Table 25 *Fit Index Values Obtained After CFA for Knowledge Scale*

Fit Indices	Obtained value
χ^2	817,19 (p=.000; significant)
df	88
χ^2 / df	9.286
RMSEA	.137
NFI	.546
CFI	.860
RMR	.038
GFI	.783
AGFI	.704

The first value to be examined in the remodelled analysis is the p-value, which provides information about the significance of the difference between the expected and observed covariance matrices (χ^2 value). Ideally, the p-value should be non-significant. According to Table 25, p-value is significant. However, in many confirmatory factor analyses, especially with large samples, a significant p-value is common and thus, alternative fit indices are also considered. In other words, a significant p-value is often tolerated in many studies.

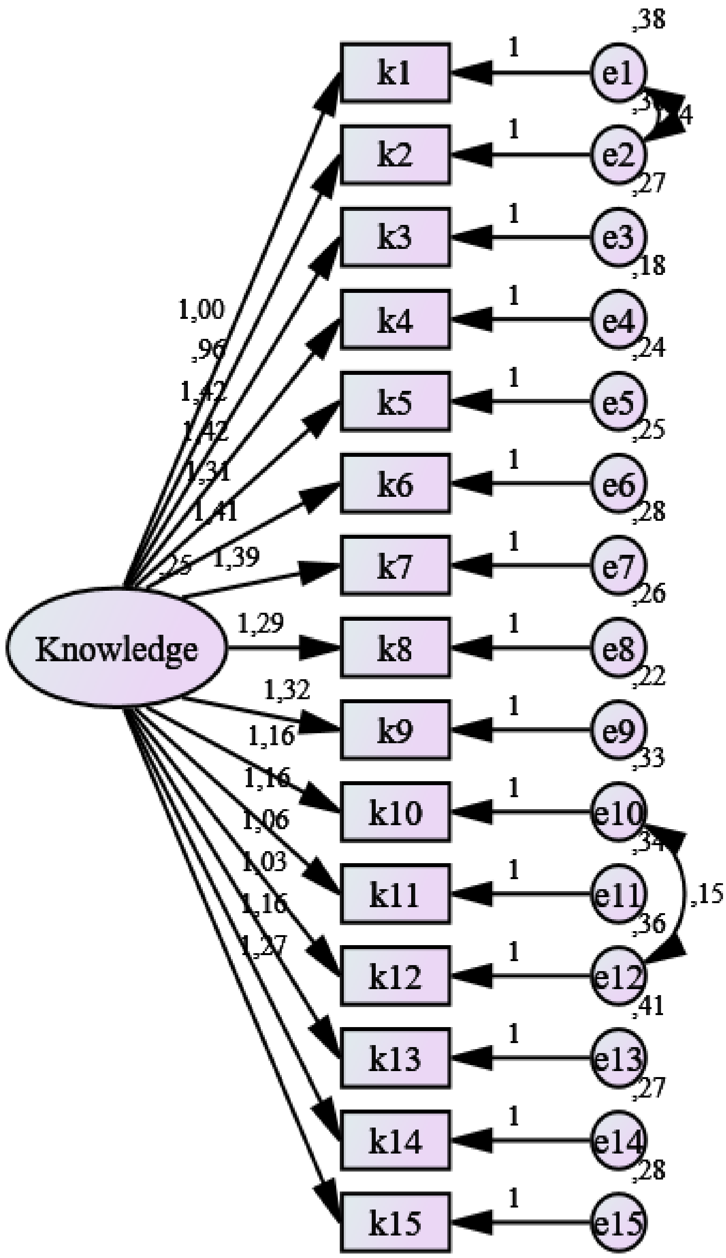


Figure 16 Diagram of Factor Loadings for Knowledge Scale

Another fit index considered is the χ^2 value. However, χ^2 is not evaluated in isolation but is ratioed against the degrees of freedom (df). As seen in Table 25, χ^2 is 817.19 and df is 88. When these values are divided, the χ^2 / df ratio is 9.286 (817.19/88=9.286). In large samples, a ratio below 3 indicates excellent fit, and below 5 indicates a moderate level of fit (Kline, 2005; Sümer, 2000). Therefore, the analysis does not provide an acceptable fit according to the χ^2 / df ratio.

Examining the RMSEA in Table 25, a fit index of .137 is observed. An RMSEA below .05 indicates excellent fit, and below .08 indicates good fit (Jöreskog & Sörbom, 1993). Thus, the analysis's fit index is considered weak. Continuing with the examination of fit indices, the GFI is .78 and the AGFI is .70. GFI and AGFI indices above .95 indicate good fit, and above .90 indicate acceptable fit (Hooper et al., 2008). Therefore, the analysis indicates weak fit for both GFI and AGFI.

The RMR fit index is observed to be .038. RMR and standardized RMR below .05 indicate good fit, below .08 indicate acceptable fit (Brown, 2006), and below .10 indicate weak fit. Hence, the analysis's RMR indicates good fit. Finally, examining the NFI and CFI fit indices, the NFI is .85 and the CFI is .86. NFI and CFI indices above .95 indicate good fit, and above .90 acceptable fit (Sümer, 2000). Therefore, the analysis indicates weak fit for both NFI and CFI.

Although recommended modifications were made, most of the model fit indices did not meet the required standards. In conclusion, it can be stated that the one-factor structure of the 15-item Mathematics Teachers' Knowledge Self-Reflection Scale was not confirmed as a model.

4.1.4. Findings Related to Construct Validity for Teacher Self-Reflection Scales: Doing Scale

In this section, the focus will initially be on checking the normality and sample size adequacy for the Doing Scale which contains 19 scale items. Subsequently, the results of the exploratory factor analysis will be presented to reveal the latent structure. Finally, information about the confirmatory factor analysis results will be provided to examine the model fit.

4.1.4.1. Suitability of Sample Size and Normality for Belief Scale

To determine the suitability of a dataset's sample size for factor analysis and to check for multivariate normality, it is essential to first conduct the Kaiser-Meyer-Olkin (KMO) and Bartlett’s tests (Seçer, 2015; Çokluk et al., 2021). The Table 26 provides statistical information related to these tests.

Reviewing the data in Table 26 reveals that the Kaiser-Meyer-Olkin (KMO) measure is .921, suggesting that the sample size of the utilized data set is sufficiently large for conducting factor analysis. Furthermore, the 'Barlett’s Test of Sphericity' value ($\chi^2(171) = 4298.098$, p=.000) is significant and this confirms the multivariate normal distribution of the data set.

Table 26 *Results of the KMO and Bartlett Tests for the Doing Scale*

	KMO	Bartlett's Test of Sphericity
Coefficient	.921	
Chi-Square		4298,098
df		171
Significance		.000

With these criteria for factor analysis being met, the next step involves analysing the scale's latent structure. The process for uncovering the scale's underlying structure through exploratory factor analysis is detailed in the subsequent section.

4.1.4.2. Findings of the Exploratory Factor Analysis (EFA) of the Knowledge Scale

In the initial phase of the exploratory factor analysis, the principal components method was utilized to determine the factors. Alongside this, the Scree plot was employed to gain insights into the scale's latent structure. While the Scree plot does not provide a comprehensive understanding of the scale's underlying structure, it serves as an initial indicator in identifying the scale's factor configuration.

The analysis revealed that for the 19 items considered as the basis of the analysis, there are three components with eigenvalues exceeding 1 according to Table 27. These components collectively contribute 55.927% to the total variance. In social sciences, a total variance percentage above 30% is considered acceptable (Çokluk, et al., 2021).

Table 27 *Total variance explained values for Doing Scale*

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8,129	42,785	42,785	8,129	42,785	42,785
2	1,386	7,292	50,077	1,386	7,292	50,077
3	1,112	5,850	55,927	1,112	5,850	55,927
4	0,967	5,088	61,015			
5	0,957	5,037	66,053			
6	0,932	4,903	70,956			
7	0,741	3,902	74,858			
8	0,677	3,563	78,421			
9	0,611	3,216	81,637			
10	0,562	2,957	84,594			
11	0,503	2,646	87,239			
12	0,418	2,198	89,437			
13	0,376	1,979	91,416			
14	0,354	1,862	93,278			
15	0,349	1,837	95,115			
16	0,293	1,541	96,656			
17	0,238	1,253	97,909			
18	0,204	1,072	98,981			
19	0,194	1,019	100,000			

To determine whether these three components represent the final number of factors, examining the scree plot will provide further insight. As per the Figure 17, the scale components start to take eigenvalues lower than 1 after the third factor. This information aligns with the eigenvalue data. However, upon examining the Scree plot, it is observed that the graph begins to flatten after the first factor. In this case, it can be interpreted that instead of 3 factors,1 factor might be more appropriate.

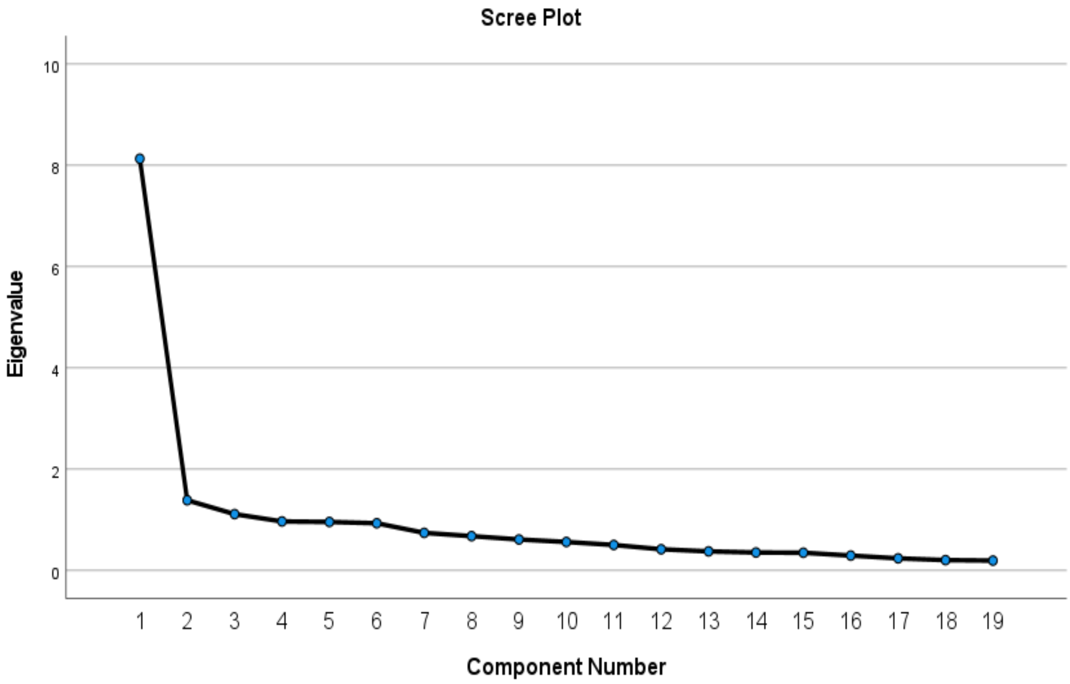


Figure 17 Scree plot For Doing Scale

To control this interpretation, parallel analysis (Watkins, 2000) was employed. The eigenvalues resulting from 100 replications using this method are presented in Table 28. In light of Table 28, it is observed that all components following the second component (eigenvalue = 1,386) in the actual data set have eigenvalues lower than the second component's eigenvalue (eigenvalue = 1,3106) generated in the random data. Based on both the scree plot and the parallel analysis, it was determined that a two-factor structure for the scale would be more appropriate.

Due to the identification of multiple factors in the analysis, a rotation process was performed. The item factor loadings resulting from the factor analysis, which was redone with a fixed two-factor structure and conducted using the Varimax rotation method, are presented in Table 29

Table 28 *Results of Parallel Analysis for Doing Scale*

Number of Eigenvalue	Random Eigenvalue
1	1,3808
2	1,3106
3	1,2558
4	1,2095
5	1,1672
6	1,1286
7	1,0922
8	1,0534
9	1,0213
10	0,9871
11	0,9556
12	0,9189
13	0,889
14	0,8595
15	0,8271
16	0,7932
17	0,7587
18	0,7192
19	0,6723

According to Table 29, it is observed that item 1 does not fall under any factor. Furthermore, items 3 have negative load values, indicating that these items are inversely related to their respective factors. Additionally, many items exhibit cross-loading characteristics in both the 1st and 2nd factors, having factor load values which have difference less than .1.

Consequently, these items were sequentially removed, and the analyses were repeated. However, during the analysis process, despite the removal of several items starting with items 1 and 3, the number of overlapping items did not decrease. This observation, along with the indications from the scree plot, suggests that the scale might have a single-factor structure.

Therefore, the analysis was redone without rotation, maintaining a fixed single-factor structure with all items. In the repeated analysis, items 1, 3, and 19 were sequentially removed either due to their negative loadings or because they did not fit into the single dimension. The final factor loadings of the items are presented in Table 30. According to Table 30, the Doing Scale being developed consists of only one dimension (factor), and all the remaining 16 items are included in this factor.

Table 29 *Doing Scale Preliminary Factor Loadings*

Number of Item	Factors	
	1	2
d15	0,836	
d14	0,809	
d16	0,801	
d13	0,794	
d9	0,633	0,537
d12	0,616	0,468
d17	0,613	
d4	0,568	0,438
d7	0,550	
d3	-0,499	
d1		
d10		0,624
d11	0,517	0,611
d6	0,407	0,597
d2		0,594
d18	0,393	0,570
d5	0,399	0,567
d8	0,513	0,553
d19		0,411

Confirmatory factor analysis, used to examine the model fit of the latent structure obtained through exploratory factor analysis, is a crucial method in the process of developing an original measurement tool. Therefore, the next section will provide information about the results of the confirmatory factor analysis. Information will be provided on the software used for confirmatory factor analysis, the stages performed, and comparative analyses of the results with fit indices.

Table 30 *Factor Loadings of Knowledge Scale*

Number of Item	Factors
	1
d9	0,827
d16	0,786
d11	0,785
d12	0,780
d13	0,748
d8	0,735
d15	0,730
d4	0,709
d6	0,682
d17	0,676
d18	0,657
d5	0,657
d14	0,646
d10	0,621
d7	0,595
d2	0,389

4.1.4.3. Findings of the Confirmatory Factor Analysis (CFA) of The Doing Scale

In the previous section, the latent structure of the Doing Scale was established through exploratory factor analysis. Confirmatory factor analysis, a crucial approach in the development of an original measurement tool, was conducted using the AMOS 22 software package. During the initial phase of the analysis, it was observed that many of the fit indices were outside the acceptable range.

Therefore, a maximum of two recommended modifications were made before repeating the analysis. And the fit index values resulting from the repeated analysis are presented in Table 31, and the diagram showing the factor loadings is displayed in Figure 18.

The first value to be examined in the remodelled analysis is the p-value, which provides information about the significance of the difference between the expected and observed covariance matrices (χ^2 value). Ideally, the p-value should be non-significant. According to Table 31, p-value is significant. However, in many confirmatory factor analyses, especially with large samples, a significant p-value is common and thus, alternative fit indices are also considered. In other words, a significant p-value is often tolerated in many studies.

Table 31 *Fit Index Values Obtained After CFA for Doing Scale*

Fit Indices	Obtained value
χ^2	695,647 (p=.000; significant)
df	102
χ^2 / df	6.820
RMSEA	.115
NFI	.828
CFI	.849
RMR	.047
GFI	.828
AGFI	.771

Another fit index considered is the χ^2 value. However, χ^2 is not evaluated in isolation but is ratioed against the degrees of freedom (df). As seen in Table 31, χ^2 is 695.64 and df is 102. When these values are divided, the χ^2 / df ratio is 6.820 (695.647/102=6.820). In large samples, a ratio below 3 indicates good fit, and below 5 indicates an acceptable level of fit (Kline, 2005; Sümer, 2000). Therefore, the analysis does not provide an acceptable fit according to the χ^2 / df ratio.

Examining the RMSEA, fit index of .115 is observed. An RMSEA below .05 indicates good fit, and below .08 indicates acceptable fit (Jöreskog & Sörbom, 1993). Thus, the analysis's fit index is considered weak. Continuing with the examination of fit indices, the GFI is .828 and the AGFI is .771. GFI and AGFI indices above .95 indicate good fit, and above .90 indicate acceptable fit (Hooper et al., 2008). Therefore, the analysis indicates weak fit for both GFI and AGFI. The RMR fit index is observed to be .047. RMR and RMR below .05 indicate excellent fit, below .08 indicate good fit (Brown, 2006), and below .10 indicate weak fit. Hence, the analysis's RMR indicates good fit.

Finally, examining the NFI and CFI fit indices, the NFI is .828 and the CFI is .849. NFI and CFI indices above .95 indicate good fit, and above .90 acceptable fit (Sümer, 2000). Therefore, the analysis indicates weak fit for both NFI and CFI. Although recommended modifications were made, most of the model fit indices did not meet the required standards. In conclusion, it can be stated that the one-factor structure of the 16-item Mathematics Teachers' Doing Self-Reflection Scale was not confirmed as a model.

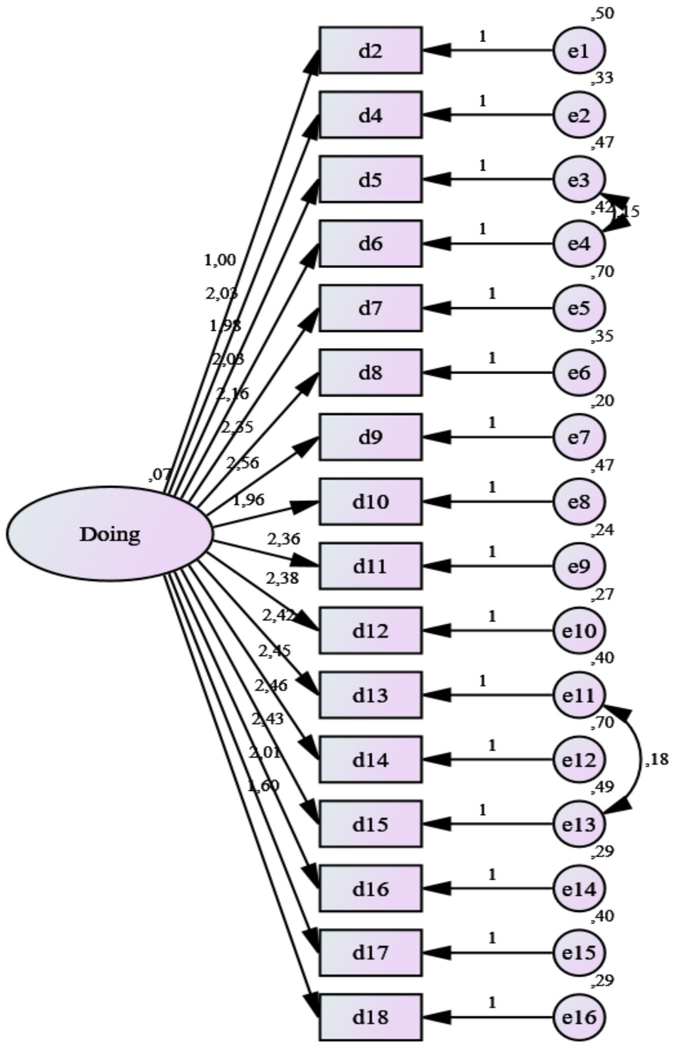


Figure 18 Diagram of Factor Loadings for Doing Scale

4.1.5. Closing Words for Findings Related to Scale Development

In this study, efforts were made to develop self-reflection scales for mathematics teachers focusing on their beliefs, knowledge, and practices. This section presents the reliability and validity analyses of these scales. The analysis results revealed that only the Mathematics Teachers Belief Reflection Scale was validated as a model, while the Knowledge and Doing scales were not confirmed as models in the confirmatory factor analysis. The underlying reason for this might be that reflections on knowledge and teaching practices cannot be effectively observed through a scale.

Consequently, it was decided to conduct interviews and classroom observations to uncover teachers' knowledge and teaching practices, and beliefs in heterogeneous classrooms offering inclusive education. The next section will analyse the interviews conducted with teachers and associate them with classroom observations.

4.2. Findings from Interviews and Classroom Observation

In this research, the objective was to uncover the knowledge, beliefs, and teaching practices of mathematics teachers in heterogeneous classrooms, particularly in the context of inclusive education. To this end, qualitative data for the study were gathered using a semi-structured interview form (Appendix J), which was developed by the researcher.

This interview form, comprising three sections with a total of eleven questions, begins with a scenario depicting a classroom characterized by academic diversity. The audio recordings interviews were transcribed into written documents with demanding considerable time and effort. The transcriptions were then analysed using the MaxQDA qualitative data analysis software.

The analysis of the interview transcripts followed these steps:

1. Initial Reading and Note-taking
2. Open Coding
3. Categorizing Codes

4. Identifying Themes
5. Interpretation and Establishing Connections

Data from the interviews were categorized under eight different themes, which are as follows:

ix. Teacher Approaches
x. Curriculum
xi. Student Diversity
xii. Differentiating Instruction
xiii. The Nature of Mathematics
xiv. Family
xv. Criticism of the Education System
xvi. Beliefs

Although these themes were identified, the analysis of interview data will not be presented on a theme-by-theme basis. This decision is due to the intersecting and overlapping nature of these themes. Instead, an attempt will be made to convey the results in a holistic manner, reflecting the interconnectedness of these themes.

4.2.1. Reflections of Teachers about Inclusive Mathematics Education in Academically Diverse Classrooms

The interview data encompassed a wide range of topics including teaching practices, challenges in addressing diverse student needs, personal reflections on the education system, and external factors affecting the teaching process. Teachers discussed the difficulties encountered in engaging with students of varying abilities and interests, particularly within a centralized and standardized test-focused education system. The discussions highlighted the limitations of current educational approaches and the struggle of teachers to adapt to diverse learning needs while fulfilling the obligations of the curriculum. Issues related to achieving equality in the classroom and contributing to each student's mathematics learning process were addressed. Additionally, teachers shared their experiences and thoughts on understanding social differences and approaching students with varying levels of achievement. While expressing a desire for change, they also mentioned the challenges of implementing new teaching methods within the limitations of the system. The importance of understanding each student's individual needs and abilities was emphasized. Adapting teaching methods to align with students' interests and real-life experiences was discussed as a means to enhance student engagement. Teachers also expressed their views on the importance of family and the inherent nature of mathematics in the context of heterogeneous classrooms with academic diversity. These and similar topics will be elaborately discussed in the later parts of the study.

4.2.1.1. Teachers Reflections about Student Diversity

Mathematics teachers' views on student diversity vary; among the participants, there was a teacher who believes that students with special educational needs or students with disabilities or students with significant learning difficulties should be removed from general education classes and placed in special education classes, or even further, sent to specialized schools. Contrarily, there were teachers who believe that even if a student does not achieve academic progress in mathematics, they should remain in the class environment to fulfil their social needs like experiencing friendship or play (see Figure 19). Teachers in this latter group argued that the role of a school extends beyond merely imparting knowledge or teaching mathematics, encompassing a broader mission. For example, one teacher, MT İsmail, expressed the following view regarding a student named Ahmet in a sample class:

> It's difficult for him [student] to continue at this level in the middle school mathematics curriculum. It seems nearly impossible. In such a case, unfortunately, I would be inclined to let the child do as he pleases without disrupting the class order. ... The child is not making an effort. I can't impose anything on him, and he just continues to attend school without much involvement. ... There are special education institutions, like the YYYY school in XXX province, where I think he might be better suited.

[Excerpt from classroom observations] Although there were no students with disabilities or enrolled in integrated education programs in the class, the teacher appeared indifferent to the lack of active participation from students who were low-performing or slow learners, if they did not disrupt the class order. (Prior to the observation, information about these students was obtained from the teacher.) From the perspective of these students, they seemed aware that the teacher either did not notice or chose to ignore their situation, leading them to continue keeping to themselves at the back of the class.

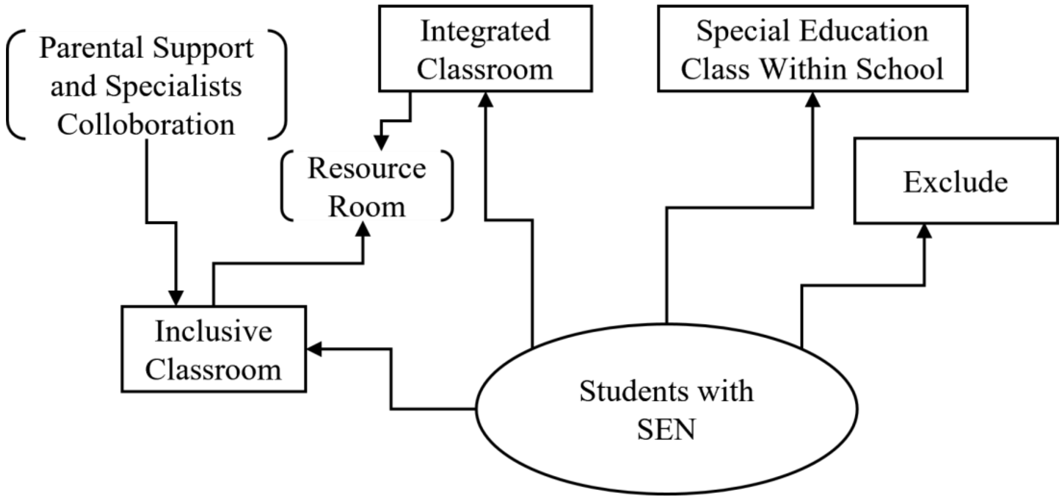


Figure 19 Reflections about Placement of Students with Special Educational Needs

On the other hand, MT Safiye found the general education class unsuitable for such students but saw value in special education classes within the school. A dialogue with MT Safiye went as follows:

> Researcher: Do you think it would be beneficial for the student to be diagnosed for integration?
>
> MT Safiye: I believe it would be beneficial for the student, but I am not in favour of them attending classes integrated with ours.
>
> Researcher: Should they be removed from the system?
>
> MT Safiye: Not removed from the system, but we have a special education class in our school. We try to integrate many students who could actually be in special education classes. In reality, these children get lost in integrated classes.

Although MT Safiye acknowledged the benefits of having a special education class within the school, she mentioned that she prepares additional worksheets for the student with educational needs in her class. She pointed out that allowing this student to solve questions at their own level while other students work on class-level activities helps prevent the student from feeling excluded. Additionally, she stated that if there is a student included under integrated education, she prepares their in-class exams separately due to legal requirements. However, when handing out the exam to the student, she mixes it with the other papers, striving to ensure that the student does not feel different from their peers.

Conversely, teachers like MT Merve and SET Baki advocated for keeping students with disabilities or students with significant learning difficulties in general education classes, provided the conditions allow for a co-teacher to support the student in the classroom, or alternatively, support in a resource room with the assistance and collaboration of a special education teacher according to the student’s individualized education program. MT Merve said:

> ... in the classroom, during breaks, playing with peers, social interaction is somewhat related to the student's nature, but I believe we can provide that. I'm not sure how much we're achieving academically, but I believe I can facilitate the social connection of an integrated student with other students on my part. However, I think resource rooms are essential for academic support. That child should be attended to individually; it's not something that can be done during the lesson.

Additionally, SET Baki suggested:

> Teachers can provide necessary support to this child through ‘Resource Room'. For instance, if the child falls behind in a topic in math while in a general education class, through collaboration between school administration and district special education institutions, education in Resource Room can be initiated. With Resource Room, this student can be developed without having to move to a special education class.

On the other hand, when examining academic diversity from another perspective, it was widely believed that gifted and talented students face as many challenges in general education classes. In Figure 20, an attempt has been made to present the main outlines of these matters.

A common agreement among mathematics teachers was that their teaching practices predominantly follow an 'Average Level Approach'. Teachers stated that students like

Başak in the example class become increasingly isolated in class, losing motivation due to unfulfilled curiosity and interest, as the teaching is directed towards the majority. The trend of moving from simple to complex problems or from concrete to abstract materials was mentioned as a factor that hinders gifted and talented students' participation and adaptation to the common classroom culture.

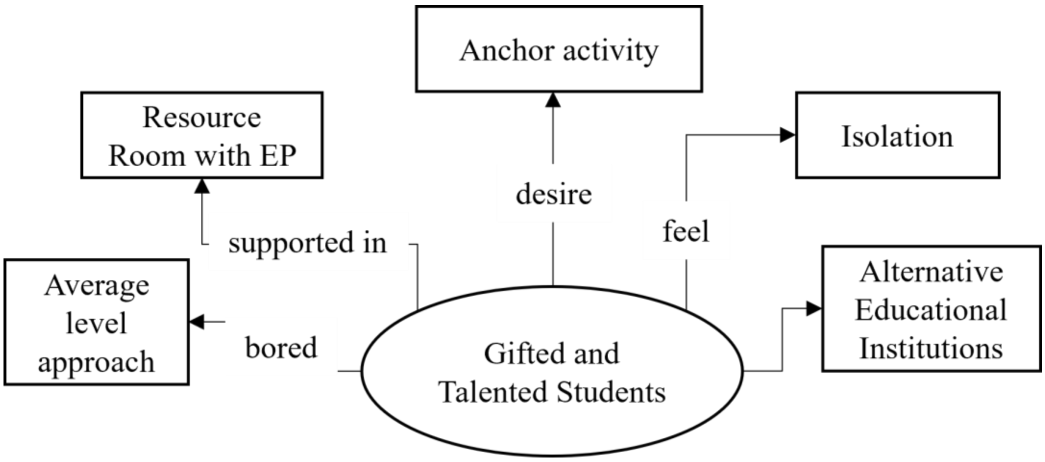


Figure 20 Reflections about Gifted and Talented Students

Some teachers suggested that an enrichment program for gifted students (EP) could offer extra and differentiated content in the Resource Room under suitable conditions (e.g., SET Baki). However, some teachers, like MT İsmail, noted that certain parents misuse the enrichment program for gifted students, expecting special individual attention for their child as if in private tutoring. Additionally, MT-SAC Melek, who works at a Science and Art Centre that caters to gifted and talented students, pointed out errors in the identification and selection of these students. She argued for the establishment of separate independent educational institutions and curriculums without examination pressure if realistic diagnosis and selection could be achieved.The need for cooperation between guidance services and expert staff in guiding these students academically and in their professional careers were also highlighted. Mathematics teachers expressed the necessity of using 'New Generation Questions' in the classroom, which require analytical skills, problem-solving abilities, and logical reasoning. However, they also conveyed concerns that constantly addressing these complex problems could challenge the rest of the class and hinder inclusivity. A dialogue regarding the situation of a gifted and talented student in the class and their comparison with other students unfolded as follows:

> Researcher: What are the specific considerations, either inside or outside school, for a student like Başak in the same class?
>
> MT Niyazi: I have students like that. They can answer the question as soon as they see it. Some of them don't even need to read the whole question. They read the bold part. They read the beginning of the question and know what it's about and how to solve it. But there's an issue with such students, like they want to answer all the questions, they answer so quickly that others don't get a chance. I usually do this for such students, I ask more straightforward questions, the kind I solve when first explaining the topic, to the class, to the average students. For example, I have a student named Faruk (pseudonym), I say to Faruk, 'your question is coming up, don't rush, I'll get to it,' and he waits for his question to come. Occasionally, I open a difficult question, maybe one or two at most per lesson or after explaining a topic. When I ask these tough ones, I let these students solve them. The other students don't really understand these difficult questions. But the student (Faruk) enjoys solving them because he can.
>
> Researcher: Does giving Faruk such a privilege create any negative effects among other students?
>
> MT Niyazi: So far, it hasn't. The other students aren't really interested in overly difficult questions. When they go to the board to solve problems they can handle, or get a chance to solve them, they are happy and enjoy it because they can solve them. But instead of demoralizing a child with difficult questions, I ask ordinary questions to the average students. They also enjoy that.

Another factor contributing to not only academic but also cultural diversity in the classroom is the presence of migrant or refugee students, as revealed by teacher opinions. It was understood that views on migrant or refugee students are influenced by elements beyond mathematics instruction (see Figure 21).

Among the teachers, some highlighted the general impact of migrant or refugee status at a national level. On one hand, a teacher mentioned that the interest and desire to do mathematics were key factors in migrant or refugee students' learning, while another pointed out the challenge of progress in math classes due to these students' lack of Turkish language skills. For instance, MT Safiye, who is lenient with students with significant learning difficulties or students with disabilities, expressed that refugee students constituted a “problem” in class and suggested it would be more beneficial for them to return to their countries, thus indicating a lack of motivation to invest extra time and energy in these students.

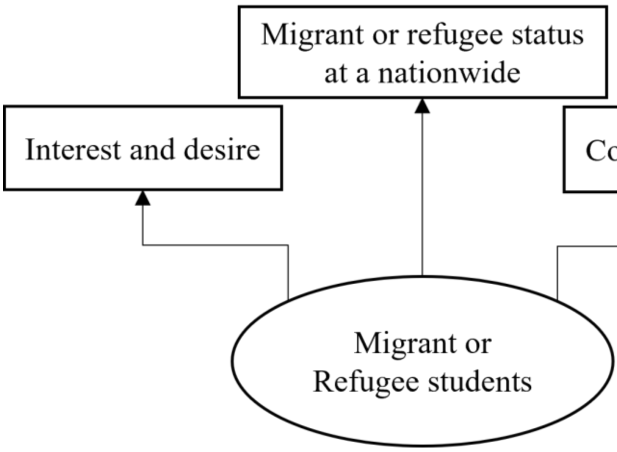


Figure 21 Reflections about Migrant or Refugee Students

MT-SAC Melek recalled having refugee students in her class and described their situation while teaching mathematics in general education institutions as follows:

> I had a student who didn’t know the (Turkish) language at all. I remember, it was like they were not there in that class. Since they didn’t know the language, I couldn’t communicate with them at all. I couldn’t establish any connection. There was no exchange of messages. Nothing worked because there was no communication. I couldn’t do anything.

However, MT Niyazi shared that refugee students themselves displayed academic diversity, with some performing very well academically, but others having no interest in school or lessons. MT Niyazi reported that among these, there were students who did not disrupt the teaching process but had to be left to themselves due to communication issues. MT Niyazi treats refugee or migrant students in the same manner as other students. He admitted to teaching those who were willing to learn but tended to ignore those students who showed no interest or desire to learn.

4.2.1.2. Teachers Reflections about Heterogenous Classroom

While teachers expressed varying views on the diversity of students and their learning needs, they shared differing or overlapping opinions on the coexistence and education of students with diverse academic achievement levels in an academically diverse classroom.

Teachers commonly agreed that students with special educational needs, whom they described as being at the extremes, would never fully learn all the mathematics topics in the curriculum and thus would fall behind in class-level activities. Even teachers willing to devote extra time to these students eventually acknowledged their learning limitations and the need to maintain balance in the classroom. It was a prevalent view that students with special educational needs were unable to participate in in-class activities and required external support outside the classroom. Teachers knew they should prepare individualized education plans (IEP) for students under integrated education due to legal obligations. However, they either received these plans in a standardized format and did not follow them (e.g., MT İsmail), or even if they prepared the plans themselves (e.g., MT Safiye), they were unable to implement them effectively in class due to time management issues.

MT Merve mentioned having students like those in the example class and emphasized that underlying familial problems often caused the students' failures. She argued that before diagnosing any disability or directing to integrated education, communication with the student's family and support structures such as guidance services should be used to integrate the student into the teaching process. And also, mathematics teaching of MT Merve would be shaped based on whether an individualized education plan was in place or not.

SET Baki, a special education teacher, pointed out that although mathematics education in a general education classroom, which is the least restrictive environment, might be slower, the student’s social development would be quicker. He also noted that including these students in integrated education and achieving success was a team effort, requiring contributions from families, peers, and administration. Even with the mathematics teacher's best efforts, desired success cannot be achieved alone.

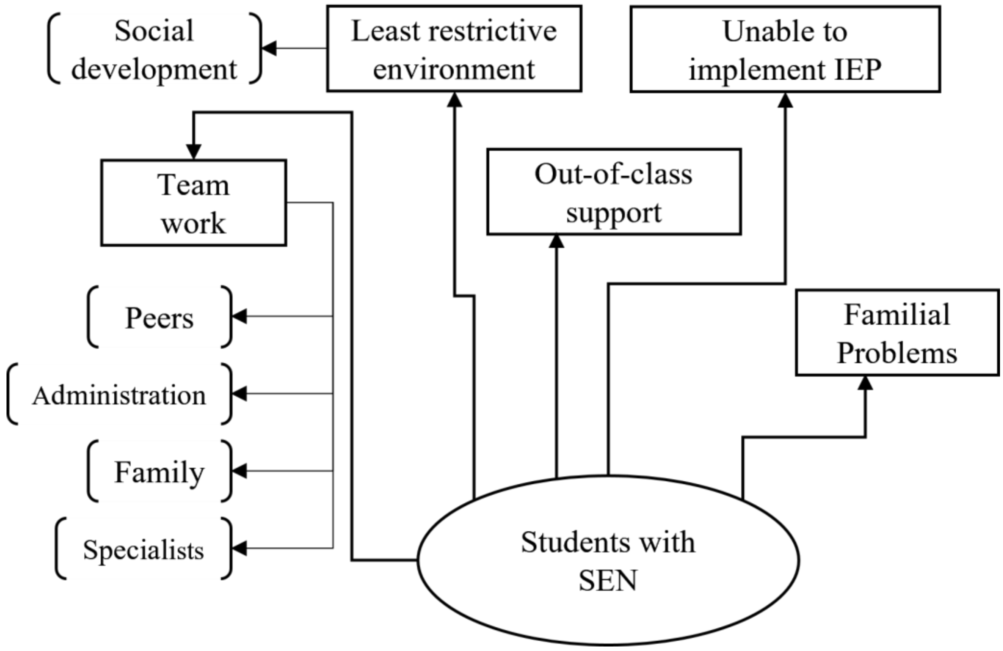


Figure 22 Reflections about Educational Process of Students with SEN

Considering these points, for the participation of a student with low achievement or special needs in a heterogeneous classroom, contributions from the teacher and other stakeholders are essential. In Figure 22, reflections related to the educational processes of students with special educational needs in a heterogeneous classroom are summarized.

On the other hand, teachers recognized that educating gifted and high-achieving students in a heterogeneous classroom can be challenging in terms of student satisfaction (see Figure 23).

However, they often do not centre their teaching around these students due to curriculum limitations and concerns about disrupting the class balance. In this context, the teachers suggested that identifying Different and Challenging resources for these students could prevent them from disengaging from the mathematics teaching process. Yet, MT Merve noted that these resources could not be used in the classroom and recommended that parents acquire them for home use. MT Niyazi and MT Safiye, while acknowledging that challenging questions requiring higher-level cognitive skills were posed at the end of topics, expressed that these students often became bored with simpler questions, making it easier for them to disengage from the mathematics teaching process. MT-SAC Melek pointed out that gifted and high-achieving students are sometimes simply fast learners who do not necessarily expect tasks far beyond the class level but rather seek a teaching process that satisfies their curiosity and fosters a sense of fulfilment.

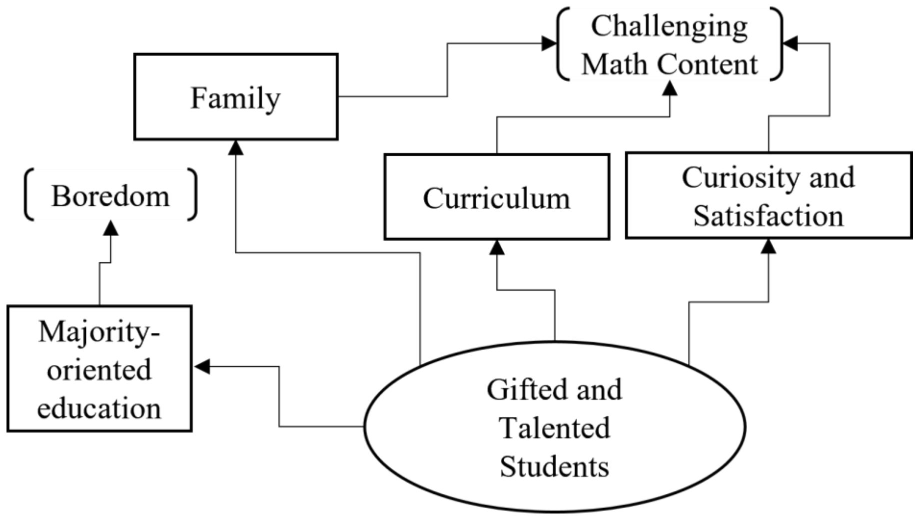


Figure 23 Reflections about Gifted and Talented Students in Heterogenous Classrooms

On the other hand, MT İsmail, similar to his approach with students with special educational needs, overlooks gifted students by adhering to a 'teaching to the average' methodology.

[Excerpt from classroom observations] Due to the location of the school where MT İsmail works, the class generally consists of relatively more successful students. However, even though there are students who are academically above average and have been selected for the Science and Art Centre (SAC) in the class, MT İsmail continued with a straightforward lecture approach. In fact, he appeared to be bothered by these students quickly solving what could be considered 'simple' questions on the board and loudly announcing the answers for the whole class to hear. His reaction, “Wait for your classmates, son,” suggests a potential discouragement of these students' curiosity and satisfaction.

From another perspective, teachers' opinions revealed that there are both positive and negative aspects of educating in a heterogeneous classroom. They shared diverse perspectives on the benefits and challenges of teaching in a heterogeneous classroom, highlighting their concerns about meeting the needs of all students while managing their own workload and teaching effectiveness (see Figure 24).

For example, MT İsmail thinks that heterogeneous classes are particularly beneficial for lower-level students but can also drag down higher-level students.

> MT İsmail: I believe heterogeneous classes are better. The benefits are more for the lower-level students because otherwise, they feel worthless... If we continue with a heterogeneous class environment, I think it will be more beneficial for the children. Especially for the ones at the bottom, but I also think it pulls down the ones at the top.

MT Safiye, while discussing the drawbacks of heterogeneous classes, emphasized 'teacher burnout' and the 'difficulty of lesson planning'. She shared her thoughts on the challenges and exhaustion faced by teachers dealing with classes that have significant learning differences and behavioural issues:

> MT Safiye: 'If it was a homogeneous class, you would make one lesson plan for the class, but here you have to make a different level plan for every level in the class. You don’t just enter one class. ..... In a heterogeneous class, especially with refugees, I don’t have the chance to individually attend to each child. Speaking for myself, even the class teacher is quite tired and fed up. All teachers inevitably struggle. The child is also in a psychology expecting this from me. We really struggle in such situations.'

MT Merve pointed out that the best aspect of heterogeneous classes for students is that they don’t feel 'alone'. Being with other students of varying achievement levels in the class helps them feel less isolated and gain motivation by comparing their success with others. On the other hand, she identified the challenge for teachers in heterogeneous classes as 'deciding at which level to teach'. She spoke of her difficulties in preparing materials suitable for students of different academic levels and in deciding what level of questions to solve, mentioning the 'efficiency' problem:

MT Merve: The students not feeling alone might be the good side. A good student goes on their way. I think like there are a few of me, others like me. I am not the only one who can't do it... Also, for a mathematics teacher, it's a bit better, constantly teaching a class of gifted students is hard. Their brains work very differently. As I said, sometimes you don't know how to answer their questions. I wouldn't want to constantly teach such a class... In a heterogeneous class, as I said, speaking for myself, we teach at a middle level. We don't go too high... Sometimes you don't know what to teach, what level the problems you solve will be, who will they be for? You bring a photocopy to class; at what level will it be? Of course, it's difficult to determine... I feel like I haven't reached either of them. Like I haven't reached these, nor have I reached the others. That's the feeling I had.

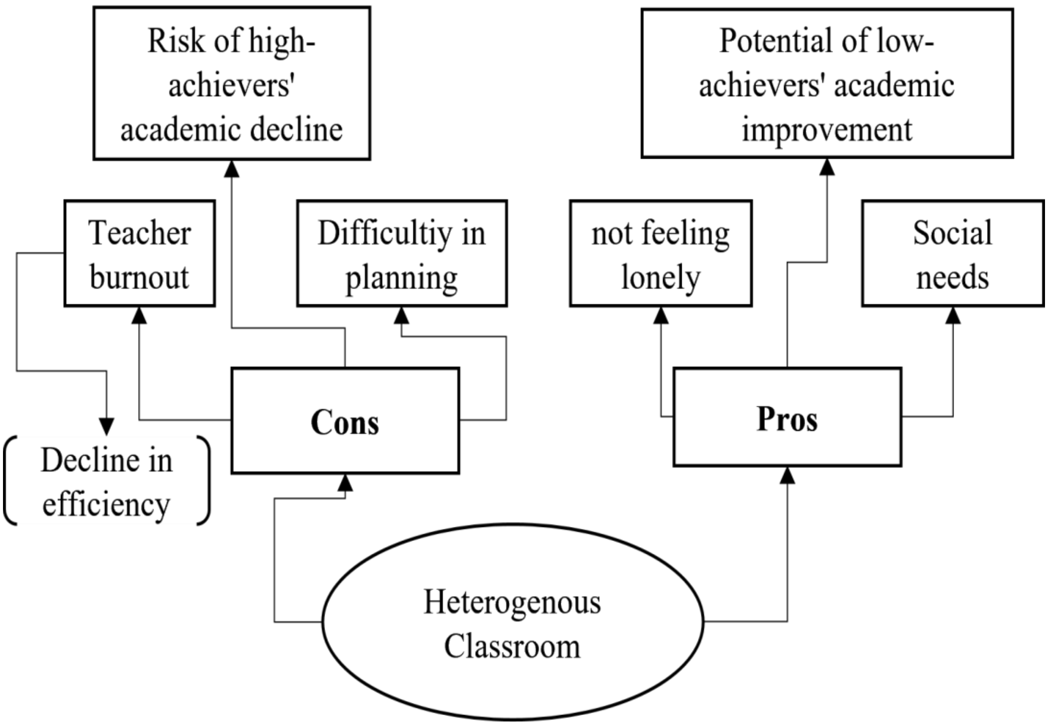


Figure 24 Reflections about Advantages and Disadvantages of Heterogenous Classroom

Additionally, MT-SAC Melek mentioned that since humans are psychological beings, having this diversity in the classroom is an advantage for students in a heterogeneous environment. However, she indicated that deciding the teaching methods and techniques to be used in the instructional process is a disadvantage for teachers.

While teachers acknowledged the challenges of teaching mathematics in a heterogeneous classroom, they also expressed various reasons for opposing the formation of 'Levelled Classes'. Apart from MT İsmail's reason, other explanations were made with the students' benefits in mind. MT İsmail, despite initially supporting levelled classes, changed his approach due to dissatisfaction with teaching the lowest-level classes and finding it unrewarding to work with those students. He also noted that in higher-level classes, the focus was not on student-centred approaches like activities and problem-based learning, but rather on solving more test questions.

Conversely, MT Safiye opposed levelled classes, fearing that ‘lowering expectations or demands’ for students in lower-level classes would widen the achievement gap between classes; she felt that students in lower-level classes would be sacrificed for the benefit of those in higher-level ones. MT Niyazi shared his views on levelled classes as follows:

> Researcher: You mentioned our classes are randomly distributed. Would you prefer levelled classes? Do you think students would be more successful?
>
> MT Niyazi: Frankly, levelled classes don’t really suit my purpose. Why? In a higher-level class, I can teach comfortably according to that level. But in a lower-level class, where all students are at a lower level, the topic is taught in a simpler way. I've worked in such a school. It's very hard to engage a lower-level class. No matter the method, the students don’t seem to care, the topics and learning outcomes feel too difficult for them, and they don’t relate to their daily lives. So, I don’t see levelled classes in a good light.

MT Merve, on the other hand, was reluctant to create levelled classes, fearing she wouldn’t be able to meet the 'high expectations' of students in higher-level classes or feel 'inadequate' in response to their demands. Additionally, MT-SAC Melek offered a different perspective:

> …students can learn from videos on computers or from robots that teach. … there are different dimensions of gains involved. We’re mathematics teachers, but we contribute to students in many areas, whether it's socially or in terms of vision. We don’t just teach mathematics, that’s why diversity is needed in the classroom.

These statements reveal that teachers were generally against the formation of levelled classes. They also supported the view that even if homogeneity was attempted, it would be impossible to create an environment where all students are identical in terms of mathematical achievement. Even in a homogeneous class, students' 'social backgrounds' and 'different experiences' would continue to cause diversity.

4.2.1.3. Teachers Reflections about Curriculum and Centralised Examinations

Mathematics teachers frequently emphasized in interviews that due to concerns about covering the curriculum and limited class hours, they were unable to fully address the needs of students with different abilities (both gifted and struggling) in academically diverse classrooms. They expressed a willingness to provide more interactive and activity-based learning environments but were unable to fully realize this due to curriculum limitations (see Figure 25). In this context, teacher opinions are shared below.

For example, MT Merve said that "... we talk about student-centred constructivist teaching, but how often can we use it? Sometimes, we have to rush through to finish the syllabus. So, I have to gloss over things".

Additionally, the rigid structure of the curriculum significantly impacts teaching processes, particularly in eighth grade, where the pressure of the curriculum due to exams makes it difficult to implement non-curricular teaching approaches and enrich the teaching process. MT-SAC Melek shared her views (Responding to a question about deviating from the curriculum):

> We can't deviate from the curriculum because of our exam concerns, we can't leave it incomplete... We can't step outside the curriculum. There's a pressure to cover it... there should be no sacrificial individual in education, but we inevitably move with the majority, facing time constraints and the need to complete the syllabus.

Despite the curriculum being simplified compared to previous years, which could have allowed for more student-centred teaching processes, advanced methods were not tried, and traditional teaching methods were still prevalent. For instance, MT İsmail shared:

> ... I have a five-hour weekly class and a syllabus to cover. Due to general curriculum concerns, unfortunately, I can't address both extremes. I go through

the annual plan at an average level... I don’t offer different activities or learning environments. I’m afraid I won’t cover the syllabus if I do. .... I wonder if the syllabus will be covered by the end of the year, there’s pressure. ... Former mathematics teachers, especially for fifth graders, would finish topics by February because the topics have actually become lighter. Maybe this offers us an opportunity, especially in fifth or sixth grade, for more activity design and activity-based teaching. I don’t know if this simplification was done with this in mind, but there’s a problem. We’re in this mode of 'finishing the topic quickly to solve more problems’.

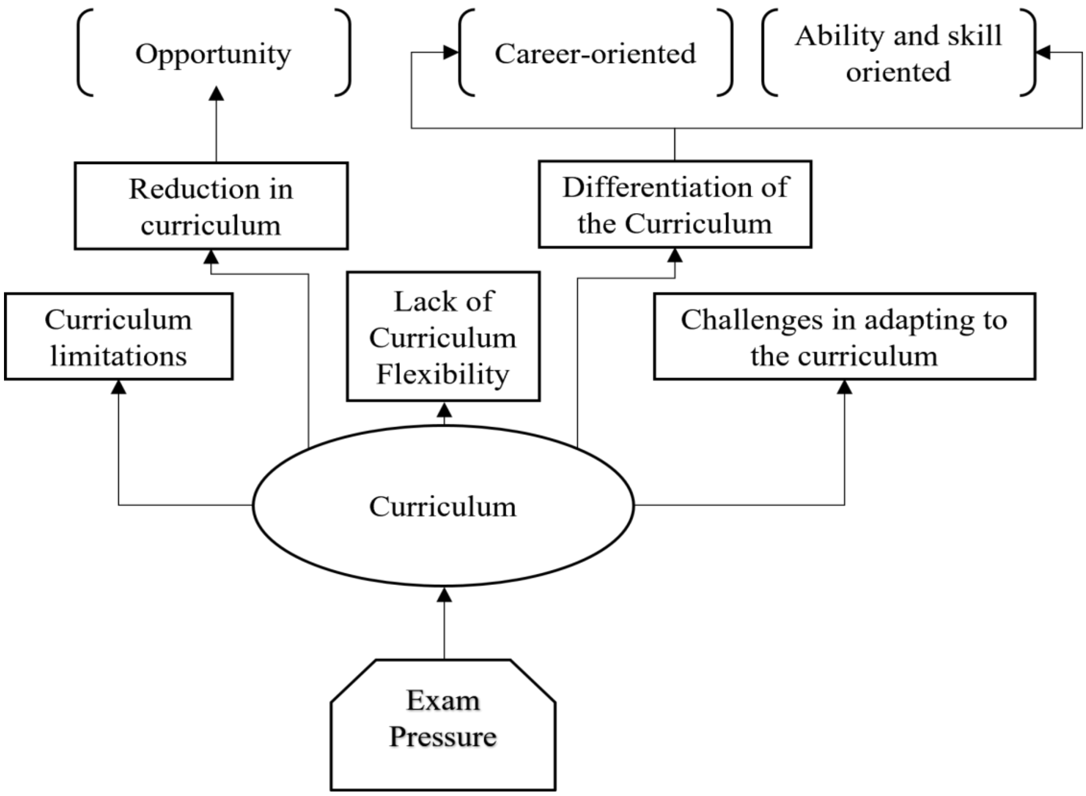


Figure 25 Reflections about Curriculum

[Excerpt from classroom observations] During the observed session, the topic of circles was being covered in the classroom. The teacher, using a direct teaching method, opened the circle section in an electronic book displayed on the smartboard. He pointed out the drawn circle and its radius, stating, ‘This is called the radius, the line segments drawn from the centre to any point on the circle, and they are all the same length. It’s also half the length of the diameter.’ By doing so, he missed the opportunity to let students discover for themselves that all radius lengths are equal through their measurements. In the later sessions, when discussing the circumference of the circle, he said, ‘The circumference of a circle is found using the formula 2πr. We usually take π as 3.’ Here, again, he missed the chance to help students discover that π is a constant and that measuring different-sized circles would reveal that the ratio of the circumference to the diameter always equals a constant value. He then proceeded to solve the questions in the book in sequence but sometimes he resolved some question in line with the request of the students who stated that they could not understand. It could be inferred that he was following a 'teaching for problem-solving' approach. Additionally, he did not allow all students who wanted to speak to solve the problems, and there was no interaction with students who were not participating in the lesson.

On the other hand, some teachers expressed that due to the curriculum, they had to move on to the next topic, even when students didn’t fully understand or were unable to perform the current topic. MT Niyazi shared his experience: (Responding to a question about whether any differentiation is made for slow learners)

> Of course, it happens, but it’s also related to time. I need to explain things and move on to the next topic... I adapt my teaching to them, of course, but at some point, I have to move on to the next topic or sometimes think they won’t understand it or be able to do it and move on reluctantly.

There were also opinions emphasizing the need for the curriculum to be flexibly adapted to each student's needs and abilities. Suggestions were made for shaping curricula to be more career-oriented and for teachers to identify the important aspects of the curriculum and know when to exceed it, a skill developed with experience in the profession. For example, MT Safiye mentioned her views about curriculum and its limitations:

> ...as teachers, the more we focus on just covering the syllabus instead of activity-centred or different real-life examples, the more the students disconnect from the class... In the eighth grade, I can’t touch on topics beyond the syllabus; it's heavy for the students. Secondly, my students are at a lower level. Thirdly, after teaching them the topic and solving outcome-based questions, I also have to give skill-based questions... Because of the curriculum, I have to ensure that the student learns calculations.

In addition to their views on the curriculum, mathematics teachers also reflected that 'Exam Pressure' is a directly related factor that complicates providing inclusive education in heterogeneous classrooms. It was noted that a student who fails to succeed in centralized exams is generally considered unsuccessful, and the exam-focused structure of the education system fails to address the diverse needs of students. Central exams challenge teachers in setting assessment criteria and preparing in-class exams. Participants stated that while in-class exams attempt to measure students' achievements in the mathematics curriculum, central exams test different skills. It was mentioned that transferring skills required by central exams to students, especially those at lower levels in a classroom setting, is difficult. The exam-focused education system was seen as limiting creative and interactive teaching methods. Teachers felt that trying contemporary and new teaching methods during exam preparation was risky. There were observations that the exam process, especially the post-exam placement part, is insufficient.

Furthermore, views were expressed opposing the idea of conducting different exams for every student, both in centralized and in-class assessments, stating that it would be unfair to conduct different exams after teaching the same topic or achievement. It was pointed out that the current level of centralized exams is not fair for all students, providing more to a certain group of students. Reducing exam-focused approaches in education and adopting methodologies that focus more on students' interests and life skills was suggested to prevent disengagement in primary and middle school levels, contributing to better learning. Challenges in implementing extracurricular activities due to curriculum pressure for exams, and sometimes not doing them at all, were mentioned. In the context of integrated education, opinions were shared that having separate plans and sometimes separate classes for students with special educational needs, and conducting different exams, accordingly, segregates these students and does not fully achieve the goal of integration. Additionally, there were comments about the improper implementation of the selection exam for the science and art centres specially designed for gifted and talented students. It was noted that students prepare for these placement exams as they would for centralized exams, leading to mistakes in identifying truly talented and gifted students. Moreover, a teacher mentioned that truly well-diagnosed gifted and talented students should receive education without exams, which is practiced in these centres. There were also views mentioning the necessity of 'selection exams' due to financial resource constraints and the obligation to place students in higher education institutions.

Based on these views, it can be inferred that the underlying or background concern in teachers' views about the curriculum is primarily about preparing students for centralized exams. The exam pressure can be inferred to directly impact both students' learning in mathematics and teachers' teaching approaches. In this context, it can be stated that for an inclusive education process to develop, restructuring selection exams might be necessary.

4.2.1.4. Teachers Reflections about Teacher Approaches

In addition to their previously mentioned views on the curriculum and centralized exams, participant teachers have also noted that these factors hinder the employment of 'process-oriented' learning in mathematics education. This, in turn, becomes a challenging issue in providing inclusive education in heterogeneous classrooms. This pressure tends to shift focus towards 'result-oriented approaches' such as whether a student solved a problem, scored high on a written exam or secured placement in a good high school. For instance:

> MT İsmail: ...I always want my students to enjoy the process. ... Ideally, we should make the environment more fun and tangible during activities to ensure students enjoy the process.... It often happens that if Şenol did it, and İsmail did it too, but Şenol did it first, İsmail still loses. It doesn't matter if he did it correctly, this leads children into an undesirable state.

Teachers also mentioned that their teaching strategy often progresses according to the average level of the class, rather than catering to students at the extremes. They aim to meet the curriculum expectations of the majority, not addressing the unique needs of different student groups. This leads to an issue of 'Not Responding to Student Diversity' within the class. For example:

> MT-SAC Melek: We know many things like 5E, 7E, etc. ... Initially, I didn't notice students like Ahmet. Similarly, I didn't recognize Başak. I wasn't aware of their differences. I was teaching only to the middle level students, just addressing the majority of class.

Similarly, in assessment and measurement, teachers mentioned that they generally compose exams with mostly medium-level difficulty questions, including a few very easy and very difficult ones. Explaining this with an example:

> MT Niyazi: In the exams I conduct in class, there are very simple questions that everyone can do and also ones that only the top-level students can. But generally, the questions are of medium difficulty. I make this kind of diversification for the class in the exams.

Some teachers exhibited what could be termed 'denial of responsibility'. When discussing student failures or academic gaps within the class, they emphasized the greater influence of primary school teachers, families, and even students themselves compared to their own. For example:

> MT Safiye: ...it’s not my intention to blame my colleagues, but in primary school, some parents choose teachers.... That teacher, to avoid looking bad, has to pay more attention to the top group, being forced to do so. There’s an impact created due to the influence of parents and the teacher's need to maintain their image or status.

Moreover, teachers criticized the practical application of their university education, emphasizing the importance of hands-on teaching experience and professional development activities. They felt equipped with knowledge but struggled to apply it in teaching mathematics and providing inclusive education in a heterogeneous classroom. Teachers highlighted the importance of learning through experience in the teaching profession. MT Merve said: “In education faculties, we acquire the knowledge, but when we enter the classroom, we struggle a lot to apply many things.” Similarly, MT Niyazi gave advice to a new mathematics teacher:

> I’d say what we learned in university is somewhat abstract. In a real classroom, what we learned doesn't always work. We use it, but what we apply is a bit different. Our teaching methods improve as we gain more experience... But it’s something they have to experience themselves.

Some teachers tried problem-based and activity-based teaching approaches in their early years of teaching mathematics but reverted to 'traditional teaching methods' and a 'direct instruction method' due to either lack of expected effectiveness or the substantial effort and time required. MT İsmail reflected:

> ...it's due to being a bit unplanned, as self-criticism.... For instance, in previous years, I used skewers and macaroni packets to teach natural numbers to fifth graders, but then I thought, 'never mind,' and the next year, I just went with straight lecturing and continued that way.

[Excerpt from classroom observations] During the observation, it was noted that the teacher did not offer options to encourage student participation through activities or interactive environments. The teacher was observed to continue employing a teacher-centred approach, such as direct instruction. It is understood that what MT İsmail says and does are consistent with each other.

However, it was a common view among teachers that to be successful in teaching mathematics, a teacher must continually learn. Despite their desire to improve their mathematics teaching, some teachers expressed reluctance due to a lack of courage or feeling 'inadequate' in providing inclusive education. Teachers who sought new teaching methods to respond to student diversity and integrate technology into their teaching to diversify and enrich the learning environment were also mentioned.

For example, MT Safiye shared her views:

> During the pandemic, I took a coaching certificate. I applied those tests to the students, and I saw how it caught their attention. Their attitude towards mathematics changed, I saw them trying to memorize the multiplication table to score high on the test. I found it motivating... Because of the coaching training at school, we are in constant communication with many students' families. But of course, I can’t do this for every class I teach.

One of the biggest barriers to providing inclusive mathematics education was identified as 'diminishing teaching motivation.' Teachers expressed that their teaching methods, especially for slow learners or students with special educational needs, failed to elicit a response, leading to a lack of 'professional satisfaction' and feeling 'burned out'.

MT-SAC Melek shared her concerns:

> If I return to a regular middle school, of course, I could apply better methods. But I worry whether I’ll find the same fulfilment; I had at SAC. A teacher needs to be happy to be more productive. I’m concerned about not achieving that fulfilment with student diversity and lower-level students.

Similarly, MT Merve shared her views:

> I called a student to the board; the student needed to say the answer to 7 times 8. We waited, but the student couldn't say 56. But how long can we wait? You need so much time for that. Really, 40 minutes is not enough to explain so that everyone understands; it takes 80-90 minutes.

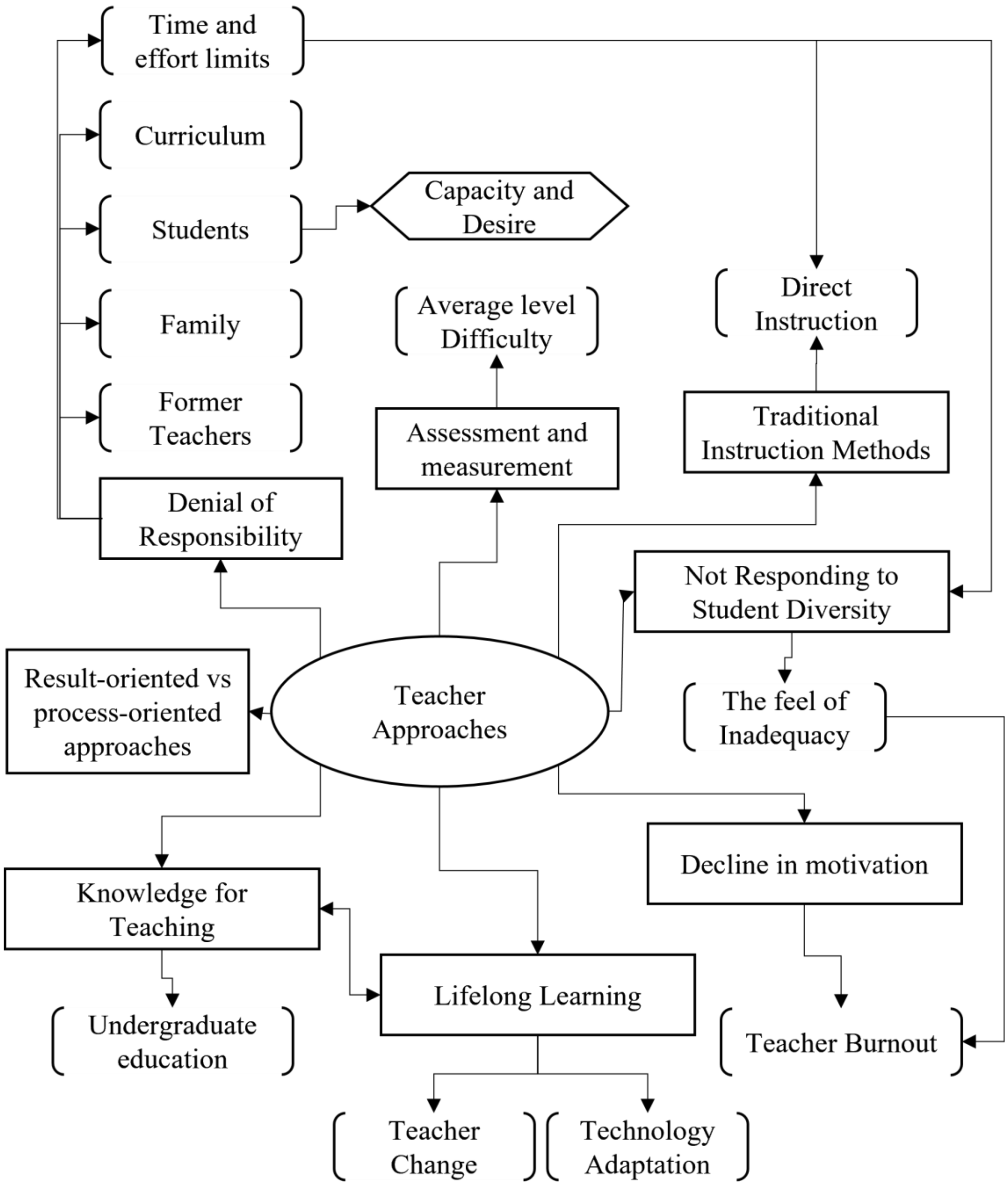


Figure 26 Reflections about Teachers Perspectives

On the other hand, teachers also expressed feeling 'inadequate' in meeting the demands of fast learners or gifted and successful students, which also reduced their teaching efficiency. However, teachers highlighted that teaching is not just about imparting knowledge or showing how to acquire it, but also about addressing the social, emotional, and psychological characteristics of students, making them feel valued, and providing material and moral support when needed.

For example, MT Safiye, despite her desire for migrant or refugee students to return to their countries, shared a dialogue with a student under temporary protection in her class:

> ...I look at some students as if they could be saved if someone held their hand. For example, I have refugee students. I have one dark-skinned girl. One day I said to her, 'İrem (pseudonym), you are such a beautiful girl.' She turned to me and said, 'Really, teacher?' She was this tall (shows with her hand), a tiny child, the same height as my son. 'Why are you surprised?' I asked. 'People on the street tell me, ‘Look at her, how dark and ugly she is,’ thinking I don’t understand' she said. 'I was so surprised when you said that. Really?' I’ve experienced this, and that child now sits at the front of my class. She always wants to participate in the lesson. I think these things are very effective, approaching a child socially.

In conclusion, teachers emphasized that successful mathematics teaching requires continual learning and a willingness to adapt and innovate. Yet, they often face challenges in applying theoretical knowledge in practice, especially in creating inclusive education environments in academically diverse classrooms. Findings from the interviews conducted with teachers have been summarized and presented in Figure 26, focusing on the reflections related to Teacher Approaches.

4.2.1.5. Teachers Reflections about Differentiating Instruction

Participant teachers expressed that, although not always feasible due to exam pressure and the obligation to complete the curriculum, they made differentiations in the mathematics teaching process. In discussions, they mentioned employing strategies like arranging questions from easy to difficult or preparing extra worksheets with simpler problems or achievements for slower-learning student groups. They also discussed posing more challenging questions at the end of lessons for gifted students, considering these practices as part of Differentiated Instruction. Specialists like MT-SAC Melek and SET Baki, working in specialized institutions with fewer students and less curriculum and exam pressure, stated they had more opportunities to differentiate in their teaching due to the individualized nature of their instruction.

Regarding how to decide on differentiation based on students' readiness levels, MT Safiye shared:

> If you teach the same students for 4 years, you get to know them quite well. But I always administer a readiness test at the beginning of each year. For instance, if I'm about to teach natural numbers in the current class, I apply a pre-test including questions on the topic covered the previous year. Then I look at the results and assess their situation. If the deficiencies are significant, I start with lower-level topics such as place value in natural numbers instead of more advanced or challenging ones.

MT Safiye also described an incident with a student disinterested in mathematics and low-performing, illustrating differentiation in student products:

> I had a student whose family have chickens. I assigned a task. I said, “For one month, I want you to chart how many eggs your chickens lay each day and bring it to me.” The student created a table on a sheet of paper; it listed each day up to thirty days, with the egg count recorded for each day. He brought this chart to me and shared details about his chickens, saying, “Teacher, our chickens laid these, many eggs, etc.” This led to a different kind of interaction; normally, he doesn’t actively listen in math class, but he was sharing his dreams about the chickens.

Additionally, MT Safiye described an example of enriching or differentiating the teaching process based on students' interests and expectations:

> For instance, in my last lesson, I set up a problem for the girls about baking a cake. In the same lesson, I gave the boys a problem about repairing a car, asking how they would plan it and budget for tools. Such problem-setting engages students.

MT Niyazi shared an example of adapting lessons based on students' interests and backgrounds:

> One of my students works in a carpenter workshop after school and on weekends. When a skill-based question comes up on the smartboard about placing phones or tablets, I adapt it for this student. I say, ‘Imagine you have

> various planks and you're arranging them on shelves or making a bench. How much wood would you need?’ Making the question related to the student's life or work catches their interest, but you need to know about the student's life.

MT-SAC Melek reflected on her experience in a regular middle school, highlighting the misapplication of teaching strategies tailored to learning styles:

> ...a learning style scale was used in class. The average of the class was determined, and we were asked to plan according to this predominant learning style, but we didn’t really follow it. In retrospect, I think we misused those scales for the wrong purpose.

In a dialogue with MT İsmail, the lack of differentiation in both curriculum elements and student diversity was discussed:

> Researcher: Every student has a different level of readiness and background. Do you consider these differences?
>
> MT İsmail: I don’t!
>
> Researcher: Would it make a difference if you did? Have you observed any impact?
>
> MT İsmail: Considering 30 different individuals in a class and tailoring to their uniqueness, based on experience, seems easier to go with the general flow.
>
> Researcher: Do you think the general approach suits everyone? Is it working at all readiness levels?
>
> MT İsmail: We think it should suit everyone, and if it doesn’t, we consider the non-conforming as problematic. Different? I don’t know. I’ve never done anything specific for these differences.

[Excerpt from classroom observations] MT İsmail's approach was also evident during classroom observations. There was no preparatory work or planning to address student diversity, nor were there efforts to motivate disengaged students through accommodations or modifications. Moreover, during the observed process, the teacher simply continued teaching from the last question or topic covered in the previous lesson without paying attention to whether the students had fully grasped and internalized the subject matter. Additionally, in the observed lessons, the teacher directly taught the topic from an electronic book opened on the smartboard, only solving the questions from that source, resulting in no differentiation in content or products. Furthermore, due to low interaction with students in the five observed class sessions, there was also no differentiation in the process dimension.

The findings derived from participants views and observations are attempted to be presented in Figure 27. This figure does not indicate that all participants are totally familiar with differentiated instruction. It was used to demonstrate different examples of differentiated instruction from various participants. In light of this data, it can be interpreted that teachers actually know how to differentiate instruction, but due to various reasons, they often do not choose to do, or they are unable to do so.

4.2.2. Summary of Teacher Reflections

The findings from interviews with teachers and classroom observations can be summarized as follows:

All participating teachers indicated that students at both ends of the academic achievement scale face difficulties in general education classrooms. Their views on placing students with special educational needs in general education institutions or alternative educational establishments varied due to differing perspectives.

They highlighted that focusing solely on academic success leads to neglecting students' social needs. Some participants mentioned that addressing student diversity and varied expectations often extends beyond the scope of the mathematics teaching process. Another consensus among the teachers is the impact of exam-focused education and the obligation to cover all content in the mathematics curriculum. This approach complicates and sometimes even renders it impossible to satisfy students' academic, social, and emotional desires and needs. Teachers also noted that the knowledge and skills acquired during their training in education faculties are not always converted effectively into real classroom environments, often requiring significant time and effort to implement. They suggested that a greater emphasis on practical, applied courses, rather than purely theoretical ones, would be more beneficial. Increasing the focus on courses like 'school observation' or 'teaching practice' in real schools would provide more valuable experience in preparation for the profession.

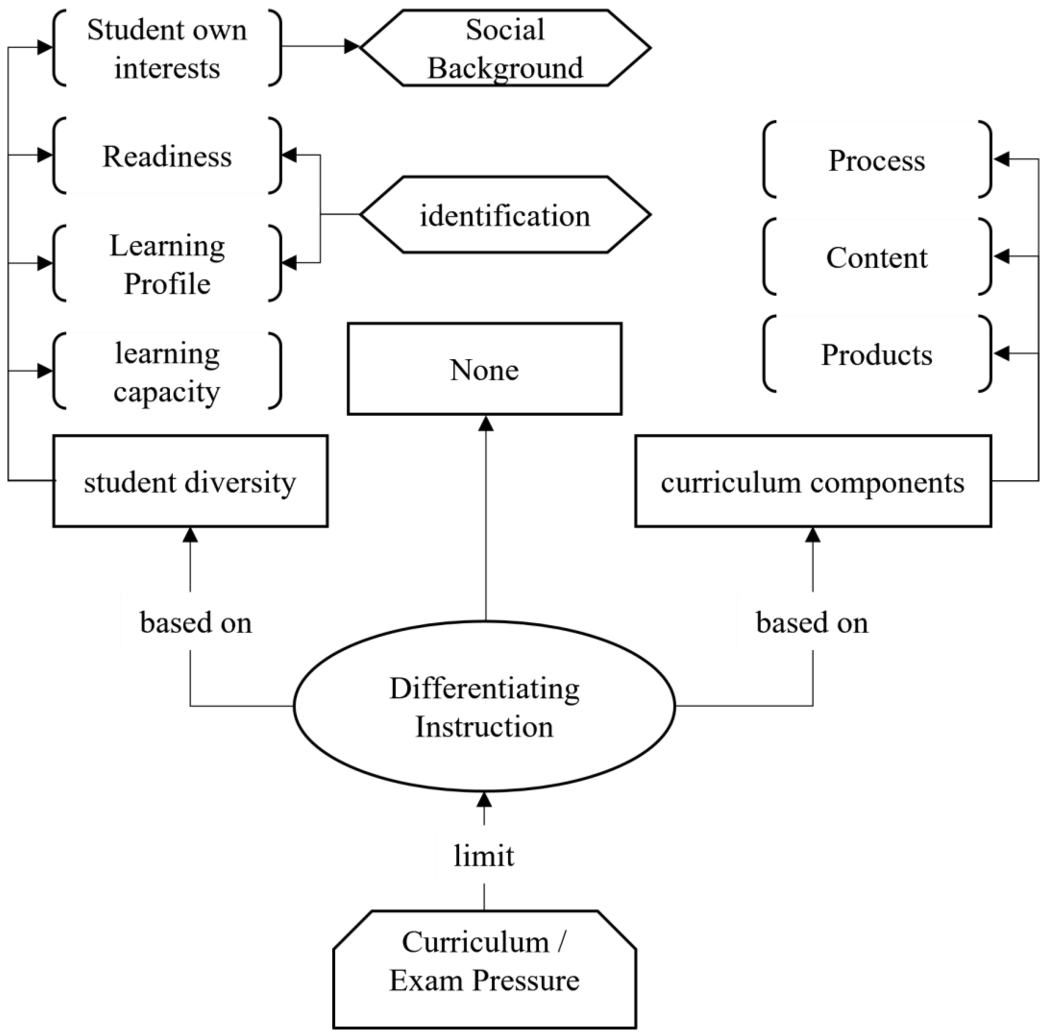


Figure 27 Reflections about Differentiated Instruction

In general, it was acknowledged that providing inclusive mathematics education in a heterogeneous classroom is indeed challenging, influenced by numerous factors. It was emphasized that elements such as family, teacher, student should work in harmony and support each other to achieve a balance in meeting both academic and social needs.

CHAPTER 5

DISCUSSION & CONCLUSION

As teaching increasingly shifts towards a more student-centred approach, there is a growing demand among teachers for strategies to effectively teach mathematics in classrooms with academically diverse learners. This demand becomes even more pronounced in heterogeneous classrooms that include students with disabilities or students with significant learning difficulties and gifted and talented students, each with varying learning paces.

Traditionally, mathematics education is approached with the assumption that it requires the development of sequential or incremental skills, meaning that understanding a new concept relies on mastering prerequisite topics. This belief led to the perception that differentiating the mathematics curriculum is more challenging compared to other subjects. However, much of mathematics learning relies not solely on innate talent but on timely, appropriate encouragement and practice, placing significant responsibilities on mathematics teachers.

Understanding the classroom process and identifying the challenges faced by teachers in delivering inclusive mathematics education is crucial. Knowing what teachers need to provide effective mathematics instruction can inform solutions and strategies. This study investigates what it means for middle school mathematics teachers to teach academically diverse students, exploring the meaning, structure, and essence of their teaching experiences in these classrooms.

The findings gathered from the views of participating teachers and classroom observations are broadly presented in Figure 28. In this section of the study, the findings will be discussed in light of relevant literature. Additionally, recommendations for future research based on these findings and conclusion will be presented.

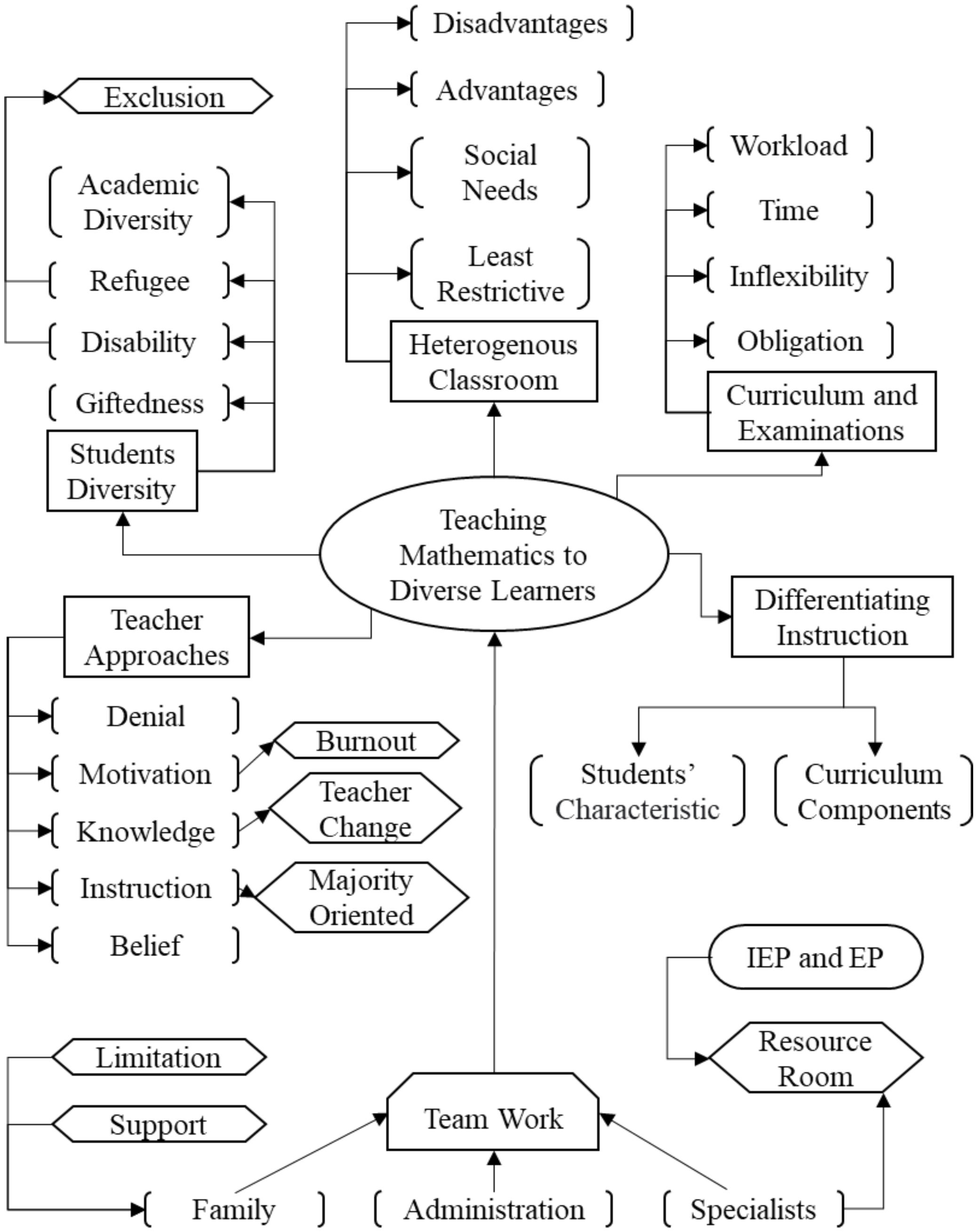


Figure 28 Overall Reflections of Participant Teachers

5.1. Teaching Approaches

The primary finding of this study relates to the approach of mathematics instruction in classrooms. Teachers observed that there is a wide range of diversity among students, both in terms of academic abilities and social backgrounds. As a result, they often engage in what is commonly referred to as 'teaching to the average' or 'focusing on the majority.' In discussing their methods in teaching mathematics in heterogenous classrooms, the teachers noted their adherence to a 'teaching for problem-solving' methodology (Schroeder & Lester, 1989). This method entails imparting a skill with the intention that students will apply it to solve problems later. Such an approach usually starts with the introduction of an abstract concept, which is then utilized in problem-solving applications. For instance, educators might teach the Pythagorean theorem, expecting students to first 'learn' and then 'master it', subsequently applying it to solve related word problems or real-life situations involving right triangles. However, this teaching method is found to be ineffective for many students in grasping or retaining mathematical concepts (Van de Walle et al., 2012). The limitations of teaching for problem-solving instructional approach (Cai, 2010; Hiebert et al., 1997) include:

- The assumption that all students possess necessary foundational knowledge to grasp the teacher's explanations.
- A failure to accommodate diverse learning styles and individual student needs.
- Often presenting only a singular method to solve a problem, which may not resonate with or be accessible to all students.
- Lacking opportunities for differentiation that could inspire and engage students.
- Positioning students as passive recipients of knowledge rather than as active, independent problem-solvers.
- Diminishing the probability of students tackling new problems without explicit, step-by-step guidance.

While some participant teachers suggested that demonstrating how to solve a sequence of problems is effective and efficient, true learning often arises from challenge and struggle. Teachers, therefore, should refrain from excessively simplifying or eliminating challenges, as minimal assistance often yields the most substantial learning outcomes (Lesh & Zawojewski, 2007). In essence, a strict adherence to teaching for problem solving may inadvertently hinder rather than help students' ability to solve problems and engage in mathematical thinking. The challenge faced by teachers in addressing the wide array of academic capabilities within their classrooms could be attributed to a lack of providing adequate opportunities and autonomy for students to explore and learn.

On the other hand, the commonly recommended technique for teaching mathematics to students with disabilities, especially those with intellectual disabilities and mathematical learning difficulties, is Explicit Instruction (Fuchs et al., 2011, Westwood, 2000). This approach is defined differently from direct instruction; it involves teachers in a structured classroom using specific procedures systematically to deliver mathematics lessons by introducing goals, reviewing previously learned concepts, modelling new skills, and providing guided and independent practice (McKenna et al., 2015).

Although explicit instruction is seen as an important approach by some mathematics education researchers, it is not considered effective on its own; researchers advocate for a balanced approach that includes explicit teaching in numerical techniques as well as opportunities for strategic thinking and reasoning (e.g., Baroody, 2006, 2011). According to Baroody (2011), teaching these students solely with Explicit instruction will lead to a decrease in expectations and fewer diverse opportunities offered. This will start a vicious cycle of lower expectations, followed by fewer opportunities, and then even lower expectations. In this light, the participant teachers' practice of providing students with special education needs with 'simpler' extra worksheets that differ from the class curriculum or engaging them in class only with problems they deem 'suitable for their level' indicates their low expectations. This approach of 'segregating while integrating' could be leading to the lack of expected academic success in mathematics.

Additionally, when considering the views of participant teachers regarding gifted and talented children, teachers reported generally involving these children in class only with 'challenging' or hard problems at the end of the topic. Developmental characteristics that most affect gifted children's school experience and learning process are ‘asynchronous development, perfectionism, and overexcitability’ (Uyaroğlu, 2022, p.1).

Supporting the areas where these children lag in their development is necessary for their developmental adjustment. Program differentiation and enrichment are some of the most important measures that can be taken for developmental asynchrony (Webb et al., 2007). Developmental skills that are lagging behind their mathematical abilities also need support. Using their strong areas, opportunities for experience should be provided for lagging developmental skills (Chen & McNamee, 2007). For instance, in a game where numbers are hit on a wall, motor coordination will be supported through strong numerical skills. Participants did not report using such practices in the classroom. These activities would not only attract the attention of gifted children but also all students in the classroom.

Additionally, one of the most important measures for perfectionism (the desire to achieve perfection) is to provide effort-focused feedback. Communicating focused on effort rather than success, and on the process rather than the result, will ensure the proper use of perfectionism (Uyaroğlu, 2022). Also, defining and grading goals appropriate to the student’s developmental skills and level will protect against the adverse effects of perfectionism (Siaud-Facchin, 2018). In this context, the participant teachers reported ‘lack of process focus’ and tendency to be result-oriented could be fuelling the perfectionism of gifted children. However, the dissatisfaction and loss of motivation encountered after a certain period may be due to the ineffective process not being enjoyable.

Looking at the overexcitability aspect, children need educational methods that support their imagination. A gifted child, who is concerned about being criticized, scolded, or even punished, is struggling to cope with this anxiety rather than learning. Therefore, educational opportunities that appeal to different senses should be provided in the learning environment, and opportunities for sensory education and sensory integration should be created (Webb et al., 2007). The participant teachers reported that they could not engage in interactive practices in the teaching process due to various reasons. This might let to a lack of teacher-student dialogue and the possibility of misinterpretation of the teacher’s words.

5.2. Student Diversity and Heterogenous Classrooms

Participant teachers expressed that the presence of academic diversity in heterogeneous classrooms brings certain challenges. These challenges can be outlined as follows:

- In schools with limited financial and human resources, providing appropriate materials and support for students with diverse needs and abilities is a significant challenge, as reported by the participant teachers.

- Additionally, some physical disabilities may require specific classroom or school infrastructure (such as wheelchair ramps, Braille books, etc.), and securing these facilities can be difficult.

- Managing a classroom with students of different academic levels can pose challenges in terms of classroom management and discipline. Teachers particularly mentioned difficulties in handling situations involving students with conditions like hyperactivity.

- Communication barriers with migrant or refugee students were also highlighted as a disadvantage of heterogeneous classrooms.

- Teachers reported difficulties in fairly allocating time to all students.

- In some cases, they noted that focusing on students who require more support could lead to inadvertently neglecting other students.

- Teachers observed that students at lower academic levels might experience self-confidence issues when comparing themselves to their classmates.

- It was mentioned that while some students are actively engaged in the classroom, others tend to remain passive, which leads to interaction challenges among students.

- The challenge of devising fair and effective assessment methods for students of varying academic levels was highlighted, with an emphasis on the near impossibility of conducting different exams for these diverse groups due to legal constraints.

The challenges reported by teachers, which they frequently encounter in heterogeneous classroom structures, are documented in institutional reports by organizations such as UNICEF (2023) and the Education Reform Initiative ([ERG], 2016). Although the existence of these challenges is an undeniable reality, they can be effectively addressed and mitigated through the positive aspects of a heterogeneous classroom environment (Castellon et al., 2011; Seah et al., 2015; Sullivan et al., 2006).

The greatest positive aspect of a heterogeneous classroom structure is the development of social skills. It aids students in learning to respect different perspectives, to be patient, and to collaborate effectively. This environment enhances students' ability to empathize and understand the experiences of others (Gervasoni, 2020; Lerman, 2000; Shakespeare, 2013).

Considering that the classroom environment is a microcosm of real life, creating a homogeneous classroom structure or reducing diversity can lead to challenges for each student group in their future lives or professional careers. The development of social skills is not just beneficial for typically developing or regular students. For instance, students who are removed from general education institutions and 'pushed' into special education schools face challenges in these settings as well; since they all have certain disabilities, they are expected to show tolerance and respect towards one another. However, in their daily lives, they need to interact with a diverse range of people, coming from varied backgrounds and mindsets. In such scenarios, others may not always feel inclined to show tolerance or respect.

From another perspective, completely removing gifted individuals from general education and placing them in independent schools tailored to their needs can also pose problems. In such environments, where every student is fast-thinking and adept at devising practical solutions, there may develop a perception that everyone functions at this level. However, in real-life situations, they might struggle to communicate with, work alongside, or participate in team efforts with individuals who do not share their level of practical thinking ability.

Students educated in heterogeneous classroom environments are more likely to learn how to live harmoniously with individuals who possess diverse thoughts and behavioural styles. Such settings facilitate their ability to be flexible in social situations and to embrace diversity more readily (Barnes, 1998; Boaler, 1997; Bogart, 2023). A significant aspect of social skills development in mathematics education is the benefit of group work and peer learning, which have a reciprocal relationship of mutual benefit. The development of social skills will enhance the effectiveness of group work, and the efficacy of group work and peer learning, in turn, will foster further development of social skills (Burris et al., 2006; Černilec et al., 2023). This interaction can potentially reduce the issues of lack of confidence and disengagement in class, which teachers view as disadvantages. However, the responsibility largely falls on mathematics teachers to effectively plan and implement a teaching process that fosters group work and peer learning. It's important to prevent scenarios where some students become overly dominant while others recede into the background, thus balancing engagement among all students (Cohen & Lotan, 2014).

Another positive aspect of the heterogeneous classroom structure is that it offers opportunities for diversification of teaching methods and implementation of differentiated instruction in inclusive mathematics education. Mathematics teachers can explore various teaching methods and strategies to effectively teach students with different academic achievement levels. Teachers have the opportunity to create differentiated learning experiences tailored to the individual needs of each student. Although these elements might be perceived as challenges by the participating teachers, they actually enhance their flexibility and contribute to their professional development (Guskey, 2002). In fact, continuously presenting a monotonous teaching style without diversifying teaching methods and being trapped in a cycle of covering more topics and solving more problems without real understanding (teaching for problem-solving), might lead to reduced effectiveness and a sense of diminished professional achievement for mathematics teachers (Madigan & Kim, 2021). While the topics in mathematics curricula remain largely unchanged, new approaches and methods for teaching these topics are constantly proposed, such as the integration of technology. Additionally, the academic and cultural diversity in classrooms enables teachers to develop their observation and assessment skills to better understand individual student needs (Cassady et al., 2004). In light of these explanations, heterogeneous classrooms offer significant opportunities for teacher development. The disadvantages of 'inability to provide appropriate materials and support' and 'difficulties in classroom management and discipline' could potentially be mitigated by incorporating various teaching methods and strategies, which teachers have already learned during their undergraduate education, into their mathematics teaching processes.

Another positive aspect of heterogeneous classroom structures is that they foster the development of problem-solving skills due to the emergence of various thinking styles and approaches among students (Lubienski, 2000). In such classrooms, students from diverse academic, cultural, and social backgrounds are present. This diversity helps students to assess problems with approaches that feel more relevant to them and find alternative solutions that suit their perspectives (Fuchs & Fuchs, 2005). For example, while one student may propose solving a problem through drawing, another might prefer creating a table. Presenting these solutions in the classroom environment allows each student to be exposed to different problem-solving methods. If the teacher provides an appropriate environment and grants students the opportunity to express their ideas, students from diverse social and emotional backgrounds are expected to come up with more creative and innovative problem-solving strategies, such as brainstorming (Fuchs & Fusch, 2005). For instance, in discussing the topic of 'slope,' there are often questions like, 'Find the length of a ramp at a 45-degree angle used for unloading trucks.' A wheelchair-bound student who experienced the difficulty of navigating steep ramps can explain to their classmates that such a ramp, angled at 45 degrees, would be impractical for use since it would be too steep for wheeled devices. This type of situation helps to bring real-life scenarios into the classroom. By capitalizing on these differences and recognizing diversity as an opportunity, the disadvantage of 'not being able to allocate fair and balanced time' mentioned by the participating teachers can be mitigated.

Additionally, the participant teachers viewed the challenge of developing fair and effective assessment methods for students of different academic levels as a disadvantage of heterogeneous classrooms. After fulfilling specific configurations or accommodations required for students with disabilities (such as printing exam papers in large fonts, using text-to-speech applications for dyslexic students) or students with significant learning difficulties, opportunities for assessment that leverage student diversity can actually be provided.

In this context, Thompson and Kaur (2011, p.20) indicated that learning is multidimensional, and presenting questions that measure the dimensions of 'Skills, Properties, Uses, and Representations' simultaneously can address the diverse characteristics of students in the classroom. They explain these dimensions as follows:

1. **Skills:** This encompasses the procedural aspects that students should master. It involves everything from the application of standard algorithms to the creation or discovery of new algorithms, including the use of technology.

2. **Properties:** These are the underlying principles of mathematics, ranging from the identification of properties used to justify mathematical reasoning to more complex derivations and proofs.

3. **Uses:** This dimension refers to the application of mathematical concepts in real-world scenarios or in relation to other mathematical areas. It includes solving practical problems and creating mathematical models.

4. **Representations:** This involves the visual depiction of mathematical concepts through graphs, diagrams, and other visual means, including standard and innovative ways to represent these ideas.

By incorporating these dimensions into assessment tools, teachers can cater to the varied needs and strengths of students in a diverse classroom setting. So that students can succeed, at least in those dimensions in which they are proficient.

5.3. Differentiated Instruction

In the conducted interviews, it was observed that participant teachers made efforts to differentiate their teaching, though these efforts did not encompass the entire class. For instance, while MT Niyazi’s example of adapting lessons for a student working in carpentry is a commendable instance of interest-based differentiation (Tomlinson, 2017), it remained an individual-focused effort and did not engage the whole class. Similarly, MT Safiye’s activity asking a student from a family with chickens to create a graph was a fine example of interest-based differentiation but again was tailored to an individual and didn’t broadly impact the class. Moreover, MT Safiye's activity involving baking for girls and car repair for boys is an example of overgeneralization, presuming all girls are interested in baking and all boys in mechanics. Though well-intentioned, such efforts may not achieve the desired impact.

Furthermore, as previously mentioned regarding the teaching for problem-solving approach, it was understood or observed that the problems used by teachers in the instructional process are not well-structured. Typically, problems found in textbooks or test books are solved in a sequential manner. Some teachers viewed solving cognitively demanding questions at the end of a topic as a form of differentiation.

However, there was no indication that 'multiple entry and exit' problems (van de Walle et al., 2012) were used, which allow for various difficulty levels and solutions. Scherer’s (2019) study employed 'open problems,' where students chose the largest number that they believed they could factorize into a factor tree. While some chose single-digit numbers, others worked with hundreds or even thousands. In contrast, participant teachers did not report using such problems that allow for individualized responses.

On the other hand, although the participant teachers reported teaching 'to the average' or 'to the majority', they could not clearly articulate what they meant by 'average'. Furthermore, they were unable to provide detailed explanations on how they determined this 'average'. This ambiguity complicates the planning of differentiations according to students' readiness levels. Additionally, it can be inferred that mathematics teaching 'to the majority', without clearly defining student needs, hinders the process of differentiating content and instruction (Tomlinson, 2017).

Participant teachers SET Baki and MT-SAC Melek, who work in institutions where teaching is based on individuality, reported that students' performance assessments are meticulously conducted, leading to plans tailored with necessary differentiations. Specifically, MT-SAC Melek, benefiting from the suitable technological infrastructure of their institution, mentioned using more teaching technologies such as 'word wall' and SCRATCH. However, other teachers’ claims of 'using technology in the classroom' typically referred to utilizing electronic books on smart boards or showing videos. There was no indication from these teachers of using visual-enhancing software or applications like virtual manipulatives (Moyer-Packenham & Westenskow, 2013) or GeoGebra (Özçakır & Çakıroğlu, 2019) in their teaching process. In fact, MT Ismail admitted to not knowing these tools and even if known, expressed no desire to use them. The teachers missed the opportunity to engage students with innovative methods through differentiated teaching using technology. They also failed to exploit the chance to adjust teaching pace, complexity level, and strategies in a manner that could capture students' interests and present them with challenges (Stanford, 2010).

In conclusion, while teachers seem to be aware of the basic principles of differentiating instruction to address academic diversity, they choose not to employ these methods due to various reasons, such as limited technology literacy, lack of time, or unwillingness to invest the necessary effort. It cannot be expected of teachers to apply differentiation in every lesson, topic, or learning objective (Small, 2020). However, to create a mathematics teaching environment that includes all students, it is essential for teachers to have a good understanding of individual students' interests and learning styles. The discussion on the pressure of exams, which teachers persistently mention as a barrier to differentiation, will be addressed in the next section.

5.4. Curriculum and Centralised Examinations

External examinations with significant consequences for both students and teachers are commonly known as high-stakes tests. These standardized tests are utilized to make crucial decisions affecting students, educators, schools, or entire districts, primarily for accountability purposes (Amrein & Berliner, 2002). The high stakes associated with these tests create substantial pressure for students (e.g. "Will I pass?" or "Will my parents be disappointed?") and for teachers (concerns like "Will my class achieve the high proficiency to place a high school?"). Such pressures inevitably influence the way instruction is conducted in the classroom (Plank & Condliffe, 2013).

In interviews with teachers, the pressure to prepare students for the end-of-middle-school exams and the necessity to cover all topics in the curriculum were the most emphasized factors. Teachers link their tendency to overlook student diversity and fail to provide responsive teaching to the pressure of exam preparation. Indeed, it can be argued that the pressure of exams underlies their preference for the 'teaching for problem solving' approach and tendencies like 'teaching to the average' or 'teaching to the majority.'

There's considerable truth in these claims by the participants. One of the major issues in both national and international mathematics education is the tension between what is considered good mathematics teaching and the demands for higher standardized test scores. Teachers often feel torn between giving students time to develop an understanding of mathematical concepts and the pressure to produce higher test scores (Litton & Wickett, 2009; Phelps, 2011).

Not only teachers but school administrations and even local education authorities, in an attempt to ensure students are ready for standardized tests, add more summative assessments throughout the year. However, this results in less time for teaching and a rigid schedule that doesn't consider the pace at which children acquire skills and construct knowledge.

Teaching to the test can be both good and bad. If curricula are well-developed by educators and the test aligns with the curricula, then teaching to the test means imparting the knowledge and skills we agree students should learn, fulfilling teachers' legal and ethical obligations. Well-designed tests can reveal strengths and weaknesses in programs, instruction, and students (Litton & Wickett, 2009).

However, according to Phelps (2011) teaching to the test can be harmful in two ways: excessive preparation focusing more on the test's format and test-taking techniques than on the subject matter, and reallocating classroom time from untested subjects to tested ones (often reading and mathematics). Teachers often feel compelled to drill students in test-taking techniques, but this doesn't always result in higher scores. Participant teachers expressed that they feel obligated to solve more test-like questions in preparation for exams, but this doesn't always lead to the desired success.

Why do teachers persist in extensive test preparation? Partly because they are misled, but also because it sometimes works for a reason: drilling on test questions only works when the items closely match those on the upcoming test (Phelps, 2011). Additionally, Darling-Hammond (2004) reported that schools with a high number of students needing special education were penalized due to their low scores in centralized exams. As a result, teachers felt compelled to continue preparing their students for these centralized exams to avoid such penalties. Additionally, Peters and Oliver (2009) noted that a significant market is developed around preparing for centralized exams, leading both policymakers and teachers to be persuaded towards focusing on such exam preparation. One underlying principle of teaching to the test is the belief that all students should reach the same proficiency level set by a central authority within a specific time frame (annually, according to grade level). Moreover, measuring students' performance through standardized tests, aligned with grade/age-level expectations established by the central authority, is viewed as the optimal approach (Darling-Hammond, 2004). However, test developers may include extremely challenging or skill-demanding items in exams to ensure the system's continuity and to achieve a spread of scores among test-takers (Litton & Wickett, 2009). This situation, in turn, raises questions about the appropriateness and effectiveness of standardized tests in accurately measuring student performance.

As long as central and standardized tests exist (and their elimination seems nearly impossible), mathematics teachers will not escape the pressures of high-stakes testing. The question is ‘how teachers will respond?’. Van de Walle et al. (2012) advise that the best way to succeed on high-stakes tests is to teach the big ideas in the mathematics curriculum. Conceptually taught students who understand mathematical processes and practices will perform well on tests, regardless of format or objectives.

Activities that are neither too hard nor too easy, but challenging and intriguing, make good choices for meaningful learning and standardized test preparation. These activities should have multiple solutions and access points, build on previous learning, and offer challenge without being overwhelming (Litton & Wickett, 2009). Providing problem-solving and communication skills prepares students well for standardized tests, as evidenced by successful schools in Chicago and Massachusetts (Jerald, 2006).

Schoenfeld (2002) concludes about mathematics curricula and standardized testing that students from reform curricula (which offers ‘teaching through problem solving’ approach (Schroeder & Lester, 1989)) outperform those from traditional curricula in conceptual understanding and problem-solving, though there are no significant differences in basic skills tests. This suggests reform curricula can narrow the performance gap between whites and underrepresented minorities.

In summary, teachers might be hiding behind exam pressures, either due to misinformation or because it's perceived as the easier path with fewer problems from parents or administrators. Perhaps the reason teachers perceive the purpose of education as preparing students for tests is due to their own educational experiences being predominantly focused on test preparation. Hence, mathematics teaching cannot respond to diversity with a teach-for-testing approach, as it leaves no one to assist those who are falling behind.

5.5. Suggestions and Implications for Future Studies

One of the key findings from this study, which explored mathematics teachers' views on providing inclusive education in classrooms with academic diversity, is the need for professional development activities that can influence ‘beliefs’ of mathematics teachers. According to the traditional approach (e.g., Little, 1993), teacher change begins with a shift in 'teachers' beliefs and attitudes'. This is followed by changes in 'classroom practices', and finally, a change in 'student learning'. However, if beliefs must change before behaviour, how can these beliefs be altered? Studies shown that professional development (or broadly, professional learning) is the key factor in changing beliefs (Desimone, 2009; Guskey, 2002).

According to Desimone's approach, i) teachers first participate in professional development activities, ii) these activities enhance their knowledge and skills and alter their attitudes and beliefs, iii) teachers then apply this new knowledge, skills, attitudes, and beliefs in their teaching and iv) changes in teaching practices lead to improved student achievement. On the other hand, another perspective suggests significant changes in teachers' beliefs and attitudes are likely to occur only after evidence of changes in student learning outcomes. Therefore, Guskey (2002) proposes a different approach: i) following professional development activities, ii) there is a change in classroom practices, iii) change in student learning, and iv) change in teachers' beliefs and attitudes. These two approaches highlight that professional development aims to change classroom practices, beliefs and attitudes of teachers, and student learning outcomes. Positive changes in these three components will lead to the delivery of more inclusive mathematics education. When change in teachers occur, it will reduce the marginalization of students and enhance both their academic and social success. From the teachers' perspective, a significant sense of professional satisfaction will emerge. In the context of the findings of this study, there is a need to develop professional development activities that are more practice-oriented and involve active participation of teachers, rather than just knowledge transmission where teachers remain passive.

Another inference that can be drawn from this study is the negative impact of centralized exams on the implementation of inclusive education. While the reality that centralized exams cannot be entirely eliminated is clear, the transformation of mathematics education, and indeed general education, into a system entirely focused on these exams, leads to the production of 'cookie-cutter' students (Pandina Scot et al., 2009). The education system operates akin to a 'special preparation course' solely for preparing students for these exams. From elementary school onwards, a teaching-for-test approach forces students to continuously focus on solving test questions. While it's natural for specialized preparation courses to do this, it's not appropriate for schools to be used solely for this purpose (Peters & Oliver, 2009). Preparation for centralized exams should not restrict curricula and classroom content. The existence of these exams drives teachers towards exam-oriented teaching, which in turn limits the diversity and creativity in instruction. However, assessment should be utilized to enhance student learning, not just for preparing for standardized tests (Pandina Scot et al., 2009). It’s crucial to broaden the format of centralized exams to consider students with different learning styles and needs. For instance, employing assessment methods that include open-ended questions could be beneficial. The goal of mathematics education for students should not be merely to 'fill in a box'. While there may be concerns about the difficulty and subjectivity of evaluating open-ended questions, according to data published by The Turkish Publishers Association (2013), more than half of the printed educational books are related to exam preparation. Redirecting resources allocated for these books to student assessment and evaluation is feasible. Additionally, considering students' classroom performances and their exams for assessment should be contemplated. However, at this point, it’s essential to support teachers in developing assessment methods suitable for different learning needs and convince them of the necessity of doing so. Even if changes to the exam format are not feasible, teachers and families should be convinced that teaching processes which encourage active participation and learning of students are an effective approach for preparing for exams, regardless of their format. This is because such teaching methods help a deeper understanding, which in turn prepares students more effectively for exams. Engaging students actively in their learning process both enhances their learning of the subject matter and prepares them with the skills to perform better in various exam circumstances.

On the other hand, the foundational recommendation for all other actions is **the need for dedicated teachers**. It is inevitable that teachers will have criticisms about various aspects of their profession. They might attribute the 'blame' and 'responsibility' to others or to certain circumstances, which can often seem like an easy way out. However, no educational approach, in mathematics or any other subject, will succeed without the time and effort of teachers. Therefore, the only apparent solution for teachers to truly impact their students is to work with dedication and commitment. This means going beyond simply assigning blame to other things. Also, teachers should take active responsibility for the learning environment and student outcomes. Teachers can effectively address the diverse needs and challenges of their classrooms only by engaging in dedicated efforts.

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APPENDICES

APPENDIX A. APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
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Sayı: 28620816 /

15 NİSAN 2021

Konu : Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi : İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Prof.Dr. Erdinç ÇAKIROĞLU

Danışmanlığını yürüttüğünüz Şenol NAMLI'nın "Ortaokul Düzeyinde Akademik Başarı Yönünden Çeşitlilik Gösteren Öğrencilere Matematik Öğretmek" başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **138-ODTU-2021** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

Dr.Öğretim Üyesi Ali Emre TURGUT
İAEK Başkan Vekili

APPENDIX B. PERMISSION FROM MoNE

T.C.
MİLLÎ EĞİTİM BAKANLIĞI
Strateji Geliştirme Başkanlığı

Sayı : E-49614598-605.01-46025751 18.03.2022
Konu : Araştırma Uygulama İzin Talebi

DAĞITIM YERLERİNE

İlgi: a) Orta Doğu Teknik Üniversitesi Rektörlüğünün 31/01/2022 tarihli ve 54850036-044-E.275 sayılı yazısı.
b) Millî Eğitim Bakanlığının 21/01/2020 tarihli ve 2020/2 Nolu Araştırma Uygulama İzinleri Genelgesi.

İlgi (a) yazı ile Orta Doğu Teknik Üniversitesi, Sosyal Bilimler Enstitüsü İlköğretim Anabilim Dalı Doktora Programı öğrencisi Şenol NAMLI'nın "Ortaokul Düzeyinde Akademik Başarı Yönünden Çeşitlilik Gösteren Öğrencilere Matematik Öğretmek" konulu çalışmasına veri sağlamak amacıyla anket çalışması yapma izin talebine ilişkin ilgi yazı ve ekleri Bakanlığımız tarafından incelenmiştir.

Bakanlığımıza bağlı resmi/özel okul ve kurumlarda öğrenci, öğretmen ve okul yöneticilerinin katılımıyla yapılması planlanan uygulamanın covid-19 tedbirlerine uyulması ve denetimi il/ilçe millî eğitim müdürlükleri ve okul/kurum idaresinde olmak üzere, kurum faaliyetlerini aksatmadan, gönüllülük esasına göre; onaylı bir örneği Bakanlığımızda muhafaza edilen ve uygulama sırasında da mühürlü ve imzalı örnekten çoğaltılan, veri toplama araçlarının https://forms.gle/pUsmD8gExTcU8CxY7 ve https://meet.google.com/rbu-zehy-iwi adreslerinden online olarak uygulanmasına ilgi (b) Genelge doğrultusunda izin verilmiştir.

Gereğini bilgilerinize rica ederim.

Mehmet Fatih LEBLEBİCİ
Bakan a.
Başkan

Ek:
1-Onaylı Veri Toplama Araçları (10 Sayfa)
2-Ayşe Başvurusu (2 Sayfa)

Dağıtım:
Gereği:
B Planı

Bilgi:
Orta Doğu Teknik Üniversitesi Rektörlüğüne

Bu belge güvenli elektronik imza ile imzalanmıştır.

Adres : MEB Atatürk Bulvarı No:98 Kat:4 A Blok Bakanlıklar/ANKARA
Belge Doğrulama Adresi: https://www.turkiye.gov.tr/meb-ebys
Bilgi için: İstatistikçi Özlem BEYAZPİRİNÇ
Telefon No : 0 (312) 413 27 53
Unvan : İstatistikçi
E-Posta: sgb_arastirmaizinleri@meb.gov.tr
İnternet Adresi: www.meb.gov.tr
Faks: 3124186401
Kep Adresi : meb@hs01.kep.tr

Bu evrak güvenli elektronik imza ile imzalanmıştır. https://evraksorgu.meb.gov.tr adresinden 7d74-8f2a-33df-bbd6-7b12 kodu ile teyit edilebilir.

APPENDIX B (Continued)

TG.

T.C.
YOZGAT VALİLİĞİ
İl Millî Eğitim Müdürlüğü

Sayı : E-55005497-605.02-26067902 07.06.2021
Konu : Araştırma İzni
(Şenol NAMLI)

ORTADOĞU TEKNİK ÜNİVERSİTESİ REKTÖRLÜĞÜNE
ÇANKAYA/ANKARA

İlgi : a)Millî Eğitim Bakanlığı'nın 21/01/2020 tarihli ve 1563890 sayılı Araştırma Uygulama İzinleri 2020/2 Nolu Genelgesi.
b)Ortadoğu Teknik Üniversitesi Rektörlüğünün 06/05/2021 tarih ve 25078731 sayılı yazısı.
c)Yozgat Valiliği 03/06/2021 tarih ve E-55005497-20-25972666 sayılı Olur'u

Ortadoğu Teknik Üniversitesi Sosyal Bilimler Enstitüsü İlköğretim Eğitimi Anabilim Dalı Doktora öğrencisi Şenol NAMLI'nın "Ortaokul Düzeyinde Akademik Başarı Yönünden Çeşitlilik Gösteren Öğrencilere Matematik Öğretmek" konulu çalışmasının Müdürlüğümüze bağlı İlimiz Geneli resmi ortaokul öğretmenlerine 2020-2021 eğitim/öğretim yılı içeresinde veri toplama uygulaması için gerekli izin isteğine ait ilgi (c) Makam Onayı ile onaylanmış anket örneği formları ekte gönderilmiş olup, süreç sonunda hazırlanacak olan raporun bir örneğinin Müdürlüğümüze gönderilmesi hususunda;

Bilgilerinizi ve gereğini arz ederim.

Yusuf YAZICI
İl Millî Eğitim Müdürü

Ekler:
1- Makam Onayı (1sayfa)
2- Onaylı Anket Örneği (3 sayfa)

Bu belge güvenli elektronik imza ile imzalanmıştır.

Adres : Karatepe Mah. H.Ahmet Yesevi Cad. No57 Yeni Valilik Hizmet Binası Kat, D:2, 66100 Yozgat
Telefon No : (0354) 280 66 00:
E-Posta:arge66@meb.gov.tr
Kep Adresi : meb@hs01.kep.tr

Belge Doğrulama Adresi : https://www.turkiye.gov.tr/meb-ebys
Bilgi için: Mehmet DEMİR
Unvan : Memur
İnternet Adresi:http://yozgat.meb.gov.tr Faks:

Bu evrak güvenli elektronik imza ile imzalanmıştır. https://evraksorgu.meb.gov.tr adresinden 483d-550e-3141-875f-e276 kodu ile teyit edilebilir.

APPENDIX C. CONSENT FORM

Gönüllü Katılım Metni

Sayın katılımcı,

Orta Doğu Teknik Üniversitesi İlköğretim Bölümü Matematik Eğitimi alanında "ORTAOKUL DÜZEYİNDE AKADEMİK BAŞARI YÖNÜNDEN ÇEŞİTLİLİK GÖSTEREN ÖĞRENCİLERE MATEMATİK ÖĞRETMEK" konulu doktora tezim için bir çalışma yürütmekteyim. Araştırmanın amacı; matematik öğretmenlerinin, matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, matematik öğretmeyi nasıl tanımladıklarını ve algıladıklarını ve bu sınıflarda matematik öğretmenin onlar için ne anlama geldiğini ortaya koymaktır. Bu kapsamda hazırlamış olduğum Ölçeği tüm samimiyetinizle doldurmanızı rica ediyorum. Çalışmadan elde edilecek olan verilerin sadece akademik amaçlı kullanılacaktır. Çalışma içerisinde gerektiği hallerde, öğretmen isimleri takma isimler kullanılarak paylaşılacaktır. Okul ismi çalışma içerisinde kullanılmayacaktır, onun yerine, gerekli hallerde, çalışma içerisinde 'devlet okulu', 'özel okul' tabirleri kullanılacaktır. Sizin tanınmanızı sağlayacak herhangi bir kişisel verinin kimseyle paylaşılmayacağını temin ederim.

Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz. Araştırmaya yönelik sorularınız olması durumunda ya da çalışma hakkında daha fazla bilgi almak için Arş. Gör. Şenol NAMLI (Tel: 0 5XX XX XX XX; e-posta: [redacted] ile iletişim kurabilirsiniz.

Bu çalışmada toplanan verilerin izniniz dışında hiçbir şekilde herhangi bir yerde yayınlanmayacağını teyit ederim. Aksi durumda gönüllü katılımcı hukuki yollara başvurabilir.

Adı-Soyadı: Şenol NAMLI **Tarih: …./….202..**

Bu çalışmaya gönüllü olarak katılmayı kabul ediyorsanız, lütfen aşağıda belirtilen yere isminizi ve tarihi yazarak, gönüllü katılmayı onaylıyorum kutucuğunu işaretleyiniz.

Katılımınız için teşekkür ederim.

Adı-Soyadı: **Tarih: …/…/202..**

Gönüllü katılmayı onaylıyorum ☐

APPENDIX D. FIRST DRAFT ITEMS OF THE SCALES

ÖLÇEK İLK TASLAK MADDELERİ

1. Her öğrenci matematik öğrenebilir mi?
2. Her öğrenci matematik öğrenmeli midir?
3. Her öğrenciye matematik öğretebilir misiniz?
4. "Tüm öğrenciler matematiği aynı şekilde öğrenir." yargısına ilişkin görüşünüz nedir?
5. "Her bir öğrenci matematiği farklı şekilde öğrenir." yargısına ilişkin görüşünüz nedir?
6. "Her bir öğrenci matematiği farklı şekilde öğrenir.' yargısına ilişkin görüşünüz nedir?
7. "Tüm öğrenciler matematiği aynı şekilde öğrenir, fakat farklı oranda öğrenir." yargısına ilişkin görüşünüz nedir?
8. "Tüm öğrenciler matematiği aynı şekilde öğrenir, fakat farklı hızda öğrenir." yargısına ilişkin görüşünüz nedir?
9. "Tüm öğrenciler matematiği aynı şekilde öğrendiği için; bütün öğrencilere matematik aynı şekilde anlatılmalıdır." yargısına ilişkin görüşünüz nedir?
10. "Her bir öğrenci matematiği farklı hızda öğrendiği için; matematik öğretiminde farklılaştırma yapılmalıdır." yargısına ilişkin görüşünüz nedir?
11. "Her bir öğrenci matematiği farklı şekilde öğrendiği için; her bir öğrenciye matematik farklı şekilde anlatılmalıdır." yargısına ilişkin görüşünüz nedir?
12. "Tüm öğrenciler matematiği farklı oranda öğrendiği için; her bir öğrenciye farklı seviyede matematik anlatılmalıdır." yargısına ilişkin görüşünüz nedir?
13. Öğretim sürecinde teknoloji araçlarının kullanımını kapsayıcı bir matematik öğretimini destekler mi?

APPENDIX E. MATHEMATICS TEACHER SELF-REFLECTIONS SCALE ABOUT THEIR KNOWLEDGE

Madde numarası	Maddeler	Kesinlikle Katılmıyorum	Katılıyorum	Kararsızım	Katılıyorum	Kesinlikle Katılmıyorum
1	Matematik başarısı düşük olan öğrencilerin, matematik öğrenmek için nelere ihtiyaç duyduklarını biliyorum.					
2	Matematik başarısı yüksek olan öğrencilerin, matematik öğrenmek için nelere ihtiyaç duyduklarını biliyorum.					
3	Matematik başarı düzeyleri farklı olan öğrenci gruplarına matematik öğretebilmek için gerekli olan stratejileri biliyorum.					
4	Matematik başarı düzeyleri farklı olan öğrenciler için uygun hedefleri nasıl belirleyeceğimi biliyorum.					
5	Matematik başarıları bireysel farklılıklar gösteren öğrencilerin, matematik öğrenmek için neye ihtiyaç duyduklarını biliyorum.					
6	Matematik başarıları bireysel farklılıklar gösteren öğrencilerin, derslerde öğrendiklerinin takip ve değerlendirmesinin nasıl yapılacağını biliyorum.					
7	Matematik öğretirken, öğrencilerin farklı akademik ihtiyaçlarına yönelik farklılaştırmaların nasıl yapılacağını biliyorum.					
8	Matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, öğretim sürecindeki zorlukların nasıl belirleneceğini biliyorum.					
9	Matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, öğretim sürecinde ortaya çıkan zorlukların nasıl çözüleceğini biliyorum.					
10	Matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, sınıf yönetiminin nasıl sağlanacağını biliyorum.					
11	Matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, matematik sorularının çözümü için farklı problem çözme stratejilerinin neler olduğunu biliyorum.					
12	Matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, zaman kontrolünün nasıl yapılacağını biliyorum.					
13	Matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, öğretim teknolojilerini kullanmayı biliyorum.					
14	Matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, öğrencilerin matematik konularıyla ilgili tartışmalarının nasıl yönetileceğini biliyorum.					
15	Matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, kullanılabilecek farklı temsil biçimlerinin neler olduğunu biliyorum.					

APPENDIX F. MATHEMATICS TEACHER SELF-REFLECTIONS SCALE ABOUT THEIR DOING

Madde numarası	Maddeler	Asla	Nadiren	Bazen	Sıklıkla	Her zaman
1	Bütün öğrencilere matematiği öğretmek için aynı yolu izlerim.					
2	Her öğrencinin, matematik dersinde söylediklerine saygı duyarım.					
3	Matematik öğretirken, her öğrenciye farklı düzeyde matematik anlatırım.					
4	Matematik öğretirken, öğrencilerin (görerek, duyarak, yazarak, vb.) farklı öğrenme stillerini dikkate alırım.					
5	Matematik başarısı düşük olan öğrencilere fazladan destek sağlarım.					
6	Her öğrencinin, eğitsel faaliyetlere eşit seviyede erişimini sağlamak için uygun öğrenme ortamları oluştururum.					
7	Matematik öğretim sürecinde, öğrencilerin farklı ihtiyaçlarını karşılayabilmek için müfredatın dışına çıkarım.					
8	Hazırbulunuşluk seviyeleri farklı olan öğrenciler için ders içeriğini uyarlarım.					
9	Her öğrencinin ihtiyacına göre matematik öğretebilmek için uygun stratejileri kullanırım.					
10	Her öğrencinin, eğitsel faaliyetlere eşit seviyede erişimini sağlamak için meslektaşlarımla iş birliği yaparım.					
11	Sınıf içi etkinliklerde, öğrencilerin farklı akademik ihtiyaçlarına yönelik çeşitlendirme veya düzenleme yaparım.					
12	Matematik öğretirken, öğrencilerin ilgilerine yönelik farklılaştırmalar yaparım.					
13	Matematik başarı düzeyleri farklı olan öğrencilerin gereksinimlerine göre sınıfımda farklı uygulamalar yaparım.					
14	Matematik başarı düzeyleri farklı olan öğrencilerin gereksinimlerine göre ev ödevlerini farklılaştırırım.					
15	Matematik başarı düzeyleri farklı olan öğrencilerin gereksinimlerine göre derslerimi farklılaştırırım.					
16	Matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, öğretim sürecinde çoklu temsil biçimlerini kullanırım.					
17	Matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, öğretim teknolojilerini kullanırım.					
18	Matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, sınıf yönetimini sağlarım.					
19	Matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, zaman kontrolünde zorlanırım.					

APPENDIX G. MATHEMATICS TEACHER SELF-REFLECTIONS SCALE ABOUT THEIR BELIEFS

Madde numarası	Maddeler	Kesinlikle Katılmıyorum	Katılıyorum	Kararsızım	Katılıyorum	Kesinlikle Katılıyorum
1	Sınıftaki her öğrencinin matematik öğrenebileceğine inanıyorum.					
2	Bütün öğrencilere, matematiğin aynı şekilde öğretilmesi gerektiğine inanıyorum.					
3	Matematik başarı düzeyleri farklı olan öğrencilerin aynı sınıfta öğrenim görmesi gerektiğine inanıyorum.					
4	Matematik başarısı düşük olan öğrencilerin, başarısı yüksek olan öğrencilere akademik yönden zarar verdiğine inanıyorum.					
5	Her bir öğrencinin matematik dersinde söylediklerinin önemsenmesi gerektiğine inanıyorum.					
6	Matematik başarısı yüksek olan öğrencilere, fazladan matematik öğretmeye gerek olmadığına inanıyorum.					
7	Sınıftaki her öğrencinin matematik öğrenmesi gerektiğine inanıyorum.					
8	Aynı sınıf içerisindeki başarı düzeyleri farklı olan öğrencilere, matematik konularının farklı seviyede öğretilmesi gerektiğine inanıyorum.					
9	Her öğrencinin matematiği farklı hızda öğrendiğine inanıyorum.					
10	Tüm öğrencilerin matematiği aynı şekilde öğrendiğine inanıyorum.					
11	Öğrencilere, akademik başarı seviyelerine göre farklı ödevler/görevler verilmesi gerektiğine inanıyorum.					
12	Matematik başarısı düşük olan öğrencilere, matematik öğretmeye gerek olmadığına inanıyorum.					
13	Matematik öğretiminde, öğrencilerin (görerek, duyarak, yazarak, vb.) öğrenme stillerine göre farklılaştırma yapılması gerektiğine inanmıyorum.					
14	Matematik öğretirken, öğrencilerin ilgi alanlarına göre farklılaştırma yapılması gerektiğine inanıyorum.					
15	Matematik başarısı yönünden bireysel farklılıkların görüldüğü sınıflarda, öğretim teknolojilerinin matematik öğretmede yararlı olmadığına inanıyorum.					
16	Matematik başarısı yüksek olan öğrencilerin, başarısı düşük olan öğrencilere akademik açıdan zarar verdiğine inanıyorum.					
17	Matematik öğretirken, öğrencilerin hazırbulunuşluk düzeylerine göre farklılaştırma yapılması gerektiğine inanıyorum.					
18	Seviye sınıfları oluşturulmasının bütün öğrencilerin matematik başarısını arttıracağına inanıyorum.					
19	Farklı düzeylerdeki öğrencilerin ihtiyaçlarına göre matematik öğretilmesinin, mesleki bir sorumluluk olduğuna inanıyorum.					

APPENDIX H. FINAL VERSION OF MATHEMATICS TEACHERS' BELIEF SELF-REFLECTION SCALE

Boyut İsmi	Madde numarası	Maddeler	Kesinlikle Katılmıyorum	Katılıyorum	Kararsızım	Katılıyorum	Kesinlikle Katılıyorum
Eğitim Hakkına Yönelik İnançlar	1	Bütün öğrencilere, matematiğin aynı şekilde öğretilmesi gerektiğine inanıyorum.					
	2	Matematik başarısı yüksek olan öğrencilere, fazladan matematik öğretmeye gerek olmadığına inanıyorum.					
	3	Tüm öğrencilerin matematiği aynı şekilde öğrendiğine inanıyorum.					
	4	Matematik başarısı düşük olan öğrencilere, matematik öğretmeye gerek olmadığına inanıyorum.					
Öğretimi Farklılaştırmaya Yönelik İnançlar	5	Her öğrencinin matematiği farklı hızda öğrendiğine inanıyorum.					
	6	Öğrencilere, akademik başarı seviyelerine göre farklı ödevler/görevler verilmesi gerektiğine inanıyorum.					
	7	Matematik öğretirken, öğrencilerin ilgi alanlarına göre farklılaştırma yapılması gerektiğine inanıyorum.					
	8	Matematik öğretirken, öğrencilerin hazırbulunuşluk düzeylerine göre farklılaştırma yapılması gerektiğine inanıyorum.					

APPENDIX I. THE DIFFERENTIATED CLASSROOM OBSERVATION SCALE

Differentiated Classroom Observation Scale Protocol

Pre-Observation Phase

Before going to the teacher, the observer will contact the teacher to find a time that is convenient for the observation. The following will need to be arranged before the observation date:

- Permission to observe from teacher
- Copy of lesson plan
- Teacher will visually identify targeted group of students in classroom (with color-coded name tags or teacher's chosen strategy)
- Teacher is made aware that there is a brief (5 minutes or so) pre-observation interview, and a short post-observation debriefing.

Pre-Observation Interview

Before beginning the interview, please arrange to have the following questions answered. Some of this will be facilitated with prior contact with the teacher. In particular, having a copy of the lesson plan in advance would make the following questions less laborious for the teacher to answer prior to the observation period. This is an informal interview that is merely to gain essential descriptive information.

1. Is this lesson tiered?
   ___ Yes (based on identification status)
   ___ Yes (not based on identification status)
   ___ Not explicitly, but cluster grouping will be used
   ___ No, all students completing same activities

2. Who developed this lesson?
   ___ This teacher
   ___ Other: ______________________

3. How closely will you be following the pre-designed lesson plan?

4. Have you used this lesson before?
   What success have you noted with this lesson regarding this identified population?

5. Are learning contracts being used?
   ___ Yes (multiple identified students)
   ___ Yes (single identified student)
   ___ Yes (not related to identified status)
   ___ Yes (IEP-determined)
   ___ No

6. Has any of this lesson been compacted for any child?
   If so, please explain the alternate learning activities that are substituting for the lesson.

7. What are the goals/objectives of this lesson?

8. Anything else the teacher wants to add before the observation:

Classroom Observation Phase

School: ______________________ Teacher: ______________________

Time of observation: ______________________

Total number of students: ______________________ Number from identified group: ______________

List additional adults in room, including time in room, role, and number of children served:

Five-Minute Segment Scoring (use DCOS Scoring Sheet)

During the observation period, please indicate for each 5-minute segment which of the following instructional activities were in practice. There will be at least one per segment, and each segment will likely have more than one. The segment ratings should be marked separately for the two groups of students: "Identified" and "Not identified." In the event that there is no way to distinguish between the two groups, make whole-group ratings in the "Not Identified" group location only.

In addition to the instructional activities, please also rate student engagement, cognitive level, and "Learning Director" for each 5-minute segment.

APPENDIX I. (Continued)

Instructional Activity Codes		
Instructional Activity	**Code**	**Description**
Lecture	L	Teacher lecturing to group of students
Lecture with Discussion	LD	Teacher-led lecture, with periodic student discussion (recitation)
Class Discussion	CD	Discussion in class, students are primary discussants
Small Group Discussion	GD	Discussion in class, but in small groups, not whole group
Problem Modeling by Teacher	PM	Teacher demonstrating how to execute a task (e.g., working a math problem on board)
Student Presentation	SP	Student(s) presenting information to the class (either planned presentation or on-demand task)
Demonstration by Teacher	D	Teacher demonstrating a procedure to the class (e.g., how to safely use lab equipment)
Questioning by Teacher	Q	Teacher asking question of student(s) in group setting
Student Responding	SR	Student(s) answering questions posed by teacher (choral response included in this category)
Manipulatives	M	Student(s) working with concrete materials to illustrate abstract concepts (e.g., math blocks)
Cubing	C	Student(s) working with cubing curriculum materials (differentiated, see Adams & Pierce [in press] for details)
Learning Center(s)	LC	Student(s) working at planned learning center(s) individually or in small groups (computer stations can be included if they are planned activities)
Anchoring activity before lesson	AB	Use of lesson-anchoring materials prior to teacher presentation of content. (see Adams & Pierce [in press] for details).
Anchoring activity during lesson	AD	Use of lesson-anchoring materials during teacher presentation of content.
Anchoring activity after lesson	AA	Use of lesson-anchoring materials after teacher presentation of content.
Seat work-Individual	SWI	Student(s) working at desk on academic materials (independently).
Seat work-Group based	SWG	Student(s) working at desk on academic materials (groups).
Cooperative learning	CL	Students working in a planned cooperative structure to complete a task.
Role Playing	RP	Student(s) engaged in role play exercises (e.g., "playing store" to practice counting change).
Teacher interacting with individual student	TIS	Teacher working with/talking to/helping individual student.
Teacher interacting with small group	TIG	Teacher working with/talking to/helping small group of students.
Technology use-Students	TS	Technology being used by students for related learning activities.
Technology use-Teacher	TT	Technology being used by the teacher for presenting instructional content.
Assessment activity	A	Student(s) engaged in a formalized assessment activity (e.g., test; performance).
Pull-out activity, individual or group	PO	Student(s) removed from the room -- no observation of these students possible.
Other	O	List "other" activities.

Student Engagement, Cognitive Activity, & "Learning Director"

These are global ratings for each 5-minute segment. Thus, each segment will have only one rating for each of these two domains, the rating that is most representative of that time period for that group.

Student Engagement	Cognitive Activity	"Learning Director"
L – Low engagement = 20% or fewer of students engaged in learning **M** – Moderate engagement = 21 - 79% of students engaged in learning **H** – High engagement = 80% or more students engaged in learning	Remember Understand Apply Analyze Evaluate Create Ratings are made in each segment following the given scale: **1** – Not evident **2** – Evident **3** – Well-represented	*Who directs the learning, or makes the decisions about the learning activities.* Use the following scale for making your segment ratings for the identified groups: **1** – Teacher directs all learning. **2** – Teacher directs most learning. **3** – Teacher and student share learning decisions **4** – Student directs most learning **5** – Student directs all learning

APPENDIX I. (Continued)

Differentiated Classroom Observation Scale: Scoring Form

			1	2	3	4	5
Identified	Activity						
	Engagement		☐L ☐M ☐H	☐L ☐M ☐H	☐L ☐M ☐H	☐L ☐M ☐H	☐L ☐M ☐H
	Cognitive	Remember	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③
		Understand	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③
		Apply	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③
		Analyze	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③
		Evaluate	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③
		Create	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③
	Learning Director		① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤

			1	2	3	4	5
Not Identified	Activity						
	Engagement		☐L ☐M ☐H	☐L ☐M ☐H	☐L ☐M ☐H	☐L ☐M ☐H	☐L ☐M ☐H
	Cognitive	Remember	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③
		Understand	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③
		Apply	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③
		Analyze	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③
		Evaluate	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③
		Create	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③

Holistic Observation Ratings

At the conclusion of the segment ratings, complete the following items, PRIOR TO the teacher debriefing.

Please describe how grouping (if any) occurred in this classroom:
Were differentiated practices used in the classroom for Identified and Not-Identified students?
___ Yes ___ No
If Yes, please rate each of the following items based on your OVERALL perception, for each group separately.
If No, simply respond in the "Not Identified Group" column, using the following scale for both:

SD	D	N	A	SA	NA
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not able to respond, lack of evidence (use sparingly)

	Identified Group	Not Identified Group
This lesson encouraged students to seek and value multiple modes of investigation or problem solving.		
Students were reflective about their learning.		
The instructional strategies and activities respected and accounted for students' prior knowledge.		
Interactions among students demonstrated collaborative learning environment.		
The teacher clearly enjoyed working with this group.		
Teacher demonstrated high level of content knowledge for lesson topic.		
Transitions between activities were smooth and well coordinated.		
Group procedures were clear, established, and understood by the students (automaticity was evident).		
Anchoring activities were readily available and appropriate.		
The classroom management plan was clear and effective.		
Learning activities were primarily student-directed.		
Teacher served primarily as a "Sage on the Stage" to this group.		

Post-Observation Debriefing & Reflection

Debriefing with Teacher	Thank the teacher for the observation period, and use this last segment of approximately 5 minutes to clarify anything observed. Then, ask the teacher: *Is there anything you wanted to add regarding the observation before I leave? (take detailed notes)*
Final Reflection	**After leaving the classroom,** take a couple of minutes to make any other written comments that are relevant or make the observation more contextually-based or comprehensive. Such issues may include the tone, demeanor, or attitude of the teacher and/or students.

APPENDIX J. INTERVIEW PROTOCOL

Bir ortaokuldaki 7/C sınıfının öğrenci profili aşağıdaki gibidir.

Ahmet isimli erkek öğrencinin hikâyesi şu şekildedir: "Öğrencinin annesi ile babası boşanmış ve çocuk annesi ile birlikte yaşamaktadır. Öğrenci şimdiki okuluna gelmeden önce üç farklı okul değiştirmek zorunda kalmış ve şimdiki okulunda da sık sık devamsızlık yapmaktadır. Orta düzeyde zihinsel engelli tanısı konulmuş olan öğrenci, 7. sınıfa kayıtlı olmasına rağmen, okuma yazmada zorlanmakta ve 4 işlemi bile hatalı yapmaktadır. Sınıf içeresinde sürekli gezinmek istemektedir. Ders esnasında bir görev veya etkinlik verildiğinde bir dakika bile oturup verilen görevi yapmayan birisidir. Öğretmenleri öğrencinin bu durumunu bildikleri için, ders düzenini bozmamak adına bu öğrenciye ders anlatmaya çalışmıyorlar, ders içindeki etkinliklerde 'sen kendi başına takıl' denilerek, öğrenciyi dersten bir nevi soyutluyorlardı. Sınıftaki akranları da bu öğrenciyle arkadaşlık etmekten ve oyunlarına dâhil etmekten çekiniyorlar ve onu dışlıyorlardı."

Aynı sınıftaki Başak isimli kız öğrencinin bilgileri ise şu şekildedir: "Ailesinin ekonomik durumu ve sosyo-kültürel seviyesi oldukça yüksektir. Öğrenciye genel zihinsel yetenek alanında üstün yetenekli ve başarılı tanılaması yapılmış ve BİLSEM'e kayıtlıdır. Ailesinin öğrenciye karşı ilgisi ve ondan beklentisi çok yüksektir. Öğrenci 7. sınıf düzeyinde olmasına rağmen, cebir öğrenme alanı için lise düzeyindeki fonksiyon ve polinom konularının özelliklerini, geometri öğrenme alanında ise çemberin veya dörtgenlerin alanını integralin özelliklerini kullanarak yapabilecek düzeyde bilgiye sahiptir. Sınıf içerisinde verilen bir görevi veya etkinliği diğer arkadaşlarına nazaran çok daha hızlı bitirdiği için diğer arkadaşlarına 'böyle basit şeyleri nasıl yapamazsınız' diye alaycı bir tavır içerisine girmeye ve ders harici (camdan dışarıyı izleme, defterini veya sıranın üstünü karalama, vb.) faaliyetler yapmaya başlamaktadır.

Ayrıca, aynı sınıfta, diğer öğrenciler açısından da matematik başarısı yönünden farklılıklar bulunmaktadır. Sınıf seviyesi beklentilerini karşılayan ve 'normal' olarak tanımlayabileceğimiz öğrenciler de mevcuttur, yavaş öğrenen veya başarısı yüksek öğrenciler de bulunmaktadır.

1. Görüşme

No	Sorular	Açıklama/Cevap
1	Örnektekine benzer bir sınıfta derse girdiğiniz ilk andan dersin sonuna kadar nasıl bir süreç geçtiğini anlatabilir misiniz? ➢ (Yeterince derin bilgi alamadığımda) Böyle bir sınıftaki en son derste neler olup bittiğinden bahsedebilir misiniz? ((Yeterince derin bilgi alamadığımda) Böyle bir sınıftaki hatırladığınız en iyi ve en kötü geçen derslerinizi anlatabilir misiniz?	
2	Göreve yeni başlayan bir matematik öğretmenine veya örnekteki gibi bir sınıfla karşılaşmamış olan bir öğretmene, başarı düzeyleri çeşitli seviyelerde olan öğrencilerin bulunduğu bir sınıfta matematik öğretmeyi tanımlayacak olsanız, neler söylersiniz? ➢ (Yeterince derin bilgi alamadığımda) Bu öğretmene, önerileriniz neler olurdu? ➢ (Yeterince derin bilgi alamadığımda) Ders planlama veya sınıf yönetimi ile ilgili neler önerirdiniz? (Yeterince derin bilgi alamadığımda) Kullanabileceği matematik öğretimi strateji önerileniz nelerdir?	
3	Matematik öğrenme alanlarının hepsini göz önünde bulundurduğunuzda, sınıfınızdaki başarısı düşük, yüksek veya 'normal' olan öğrencilerin tümünü kapsayacak şekilde bir öğretim yapabilmek için kendinizi ne kadar hazır hissediyorsunuz? Neden bu şekilde düşündüğünüzü, varsa geçmişteki uygulamalarınızla birlikte, açıklayabilir misiniz?	

APPENDIX J. (Continued)

2. Görüşme		
No	Sorular	Açıklama/Cevap
1	Yukarıda bahsedilen sınıfın matematik öğretmeni olduğunuzu ve öğrencilerin durumlarını bildiğinizi düşünün; • Ahmet için özellikle dikkat edilmesi gereken noktalar var mıdır? Varsa nelerdir? • Başak için özellikle dikkat edilmesi gereken noktalar var mıdır? Varsa nelerdir? Sınıftaki her bir öğrencinin matematik öğrenmesi için neler yaparsınız?	
2	Matematik dersi özelinde düşünüldüğünde, yukarıdakine benzer bir sınıfta, • Öğrenciler arasında akademik başarı farkı oluşmasında öğretmenin rolü sizce nedir? • Öğretmenin bu farkın kapatılabilmesindeki rolü sizce nedir?	
3	Yukarıdaki örnek sınıf da göz önünde bulundurulduğunda, "Her çocuk matematik öğrenebilir" görüşü ile ilgili ne düşünüyorsunuz? Neden bu şekilde düşündüğünüzü açıklayabilir misiniz? ➢ (Eğer olumsuz cevap verirse) Ne yapılırsa yapılsın, bütün öğretim yöntem teknikleri denendiğinde bile matematik öğrenemeyecek öğrenciler var mıdır? Neden bu şekilde düşündüğünüzü, varsa örnekleri ile birlikte, açıklayabilir misiniz? • Her çocuk matematik öğrenmeli midir? Ne kadar öğrenmesi gerektiğine nasıl karar verebiliriz? Neden bu şekilde düşündüğünüzü açıklayabilir misiniz? ➢ Müfredat ne isterse onu öğrenmelidirler cevabını verirse, müfredattaki her şeyi öğrenmeli midir? Müfredatın ötesine geçilebilir mi?	
4	Sınıfınızda matematik başarısı çeşitlilik gösteren öğrencileri kapsayacak bir öğretim sunma noktasında, sizi endişelendiren veya zorlayan unsurlar nelerdir? • Bunların oluşmasındaki nedenler nedir?	

APPENDIX J. (Continued)

3. Görüşme		
No	Sorular	Açıklama/Cevap
1	Matematik başarısı yönünden farklılık gösteren öğrencilerin matematiği öğrenebilmesi için nasıl bir öğrenme - öğretme süreci gerçekleştirilmelidir? Neden?	
2	Sınıfınızdaki farklı seviyelerdeki öğrencilere nasıl bir matematik öğretim süreci gerçekleştiriyorsunuz? • Matematik öğretiminizin, sınıftaki tüm öğrencilerin akademik ve sosyal ihtiyaçlarını ne düzeyde karşıladığını düşünüyorsunuz? Sebepleri ile veya örnekleriyle açıklayabilir misiniz? ➢ (Yeterince derin cevap alamadığım durumda) Sizce, öğretiminiz en çok hangi seviyedeki öğrencilerin akademik ve sosyal ihtiyaçlarını karşılıyor? Neden böyle düşünüyorsunuz?	
3	Sınıfınızda, özellikle öğrenme güçlüğü yaşayan veya üstün yetenekli ve başarılı öğrenciler veya farklı özel öğretim ihtiyacı olan öğrenciler (ör. engelli öğrenciler veya anadili Türkçe olmayan öğrenciler) için, hangi farklı öğretim uygulamaları yapıyorsunuz? Örnekleri ile açıklayabilir misiniz? • Ölçme değerlendirme araçlarında hangi değişikliği yapıyorsunuz? Örnekleri ile açıklayabilir misiniz?	
4	Sınıfınızda özel eğitim ihtiyacı olan öğrenciler bulunmasa bile, farklı başarı düzeyindeki öğrenciler için öğretiminizi ve ölçme değerlendirme sürecinizi nasıl farklılaştırıyorsunuz? ➢ (Detaylandırmak için) Öğretiminizi, öğrencilerinizin ilgilerine göre nasıl farklılaştırıyorsunuz? ➢ (Detaylandırmak için) Öğretiminizi, öğrencilerinizin hazırbulunuşluk düzeylerine göre nasıl farklılaştırıyorsunuz? ➢ (Detaylandırmak için) Öğretiminizi, öğrencilerinizin öğrenme stillerine göre nasıl farklılaştırıyorsunuz?	

APPENDIX K. CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: NAMLI, Şenol
Nationality: Turkish (TC)
Date and Place of Birth: [redacted]
Marital Status: Married

EDUCATION

Degree	Institution	Year of Graduation
MS	Akdeniz University Elementary Education, Antalya	2016
BS	Anadolu University Public Management	2012
BS	METU Elementary Mathematics Education, Ankara	2010
High School	Göl Anatolian Teacher High School, Kastamonu	2005

WORK EXPERIENCE

Year	Place	Enrollment
2016- Present	Bozok University, Faculty of Education, YOZGAT	Research Assistant
2010 - 2016	Ali Mumcu Middle School Elmalı/ANTALYA	Mathematics Teacher

FOREIGN LANGUAGES

Advanced English, Beginner German

INTERNATIONAL PRESENTATIONS

1. Taş, T., **Namlı, Ş.**, & Gezer, U. (2023). 'But that is also not quite right': Social justice from the lenses of prospective teachers. In *Proceedings of the 10th International Eurasian Educational Research Congress* (pp. 1038-1039) [Abstract].

2. **Namlı, Ş.**, & Sungur, S. (2022). Kaynaştırma eğitimine tabi olan ortaokul öğrencilerinin matematik dersindeki motivasyon yönelimleri [Motivational orientations of middle school students in mathematics classes under inclusive education]. In *Proceedings of the International Education Congress 2022* [Abstract].

3. **Namlı, Ş.**, & Özçakır, B. (2021). Ortaokul matematik ders kitaplarında yer alan matematik görevlerinin bilişsel istem basamaklarına göre sınıflandırılması [Classification of mathematical tasks in middle school mathematics textbooks according to cognitive demand levels]. In *Proceedings of the 5th International Turkish Computer and Mathematics Education Symposium (TÜRKBİLMAT-5)* [Abstract].

4. **Namlı, Ş.**, & Çakıroğlu, E. (2020). Kapsayıcı matematik eğitimine yönelik bir mesleki gelişim seminerinin literatür temelli içerik tasarımı [A literature-based content design of a professional development seminar on inclusive mathematics education]. In *Proceedings of the 2nd International Congress on Educational Research at Izmir Democracy University* [Abstract].

5. Özçakır, B., Özdemir, D., **Namlı, Ş.**, & Ayan, R. (2018). Artırılmış gerçeklik destekli matematik eğitimi tutum ölçeğinin geliştirilmesi: Geçerlik ve güvenirlik çalışması [Development of an augmented reality-supported mathematics education attitude scale: A validity and reliability study]. In *Proceedings of the 2nd International Conference on Distance Learning and Innovative Educational Technologies* [Abstract].

6. **Namlı, Ş.**, & Özçakır, B. (2018). Middle school students' transition from arithmetic to algebra in the context of equation problems. In *Proceedings of the International Conference on Mathematics and Mathematics Education (ICMME-2018)* [Abstract].

7. **Namlı, Ş.**, & Adilov, G. (2018). The effect of Sudoku, Futoshiki and Kakuro puzzles on 8th grade students' achievement on equality and inequality subjects. In *Proceedings of the International Conference on Mathematics and Mathematics Education (ICMME-2018)* [Abstract].

8. **Namlı, Ş.**, & Özçakır, B. (2018). Ortaokul öğrencilerinin trigonometri ile ilgili matematik konularında problem çözme yolları [Middle school students' problem-solving approaches in mathematics topics related to trigonometry]. In *Proceedings of the 10th International Congress on Educational Research* [Abstract].

9. Coşkun, T. T., Alan, H. A., Yılmaz Tüzün, Ö., Karacı, G., **Namlı, Ş.**, & Yılmaz, A. (2017). Who decide what to buy in toystores? In *Proceedings of the 5th International Congress on Early Childhood Education* (pp. 347-348). [Abstract].

NATIONAL PRESENTATIONS

1. **Namlı, Ş.**, & İşler Baykal, I. (2021). Ortaokul matematik öğretmenlerinin kaynaştırma eğitimine yönelik görüşleri [Middle school mathematics teachers' views on inclusive education]. In *Proceedings of the 14th National Science and Mathematics Education Congress* [Abstract].

BOOK / BOOK CHAPTER

1. Namlı, Ş. (2023). Psikolojik testlerin sahip olması gereken nitelikler – Geçerlilik [Qualifications that psychological tests should have – Validity]. In M., Filiz, A. Ç. Özdoğan & Koldaş, M. (Eds.) *Psikolojik testler* [Psychological Tests]. Eğiten Kitap.

PROJECTS

1. İslim, Ö. F. (Principal Researcher), Özçakır, B. (Researcher), Uluay, G. (Researcher), **Namlı, Ş.** (Scholar), Özkubat, U. (Researcher), Solmaz, E. (Researcher), Öğdem, Z. (Researcher), Çırak, N. S. (Researcher), & Sanir, H. (Researcher). (2021-2023). Öğrenme güçlüğü yaşayan ortaokul öğrencilerinin fen bilimleri ve matematik öğretiminin artırılmış gerçeklik ile desteklenmesi [Augmented reality support for science and mathematics education of middle school students with learning difficulties]. TÜBİTAK 3501 Project.

2. Şen, C. (Principal Researcher), Güler, G. (Researcher), **Namlı, Ş.** (Researcher), & Yüce, S. (Researcher). (2021-2023). Cebir öncesi dönemdeki öğrencilerin cebirsel düşünce gelişimlerinin incelenmesi [Investigation of pre-algebra students' development in algebraic thinking]. Scientific research project supported by Higher Education Institutions.

3. Özçakır, B. (Principal Researcher), İslim, Ö. F. (Researcher), **Namlı, Ş.** (Researcher), & Konca, A. S. (Researcher). (2018-2019). Ortaokul matematiğine yönelik problem çözme ve arttırılmış gerçeklikle eğitsel oyun uygulamaları [Problem solving and augmented reality educational game applications for middle school mathematics]. Scientific research project supported by Higher Education Institutions.

APPENDIX L. TURKISH SUMMARY / TÜRKÇE ÖZET

GİRİŞ

Bir sınıfta öğrencilerin önceki matematik öğrenme deneyimleri, okul ortamına aşinalıkları, öğrenmeye hazır olma durumları ve matematik kavramlarını kavrama yetenekleri gibi çeşitli akademik yönlerden farklılıklar gösterdiğini düşünün. Bu sınıftaki matematik öğretmeninin hedefleri, özellikle bazı sınıf prosedürleriyle henüz tanışık olmayan öğrencilere yardımcı olmak için tüm öğrencileri yararlı öğrenme faaliyetlerine dahil etmektir. Öğretmen, her öğrencinin başarı elde etmesini, yeni öğreneceği konuyu mevcut bilgilerine bağlamasını, gelecekteki konular için hazırlanmasını ve sınıf arkadaşlarıyla kullandıkları yöntemler ve tamamladıkları işler hakkında grup tartışmalarına katılmasını istemektedir. Ancak, akademik olarak çeşitlilik gösteren öğrencilerin yer aldığı sınıflarda matematik öğretmek öğretmenler için karmaşık bir görevdir. Akademik olarak çeşitlilik gösteren öğrencilerin yer aldığı sınıflarda öğretimin karmaşıklıklarını tartışmadan önce, homojen sınıf ortamının ne olduğunu anlamak önemlidir.

Öğrencilerin benzer yetenek veya başarı düzeylerine göre ayrı sınıflarda gruplandırılması, Yetenek Gruplandırması veya homojen gruplandırma olarak tanımlanmaktadır (Boaler, 2020). Bu ayrım tek bir sınıf içinde gerçekleşebileceği gibi, birden fazla sınıfı da kapsayabilir. Yetenek gruplandırması bazı ülkelerde yaygın olmakla birlikte (örneğin, Amerika Birleşik Devletleri'nde 'tracking', İngiltere'de 'setting' olarak kullanılmaktadır), birçok Avrupa ve Asya ülkesi yetenek gruplandırması uygulamasından uzaklaşmaktadır (Boaler, 2020).

Örneğin, uluslararası sınavlarda (örneğin, TIMMS ve PISA) en başarılı ülkelerden biri olan Finlandiya, yetenek gruplandırmasının eşitlik arayışına engel teşkil ettiği görüşünü benimsemektedir (Sahlberg, 2011). Benzer şekilde, Japonya'da da zorunlu eğitim süresince, dokuz yıl, öğrencilerin akademik yeteneklerinin veya kapasitelerinin ölçülmemesi gerektiği konusunda güçlü bir fikir birliği bulunmaktadır (Bracey, 2003).

Homojen sınıf sisteminin savunucuları, alt akademik seviye sınıflarda müfredatın ve öğretimin iyileştirilmesi ve öğrencilerin daha adil yöntemlerle yerleştirilmesi sayesinde, homojen sınıf sisteminin düşük performans gösteren öğrenciler üzerindeki olumsuz etkilerinin azaltılabileceğini savunmaktadır (Gamoran & Weinstein, 1998; Hallinan, 1994; Loveless, 1998). Ayrıca, öğretmenler bu gruplarda öğrencilere daha uygun konular ve görevler verebileceklerine inanıyorlar, ancak pek çok öğrenci kendilerine verilen işlerin uygun derecede zorlayıcı olmadığını — "genellikle çok kolay olduğunu" — belirtmektedir (Blatchford vd., 2008). Benzer şekilde, Nunes ve diğerleri (2009) yetenek gruplandırmasının öğrencilerin ilerlemesini engellediğini belirtmektedir. Ayrıca, bazı öğrencilerin yararına, diğer öğrencilerin zararına olan bu sistem, düşük ve orta seviye grup öğrencilerinin akademik başarısını olumsuz etkileyip, yüksek başarı gösteren öğrencilerin akademik başarılarını belirgin bir şekilde etkilememektedir.

Bunun yanında, karma yetenek gruplaması veya heterojen gruplama, farklı beceri ve yeteneklere sahip öğrencilerin aynı okulda veya sınıfta bir araya getirildiği bir öğretim stratejisidir. Heterojen sınıflar, sadece yetenekler açısından değil, ilgi alanları, kültürel geçmişler ve öğrenme stilleri açısından da çeşitli öğrenci gruplarını içerir. Bu tür sınıflar, ileri düzey öğrencilerden belirli derslerde veya genel akademik performanslarında zorluk yaşayan öğrencilere kadar geniş bir öğrenen yelpazesini kapsayabilir. Yetenek gruplandırması veya homojen sınıf sistemine kıyasla, karma yetenek gruplaması daha kapsayıcı bir eğitim sağlar ve öğrenciler arasında akran öğrenimi ve iş birlikçi etkileşimler için fırsatlar sunar. Ayrıca, heterojen veya karma yetenek grupları, tüm seviyelerdeki öğrencilere destek olan, daha adil bir öğrenme ortamına katkıda bulunur (Boaler, 2008; 2020). Gabaldón-Estevan (2020) tarafından yapılan bir inceleme çalışması, çocukların dışlama ve çeşitlilikle ilgili deneyimlerinin arkadaşlık tercihlerini önemli ölçüde etkilediğini göstermektedir. Bu, öğrenci çeşitliliğine sahip okulların, kapsayıcılığı daha fazla benimseyen bir okul toplumu oluşturduğunu ima etmektedir. Heterojen ve homojen grup uygulamaları, Matematik eğitimi bağlamında değerlendirildiğinde; Askew ve Wiliam (1995) tarafından yapılan birden fazla çalışmanın gözden geçirilmesinde, matematikte daha yüksek seviye gruplarının, eğitim materyallerinin özellikle onlar için kişiselleştirildiğinde performanslarının arttığı gözlemlenmiştir. Bu nedenle, uygun öğretim kaynakları kullanılmadığında, öğrenci gruplandırmasının akademik başarıları üzerindeki olumlu etkilerinin beklenmemesi gerektiği sonucu çıkarılabilir. Ayrıca, homojen öğrenci gruplandırmasının etkisiz olmasının olası bir nedeni, öğretmenler arasında birbirine benzer bir öğrenci grubunu öğrettikleri varsayımının yaygın olması ve bu nedenle bu gruplar içinde görevleri farklılaştırmaya veya kişiselleştirmeye gerek duymamaları olabilir. Bu, bu gruplar içinde bile öğrenci farklılıklarının var olduğu ve dikkate alınması gerektiği gerçeğini göz ardı eder (Boaler, 1997). Buna karşılık, Černilec ve arkadaşları (2023) tarafından sunulan kanıtlar, matematik eğitiminde heterojen gruplandırmanın benimsenmesini savunmaktadır. Bu bulgu, Linchevski (1995) tarafından daha önce yapılan karşılaştırmalı çalışmalarla uyumlu olup, Linchevski'nin çalışması homojen gruplandırmanın matematik başarısı açısından önemli avantajlar sunmadığını bulmuştur. Aksine, heterojen ortamlardaki öğrenciler tutarlı bir şekilde üstün performans sergilemiştir (Boaler, 1997; Leonard, 2001). Burris vd. (2006) tarafından yapılan bir araştırma, homojen gruplandırmalardan heterojen gruplandırmalara geçiş yapan öğrencilerin, matematik derslerinde önemli ölçüde daha yüksek geçme oranlarına sahip olduğunu göstermiştir. Benzer şekilde, Venkatakrishnan ve Wiliam (2003) tarafından ortaokul düzeyinde yapılan bir çalışma, üst grup sınıflarda yer alan ve yüksek başarı gösteren öğrencilerin bu gruplardan minimal fayda sağladığını ortaya koymuştur. Ancak, farklı yeteneklerin aynı eğitim ortamında birleştirilmesi, özellikle düşük performans gösteren öğrenciler için öğrenci ilerlemesine önemli ölçüde olumlu etki yapmış, yüksek performans gösteren öğrencilere ise minimal dezavantajlar sunmuştur. Ayrıca, Nunes ve arkadaşları (2009) tarafından yapılan çalışmalar bu bulguları daha da desteklemekte olup, heterojen sınıflardaki öğrencilerin, matematiksel akıl yürütme testlerinde akranlarını geride bıraktığını göstermektedir.

Heterojen veya karma yetenekli sınıflarda, matematiksel olarak yüksek yetenekli öğrenciler, üstün yetenekli ve hediye edilmiş öğrenciler, hızlı öğrenenler, sınıf düzeyi beklentilerini karşılayan orta düzeydeki öğrenciler, yavaş öğrenenler, matematikte öğrenme güçlüğü çeken çocuklar, özel eğitime ihtiyacı olan öğrenciler ve engelli öğrenciler gibi çeşitli seviye ve kategorideki öğrenciler bulunabilir. Bu sınıf içi çeşitlilik, heterojen gruplandırmanın veya karma yetenek sınıflarının ötesine geçmektedir. Aslında bu çeşitlilik, kapsayıcı eğitim anlayışı ile uyumlu bir durumdur.

Kapsayıcı eğitim kavramı, engelli öğrencilerin genel eğitim sınıflarına yerleştirilmesinin ötesinde bir durumdur; eğitim sistemlerinin, tüm öğrenci çeşitliliğine daha uygun hale gelebilmesi için kapsamlı bir yeniden yapılandırılmasını içerir. Bu çalışmada, kapsayıcı eğitimin geniş tanımı dikkate alınmaktadır: sadece engelli bireyler veya özel eğitim ihtiyacı olanlar değil, aynı zamanda üstün yetenekli öğrenciler veya etnik olarak dışlanmış ya da ana dilinden başka dilde öğrenim gören öğrencileri de aynı sınıfta eğitim görebildiği bir sınıf ortamı kastedilmektedir. Bu çalışmada, heterojen sınıf veya karma yetenek gruplandırması hem yetenek hem de diğer yönler açısından herhangi bir sınırlama olmaksızın herkesin birlikte matematik öğrenebildiği bir ortam olarak görülmektedir ve kapsayıcı matematik eğitimini oluşturmayı hedeflemektedir. Heterojen sınıf, karma yetenek sınıfı veya kapsayıcı sınıf kavramları, farklı geçmişlere sahip öğrencilerin bir arada eğitim gördüğü ve tüm öğrencilere, yetenekleri, geçmişleri veya ihtiyaçları ne olursa olsun eşit eğitim fırsatları sağlayan ortamların oluşturulmasını ifade etmektedir.

Yukarıdaki açıklamalarda da görüldüğü gibi, öğrenci yetenek seviyelerine göre ayrılmış sınıflara kıyasla, matematik eğitiminin karma yetenek sınıflarında daha etkili olduğunu öne sürse de farklı düşünme tarzlarına ve yeteneklere, çeşitli öğrenme seviyelerine sahip öğrencileri tek bir sınıfta öğretmek, öğrencilerin çeşitli öğrenme ihtiyaçlarını karşılamak için önemli bir uzmanlık, dikkat ve beceri gerektirir (Mevarech & Kramarski 1997; Rubin 2008). Öğretmenler, tüm öğrencilerin değerli hissettikleri ve dışlanmadıkları bir ortam sağlamada hayati bir rol oynarken, çeşitlilik içeren öğrenci grubuna matematik öğretmek, eğitimcilerin öğretimsel, sistematik ve değerlendirme becerilerine sahip olmasını gerektirir. Ayrıca, öğretmeneler arasındaki iş birliği de önemlidir (Wang & Fitch, 2010; Wolfswinkler vd., 2014). Bu nedenle, çeşitlilik gösteren bir öğrenci grubuna matematik öğretmek ve geniş bir akademik ihtiyaç yelpazesine hitap eden eğitim ortamları oluşturmak zorlayıcıdır. Bu, özel bilgi, deneyim, beceri ve pozitif bir tutum gerektirir. Bu bağlamda, öğretmenlerin, heterojen veya kapsayıcı sınıflarda tüm öğrenciler için matematik eğitiminde başarıya ulaşmak için büyük bir çaba göstermeleri gerekmektedir. Rouse (2008) şu şekilde belirtmektedir:

> Etkili bir kapsayıcı eğitim geliştirmek, sadece öğretmenlerin bilgilerini genişletmekle ilgili değildir; aynı zamanda onları farklı şeyler yapmaya teşvik etmek ve tutum ve inançlarını yeniden gözden geçirmelerini sağlamakla da ilgilidir. Diğer bir deyişle, bu, 'bilme', 'uygulama' ve 'inanma' boyutları hakkında olmalıdır (s. 12).

1.1. Çalışmanın Amacı

Bu çalışmanın amacı, matematik başarısı yönünden bireysel farklılıkların görüldüğü ortaokul sınıflarında, matematik öğretimi konusunda matematik öğretmenlerinin bilgi, uygulama ve inançlarını araştırmaktır. Araştırmanın temel hedefiyle uyumlu olarak, çalışmayı yönlendiren aşağıdaki araştırma soruları şu şekilde belirlenmiştir:

i. Akademik olarak çeşitlilik gösteren öğrencilere matematik öğretmek, matematik öğretmenleri için nasıl bir deneyimdir?
ii. Ortaokul matematik öğretmenleri, akademik olarak çeşitli öğrencilere öğretim deneyimlerini nasıl algılar ve tanımlarlar?
iii. Ortaokul Matematik Öğretmenleri için akademik olarak çeşitli öğrencilere yönelik öğretimin anlamı, yapısı ve özü nedir?
iv. Ortaokul matematik öğretmenlerinin akademik olarak çeşitli öğrencilere yönelik bilgi, inanç ve uygulamaları ile yaş ve cinsiyetleri arasında bir ilişki var mıdır?

1.2. Çalışmanın Önemi

Erişilebilen alanyazın, öğretmenlerin görüşlerinin veya yansıtımlarının; öğretmen eğitim programlarının etkililiğini değerlendirme (Blake & Hanley, 1998; Barron, 2019; Rice, 2003), öğretmenlerin beceri ve bilgilerini geliştirme (Darling-Hammond, 2000; Schmidt vd., 2011) ve öğretmen değişimini kolaylaştırma (Chapman, 2016) gibi çeşitli boyutlarda kritik bir rol oynayabileceğini vurgulamaktadır.

Bu bilgiler ışığında, bu çalışmanın önemi şu şekilde özetlenebilir: Bu çalışmanın yararlanıcıları arasında akademisyenler, eğitim politikası yapıcıları ve özellikle farklı akademik yeteneklere sahip öğrencilerle ilgilenen matematik öğretmenleri yer almaktadır (Tomlinson vd., 2003). Bu araştırma, akademik olarak çeşitli yeteneklere sahip öğrencilerin matematik eğitimi alırken karşılaştıkları zorlukları ve bu bağlamda öğretmenlerin benimsediği yaklaşımları inceleyerek mevcut literatüre katkıda bulunmaktadır (Gervasoni & Peter-Koop, 2020; Helgevold, 2016). Çalışma, kapsayıcı eğitim kavramının giderek daha fazla benimsenip ana akıma girdiği bir dönemde güncel bir öneme sahiptir (Dweck, 2006). Çalışmanın bulguları, öğretmenlere heterojen sınıflarda farklı akademik seviyelerdeki öğrencileri daha etkili bir şekilde öğretebilmek için pratik yönergeler sunabilir (Wang & Fitch, 2010). Çalışmadan elde edilen bulgular, farklı akademik yeteneklere sahip öğrencilere matematik öğretiminde daha kapsayıcı bir eğitim sürecine katkıda bulunma potansiyeline sahiptir (Helgevold, 2016). Bu araştırma, ortaokul matematik müfredatını ve eğitim fakültelerinin müfredatını geliştiren politika yapıcılar için bir referans kaynağı olarak hizmet edebilir (NCTM, 2014).

ALANYAZIN

Bu çalışma temel olarak akademik çeşitliliğe sahip ortaokul sınıflarında matematik öğretimine odaklanmış olsa da çeşitli akademik ihtiyaçlara sahip öğrenci gruplarına özellikle yer verilmesi gerektiği düşünülmüştür. Bu nedenle, alanyazın kısmında; özel eğitim ihtiyacı olan öğrenciler ve özel eğitim, üstün yetenekli ve yetenekli öğrencilerin eğitimi ve dezavantajlı öğrenciler ve onların eğitimi hakkında literatür taraması sunulmuştur. Ayrıca, bu grupların matematik eğitimi ile ilgili çalışmalara da yer verilmiştir. Bunun ardından, kapsayıcı eğitim ve kapsayıcı matematik eğitimi üzerine yapılan araştırmaları hakkında bilgi sunulmuştur. Ayrıca, öğretmenlerin bilgileri, öğrencilere karşı tutumları veya sınıf uygulamaları ve inançları ile ilgili çalışmalar da ele alınmıştır. Fakat Türkçe özet kısmında bu bilgilerine detaylarına yer verilememiştir.

YÖNTEM

Bu çalışmanın yürütülmesi için karma yöntem tasarımı tercih edilmiştir. Creswell (2014) tarafından karma yöntem tasarımı, tek bir çalışma veya projede veri toplama ve analizi için hem nitel hem de nicel tekniklerin bütünleştirildiği bir araştırma yaklaşımına olarak tanımlanmıştır. Karma yöntem araştırma tasarımları çeşitli tasarım unsurları ile şekillendirilebilir. Bu çalışma, Christensen vd. (2015) tarafından önerilen sınıflandırmada yer alan 'Sıralı-NİTEL ağırlıklı' bir tasarımdır.

Araştırmanın veri toplama sürecinde, öncelikle araştırmacı tarafından 3 farklı ölçek geliştirmiştir. Öğretmen Öz-yansıtım ölçekleri olarak adlandırılan bu ölçekler; 19 maddeden oluşan inanç öz-yansıtım ölçeği, 15 maddeden oluşan bilgi öz-yansıtım ölçeği ve 19 maddeden oluşan uygulama öz-yansıtım ölçeği şeklindedir. Fakat tüm ülke genelinde veri toplama izni alınmış olmasına rağmen yeterince katılımcıya erişilemediği için ölçeklerle ayrıca veri toplaması yapılamamış olup sadece ölçek geliştirme aşamasında elde edilen veriler kullanılabilmiştir. Takiben yarı yapılandırılmış görüşme protokolü ile 5 farklı matematik öğretmeni ve bir özel eğitim öğretmeni ile mülakatlar gerçekleştirilmiştir. En son olarak da hem veri üçgenlemesi amacıyla hem de verilere derinlik katması açısından mülakata katılan matematik öğretmenlerinden birisinin ders anlattığı sınıfta gözlem gerçekleştirilmiştir.

Ölçeklerden elde edilen veriler nicel veri analizine tabi tutulmuştur. Nicel veri analizinde SPSS ve AMOS paket programı kullanılmıştır. Ölçek geliştirme aşamalarından olan geçerlilik ve güvenirlilik analizleri yapılmıştır (Seçer (2015). Diğer yandan, elde edilen tüm nitel veriler ise MaxQDA nitel veri analizi yazılımına aktarılarak, analizler MaxQDA üzerinden gerçekleştirilmiştir. Yarı yapılandırılmış görüşmelerin analizinde tümevarımsal analiz tekniği kullanılmıştır. Tümevarımsal analiz, verilerin elde edildiği grubun sembolik dünyasını anlayabilmek için, verilerin kodlanarak kategori, alt kategori ve temalara ayrılması, sonrasında ise kodlanan bu kategori, alt kategori ve temalar arasındaki ilişkilerin ortaya çıkarılması olarak ifade edilebilir (Patton, 2002).

BULGULAR

Bu çalışmanın amacı, ortaokul seviyesinde akademik olarak çeşitlilik barındıran sınıflarda matematik öğretimi konusunda matematik öğretmenlerinin bilgi, uygulama ve inançlarını araştırmaktır. Bu kapsamda öncelikle öğretmen öz-yansıtım ölçeklerinin geçerlilik ve güvenirliği ile ilgili bulgular sunulmuş olup ardından görüşme ve gözlemlerden elde edilen nitel verilerden elde edilen bulgular sunulmuştur. Öğretmen yansıtımlarına yönelik yorumlamalar yapılmıştır.

4.1. Öğretmen Öz-Yansıtım Ölçeklerinin Güvenirliliğine İlişkin Bulgular

Bu üç ölçek ile 442 ortaokul matematik öğretmeninden veri toplanmıştır. Ölçeğin iç tutarlılık düzeyleri ve madde-toplam korelasyonları SPSS 26 istatistik programı kullanılarak incelenmiştir. Verilerin güvenilirlik analizi sonucunda Cronbach alfa katsayıları 'Bilgi Ölçeği' için α=.951, 'Uygulama Ölçeği' için α=.875 ve 'İnanç Ölçeği' için α=.550 olarak bulunmuştur.

Bu sonuçlara dayanarak, Bilgi ve Uygulama ölçeklerinin güvenilirlik katsayılarının yeterince yüksek olduğu ve kabul edilebilir bir aralıkta yer aldığı görülmüştür (Seçer, 2015). Ancak İnanç ölçeği için güvenilirlik katsayısının düşük olduğu ve kabul edilebilir aralığın dışında kaldığı görülmektedir. Uygulama ve Bilgi ölçeklerindeki maddeler bu tür bir analiz için uygun olduğundan, bu ölçeklerden madde çıkarılıp çıkarılmayacağına açımlayıcı faktör analizi yapıldıktan sonra karar verilmesi uygun görülmüştür. İnanç ölçeği için, düşük güvenilirlik katsayısının nedenini belirlemek amacıyla madde-toplam korelasyonları incelenmiş, sorunlu maddelerin tek tek analizden çıkarılması ve bu işlemin alfa katsayısı yeterince yüksek bir seviyeye ulaşana ve daha fazla madde çıkarılması alfa katsayısına olumlu katkı sağlamayana kadar devam ettirilmesi uygun görülmüştür. Sonuç olarak, inanç ölçeğinin kalan sekiz maddesi (2, 6, 9, 10, 11, 12, 14 ve 17) için Cronbach alfa katsayısı .724 olarak belirlenmiştir.

4.2. Öğretmen Öz-Yansıtım Ölçeklerinin Yapı Geçerliğine İlişkin Bulgular

Yapı geçerliliğine ilişkin bulgular kapsamında öncelikle veri setinin örneklem büyüklüğü ve normalliğinin tespiti için Kaiser-Meyer-Olkin (KMO) ve Bartlett Testleri yapılmıştır. Takiben açımlayıcı faktör analizi ve doğrulayıcı faktör analizi gerçekleştirilmiştir.

Yapılan analizler sonucunda; veri setinin örneklem büyüklüğünün her üç ölçek için de yeterli olduğu ve normal dağılım gösterdiği sonucuna ulaşılmıştır.

Yapılan doğrulayıcı faktör analizi sonuçlarına göre ‘uygulama öz yansıtım ölçeği’ ve ‘bilgi öz-yansıtım ölçeği’ faktör yapısının bir model olarak doğrulanamamıştır. Bu sebeple özet kısmında inanç öz-yansıtım ölçeğine ilişkin yapı geçerliliği bulgularının sunulması uygun görüşmüştür.

4.2.1. Yapı Geçerliğine İlişkin Bulgular: İnanç Öz-Yansıtım Ölçeği

8 maddeden oluşan ölçeğin örtük yapısını ortaya koymak amacıyla yapılan açımlayıcı faktör analizinde SPSS 26 paket programı kullanılmıştır. Faktör yapısını ortaya çıkarmak için; açıklanan varyansların toplam değerleri, birikinti-yamaç grafiği ve Paralel analiz (Watkins, 2000) bulguları bir arada değerlendirilmiş ve İnanç Öz-yansıtım ölçeğinin 4er maddeden oluşan 2 faktörlü bir yapıya sahip olduğu ortaya çıkartılmıştır.

Takiben; örtük yapısı ortaya konulan inanç öz yansıtım ölçeğinin doğrulayıcı faktör analizleri AMOS 22 paket programı ile yapılmıştır. Analiz sonucu çıkan bulgulara göre, model uygunluk indeksleri gerekli standartları karşılamaktadır. Sonuç olarak, 8 maddelik İnanç öz yansıtım Ölçeğinin iki faktörlü yapısının bir model olarak doğrulandığı söylenebilir. Birinci derece çok faktörlü modelin doğrulanmasının ardından, ikinci derece çok faktörlü model için analizler yapılmıştır. Ancak, ikinci derece çok faktörlü yapının bir model olarak uygun olmadığı belirlenmiştir. Sonuç olarak, birinci derece çok faktörlü modelin kullanılması uygun bulunmuştur.

İlk faktör, 2., 6., 10. ve 12. maddeler oluşmakta ve madde havuzu oluşturma sırasında kullanılan "Tüm çocuklar öğrenebilir" ve "eğitilmeye değerdir" alt kategorileri ile ilgilidir. Bu faktörün "Eğitim Hakkına İlişkin İnançlar" olarak adlandırılmasının uygun olacağına karar verilmiştir.

İkinci kategori altında gruplanan 9., 11., 14. ve 17. maddeler, daha önce bahsedilen madde havuzu alt kategorilerinden "Uyarlama ve Düzenleme" alt kategorisi ile ilişkilidir. Bu nedenle, bu faktör için "Öğretimi Farklılaştırmaya İlişkin İnançlar" adının uygun olacağı belirlenmiştir.

4.3. Mülakatlar ve Sınıf Gözlemlerinden Elde Edilen Bulgular

Heterojen sınıflarda kapsayıcı eğitim sunmaya yönelik matematik öğretmenlerinin bilgi, inanç ve öğretim uygulamalarına yönelik öz-yansıtımlarını ortaya çıkarmayı amaçlayan bu araştırmanın nitel verileri, araştırmacı tarafından geliştirilmiş olan yarı yapılandırılmış görüşme formu ile toplanmıştır. Yarı yapılandırılmış görüşme formu akademik çeşitlilik barındıran bir örnek sınıf durumu ile başlayan ve toplamda 3 kısım ve 11 sorudan oluşmaktadır. Görüşmeler matematik öğretmenleri ile bire bir gerçekleştirilmiş olup, toplamda her bir görüşme süresi bir buçuk saat ile üç saat arasında değişmiştir. Katılımcının izni dahilinde ses kaydı alınmıştır. Uzun emek ve zaman gerektiren ses kayıtlarının yazılı dökümü yapılmıştır. Yazılı dökümler (transkriptler) MaxQDA nitel veri analiz programı yardımıyla analiz edilmiştir.

Görüşmelerin analizi sürecinde sırasıyla şu aşamalar takip edilmiştir: i) ilk okuma ve not alma, ii) açık kodlama, iii) kodların kategorize edilmesi, iv) temaların belirlenmesi ve v) yorumlama ve bağlantı kurma. Görüşme verileri, sınıf gözlemlerden elde edilen verilerle gerektiğinde desteklenmiştir. Görüşmeler ve sınıf gözlemlerinden elde edilen veriler sekiz farklı tema altında toplanmıştır ve bunlar aşağıdaki gibidir:

- Öğretmen Yaklaşımları,
- Müfredat,
- Öğrenci Çeşitliliği,
- Öğretimin Farklılaştırılması,
- Matematiğin Doğası,
- Aile,
- Eğitim Sistemine Eleştiri,
- İnançlar.

4.3.1. Öğretmenlerin Öğrenci Çeşitliliği Hakkındaki Yansıtımları

Matematik öğretmenlerinin öğrenci çeşitliliğine dair görüşleri farklılaşmaktadır; katılımcılar arasında, özel eğitim gereksinimi olan veya engelli bir öğrencinin genel eğitim sınıflarından çıkartılıp özel eğitim sınıflarına veya daha da ileri gidip özel eğitim okullarına gönderilmesi gerektiğini düşünen öğretmen var. Aksine matematik dersinde akademik bir gelişme sağlanmasa bile öğrencinin sınıf ortamında kalması gerektiğini ve arkadaş sevgisi veya oyun oynamak gibi sosyal ihtiyaçlarının giderilmesi gerektiğini düşünen öğretmenler de mevcut. İkinci grupta yer alan öğretmenler okulun sadece bilgi aktarmak veya matematik öğretmekten ibaret olmadığını daha geniş bir misyonu olduğunu savunmaktadır. Özel eğitim ihtiyacı olan veya zor öğrenen öğrencilerin genel eğitim sınıflarında kalmasını ama şartlar sağlanabilirse 'gölge öğretmen'in sınıf içerisinde o öğrenciye destek olmasını veya bu sağlanamıyorsa destek eğitim odasında mümkünse özel eğitim öğretmeni desteği ve iş birliğiyle öğrencinin bireyselleştirilmiş eğitim programı doğrultusunda desteklenmesi gerektiğini öneren öğretmen görüşleri de sunulmuştur.

Akademik çeşitliliğin öbür tarafından bakıldığında, üstün yetenekli ve başarılı tanısı konulmuş bir öğrencinin de genel eğitim sınıflarında engelli veya öğrenme güçlüğü yaşayan bir öğrenci kadar zorlandığı görüşü hakimdir. Matematik öğretmenlerinin hepsinin ortak bir kanıya vardığı nokta öğretimlerinin "Ortalama Seviye Yaklaşımı" şeklinde olduğudur. Öğretmenler, öğretim sürecinin genelinde çoğunluğa yönelik ders anlatım süreci gerçekleştirildiği için örnek sınıftaki Başak gibi bir öğrencinin giderek sınıfta yalnızlaştığını, merak ve ilgisi tatmin edilemediği için motivasyon kaybı yaşadığını belirtmişlerdir. Basitten zora doğru sorulan ve çözülen problemler veya somuttan soyuta doğru ilerleyen materyal kullanımı eğilimi üstün yetenekli ve başarılı bir öğrencinin derse katılım sağlamasının ve ortak sınıf kültürüne adapte olmasını zorlaştırdığı hususu öğretmenler tarafından değinilmiştir. Zenginleştirilmiş Eğitim Programı kapsamında Destek Eğitim Odasında uygun şartlar sağlanarak yetenekli ve başarılı öğrencilerin için ekstra ve farklılaştırılmış bir içerek sunulabileceğini öneren öğretmenler olmuştur. Fakat bazı velilerin bu uygulamayı suistimal ettiğini ve destek eğitim odasında çocuğuna özel ders alıyormuşçasına davranılmasını talep ettiğini belirten öğretmenler de olmuştur. Ayrıca üstün yetenekli ve başarılı öğrenciler için eğitim sunan Bilim Sanat merkezinde görev yapan matematik öğretmeni, üstün yetenekli ve başarılı öğrencilerin tanılanmasında ve seçilmesinde hatalar olduğunu belirtmiştir. Tanılama ve seçmenin gerçekçi bir şekilde yapılabilmesi durumunda bu öğrenciler için ayrı bağımsız eğitim kurulması gerektiğini ve ayrı müfredat hazırlanarak sınav kaygısı olmayan bir öğretim almaları gerektiğini savunmuştur. Bu öğrencilerin hem akademik olarak hem de mesleki kariyerleri bakımından yönlendirilmesi noktasında gerek rehberlik servisi gerekse uzman personelin iş birliği yapması gerektiği belirtilen hususlardan birisidir. Matematik öğretmenleri, bu öğrenciler için sınıf içerisinde 'Yeni Nesil Sorular' olarak belirtilen ve daha çok analiz yeteneği, problem çözme becerisi ve mantıksal muhakeme gerektiren beceri temelli soruların kullanılması gerektiğini ifade etmişlerdir. Fakat burada sınıf dengesini bozmamak adına sürekli bu problemlerin çözülmesinin sınıfın geri kalanının zorlanacağı ve kapsayıcılığın sağlanamamasına sebep olacağı aktarılmıştır.

Sınıftaki yalnızca akademik değil kültürel çeşitliliğe de sebep olan bir diğer unsur olarak da mülteci öğrenciler ile ilgili öğretmen görüşleri elde edilmiştir. Mülteci öğrenciler ile ilgili görüşlerin arka planında matematik öğretiminin dışında kalan unsurların olduğu anlaşılmıştır. Öğretmenler arasında mülteciliğin genel olarak ülke çapında sorunlara sebep olduğunu belirtenler vardı. Diğer yandan öğrenci ilgisinin ve matematik yapma isteğinin, mülteci öğrencilerin matematik öğrenmesindeki diğer bir unsur olduğunu belirtilirken başka bir öğretmen matematik dersinde o öğrencilerin Türkçe bilmemesinden dolayı ilerleme kaydedilemediğini belirtti.

4.3.2. Öğretmenlerin Heterojen Sınıflar Hakkındaki Yansıtımları

Çeşitli akademik başarı düzeylerine sahip öğrencilerin heterojen bir sınıfta bir arada yer almasına ve öğrenim görmesine yönelik farklı veya örtüşen öğretmen görüşleri olmuştur. Öğretmenler özellikle uçlarda yer aldığını belirttikleri özel eğitim gereksinimi olan öğrencilerin müfredatta yer alan matematik konularının tamamını asla öğrenemeyeceğini ve bu sebeple sınıf düzeyindeki etkinliklerin gerisinde kalacağı konusunda hem fikirlerdiler. Bu öğrencilere ekstra zaman ayırma isteği olan öğretmenler bile belli bir aşamadan sonra bu öğrencilerin öğrenemediğini görmelerinden dolayı ve sınıf içerisinde dengenin sağlanması açısından vazgeçtiğini belirttiler. Özellikle özel eğitim gereksinimi olan öğrencilerin ders içi etkinlikleri yapamayacağı ve onların ders dışında destek almaları gerektiği görüşü hakimdi. Kaynaştırma eğitimine tabi olan öğrencilerin yasal zorunluluk gereği bireyselleştirilmiş öğretim planı doğrultusunda öğrenim görmeleri, öğretmenin o plan doğrultusunda öğrenciye özgü çalışmalar hazırlaması gerektiğini bildiklerini belirtmişlerdir. Fakat, öğretmenler bu planı ya hazır matbu bir şekilde elde ettiklerini ve bu planı takip etmediğini ya da kendileri hazırlasa bile zaman yönetimi açısından sınıf içerisinde tamamını etkin bir şekilde uygulayamadığını belirten öğretmenler olmuştur. Öğretmenlerden bir tanesi örnek sınıftakine benzer öğrencilerinin olduğunu belirti ve öğrencinin başarısızlığının altında yatan sebebin aslında ailevi problemler olduğunu ve herhangi bir engel tanılama veya kaynaştırma eğitimine yönlendirmenin yapılmadan önce öğrencinin ailesi ile iletişime geçilmesinin ve Rehberlik servisi gibi, sınıf öğretmeni ile görüşme gibi destek yapıları vasıtasıyla öğrencinin öğretim sürecine kazandırılması gerektiğini ve matematik dersinde bireyselleştirilmiş eğitim planının olup olmamasına göre matematik öğretiminin şekilleneceğinden bahsetti. Özel eğitim öğretmeni olan katılımcı, öğrencinin en az kısıtlayıcı ortam olan genel eğitim sınıfında matematik eğitiminin belki daha yavaş olacağını ama sosyal gelişiminin daha hızlı olacağını belirtti. Özel eğitim öğretmeni olan katılımcının değindiği bir diğer husus ise bu öğrencilerin kaynaştırma eğitimi kapsamına alınmasının ve başarı sağlanmasının bir ekip işi olduğu; aile, arkadaş idare herkesin katkı vermesi gerektiğidir. Matematik öğretmeni elinden geldiğince çabalasa da tek başına istenilen arzu edilen başarı sağlanamayacağını belirtti. Burada belirtilen hususlar göz önünde alındığında heterojen bir sınıfta başarısı düşük veya özel gereksinimli bir öğrencinin derse katılımı için en başta öğretmenin kendisi olmak üzere diğer paydaşların da katkısı olmalıdır.

Bir diğer yandan, Öğretmenler üstün yetenekli ve başarılı öğrencilerin için heterojen bir sınıf içerisinde öğrenim görmesinin, öğrencilerin tatmini açısında zor olduğunu bildiklerini fakat hem müfredat sınırlaması hem de sınıf içi dengeyi sağlayamama çekincelerinden dolayı öğretimi onları merkeze alacak şekilde yapmadıklarını belirtti. Bu konuda öğretmenler bu seviyedeki öğrenciler için ‘farklı ve zorlayıcı’ kaynakların belirlenerek bu öğrencilerin matematik öğretimin sürecinden kopmamalarının sağlanabileceğini belirtti.

Öğretmenler heterojen sınıfta matematik öğretiminin zorluğunu belirmiş olmalarına rağmen ‘Seviye Sınıfı’ oluşturmasına da çeşitli sebeplerle karşı çıkmışlardır. MT İsmail seviye sınıfı oluşturulmasını desteklemesine rağmen, en alt seviyedeki sınıflarda ders vermek zorunda kalması sebebiyle ve o öğrencilerle ders işlemenin onu tatmin etmemesinden dolayı bu durumdaki öğrencilere yaklaşımının değiştiğini belirtti. Ayrıca üst seviye olarak tabir edilen sınıfta da etkinlik, problem temelli öğrenme gibi daha öğrenci merkezli yaklaşımların uygulanmadığını, aksine ‘daha fazla test sorusu çözmek' amacının olduğunu belirtti. Diğer yandan, MT Safiye seviye sınıfı uygulaması ile alt seviyedeki sınıftaki öğrencilere yönelik 'beklentiyi düşürme' eğiliminden dolayı sınıflar arası başarı uçurumunun daha da artacağını; üst seviyedeki sınıfın yararı için alt seviyedeki sınıfta yer alan öğrenciler kurban edileceğini belirtti. Diğer yandan MT Merve ise seviye sınıfı uygulamasında üst düzey sınıfta derse girmenin, öğrencilerin 'yüksek beklentilerini tatmin edememe' veya öğrencilerin talepleri karşısında bazen 'yetersiz kalma' durumları ile karşılaşacağı için seviye sınıfı oluşturulmasını istemediğini belirtti. Bu açıklamalar doğrultusunda homojen sınıf oluşturulmasına öğretmenlerin karşı olduğu ortaya çıkmıştır. Ayrıca homojenlik sağlanılmaya çalışılsa bile hiçbir şartta bütün öğrencilerin matematik başarısı yönünden özdeş olacağı bir ortam oluşturulamayacağı görüşü de öğretmenler tarafından desteklendi. Homojen bir sınıfta bile öğrencilerin 'sosyal geçmişleri', farklı yaşanmışlıkları olacağı için farklılaşma devam edeceği belirtildi.

Bir diğer açıdan bakıldığında ise, öğretmenlerin görüşleri doğrultusunda heterojen sınıfta eğitim görmenin hem olum tarafları hem de olumsuz yönleri olduğu ortaya çıktı. MT İsmail, heterojen sınıfların özellikle daha düşük seviyedeki öğrenciler için faydalı olduğunu düşünürken, ancak aynı zamanda daha yüksek seviyedeki öğrencileri aşağı çekebileceğini ifade etmiştir. MT Safiye heterojen sınıfın olumsuz yönlerine değinirken 'öğretmen tükenmişliğine' ve 'ders planlamasının zorluğuna' vurgu yaptı. MT Merve, heterojen sınıfların öğrenciler için en iyi yanının, öğrencilerin kendilerini 'yalnız hissetmemesi' olduğunu belirtti. Öğrencilerin, sınıfta farklı başarı seviyelerine sahip diğer öğrencilerle birlikte olmaları, kendilerini yalnız hissetmemelerine ve başarılarını diğerleriyle kıyaslayarak motivasyon kazanmalarına yardımcı olduğunu aktardı. Diğer yandan ise heterojen sınıfların öğretmenler için zorlayıcı yanını, 'hangi seviyeye göre ders anlatılacağını belirlemenin zorluğu' olarak gördü. Kendisinin, farklı akademik düzeylerdeki öğrencilere uygun materyaller hazırlarken ve hangi seviyede sorular çözeceğini kararlaştırma aşamasında zorlandığını ve 'verimlilik' sorununu aktardı.

4.3.3. Öğretmenlerin Müfredat ve Merkezi Sınavlar Hakkındaki Yansıtımları

Matematik öğretmenleri müfredatı yetiştirebilme kaygıları ve ders saatlerinin sınırlı olması nedeniyle akademik başarı yönünden çeşitliliğe sahip olan bir sınıfta farklı yeteneklere sahip öğrencilere (yetenekli ve zorlanan öğrencilere) tam olarak değinemediklerini görüşmeler içerisinde sıklıkla vurgulardır. Öğretmenler daha etkileşimli ve etkinlik temelli öğrenme ortamları sunmaya istekli oldukları ama bunu müfredatın sınırlamaları nedeniyle tam olarak gerçekleştiremediklerini aktardılar. Müfredatın katı yapısının öğretim süreçlerine etkisi ve özellikle sekizinci sınıfta, sınavlara yönelik müfredat baskısı nedeniyle müfredat dışı öğretim yaklaşımlarını uygulamada zorlanması ve müfredat dışına çıkarak öğretim sürecini zenginleştirmedeki zorluklarına değildiler. Müfredatın geçmiş yıllara göre sadeleştirildiği ve öğrenci merkezli öğretim süreçlerinin gerçekleştirilebilmesine fırsat tanınmış olabileceği belirtilse de yenilikçi yöntemlerin denenmediği ve geleneksel eğitim yöntemlerine bağlı kalma eğiliminden dolayı bunun başarılamadığı yönünde görüşler sunuldu. Bir diğer yandan müfredat gereği bir sonraki konuya geçmek zorunda kaldığı için bazı durumlarda öğrencilerin konuyu tam olarak anlayamadığını veya yapamadığını gözlemleyerek müfredat sınırlamasının olumsuz etkisini ortaya koyan görüşler de belirtildi. Diğer yandan Müfredatın her öğrencinin ihtiyaçlarına ve yeteneklerine göre esnek bir şekilde uyarlanması gerektiğini vurgulayan öğretmen görüşleri de vardı. Benzer şekilde meslek odaklı olacak şekilde müfredatların şekillendirilmesini öneren görüşler ve yorumlar sunuldu. Müfredatta nerelerin önemli olduğunu ve gerektiğinde müfredatı aşma noktasında nelere dikkat etmesi gerektiğini öğretmenlik mesleğindeki tecrübe ile geliştiğini belirten görüşler de sunuldu.

Matematik öğretmenlerinin müfredat ile ilgili görüşlerinin yanında bu konuyla doğrudan ilişkili ve heterojen sınıflarda kapsayıcı eğitim sunmayı doğrudan zorlaştıran bir unsurun da "Sınav Baskısı" olduğu yönünde yansıtımları oldu. Hatta öğretmenlerin müfredat ile ilgili görüşlerinin temelinde veya arka planında öğrencileri merkezi sınavlara hazır hale getirebilme kaygısının yattığı çıkarımı yapılabilir. Sınav baskısının hem öğrencilerin matematik öğrenimine hem de öğretmenlerin öğretim yaklaşımlarına doğrudan etki yaptığı fark edildi. Sınav odaklı eğitim sisteminin öğrencilerin matematik başarısı üzerindeki genel algıyı etkilediği ve merkezi sınavı kazanamayan bir öğrencinin genel olarak başarısız kabul edildiği şeklinde bir fikir beyan öğretmenler oldu. Eğitim sisteminin sınav odaklı yapısının, öğrencilerin farklı ihtiyaçlarına cevap verememe sorununu doğurduğu ortaya konuldu.

4.3.4. Öğretmenlerin Öğretmen Yaklaşımları Hakkında Yansıtımları

Katılımcı öğretmenler, müfredata ve merkezi sınavlara ilişkin yukarıda değinilen görüşlerini ek olarak, sınav odaklı öğretim yaklaşımı ve müfredat kısıtlamalarının nedeniyle matematik eğitiminde 'süreç odaklı' öğrenmeye vurgu yapılmadığını ve bunun da heterojen sınıflarda kapsayıcı eğitimi zorlaştıran bir faktör olduğunu belirtmişlerdir. Soruyu çözdü mü çözmedi mi, yazılıdan yüksek aldı mı almadı mı, iyi bir liseye yerleşti mi yerleşmedi mi gibi 'sonuç odaklı yaklaşımlara' yönelmek zorunda kaldıklarını aktaran öğretmenler oldu.

Bunun yanında; Öğretim stratejisi olarak sınıfın ortalama seviyesine göre ilerlemeyi tercih ettiklerini ve uçlardaki öğrencilere göre değil, çoğunluğun seviyesine uygun içerik sunmayı amaçladıklarını belirttiler. Farklı öğrenci gruplarına özel olarak yönelik bir eğitim yaklaşımı kullanmadığını ve sınıfın çoğunluğun müfredat beklentisini karşılamasın bir başarı kıstası olarak gören öğretmen görüşleri paylaşıldı. Bu sebeple sınıf içerisinde 'öğrenci farklılıklarına yanıt vermeme' sorunuyla karşılaştığını belirten öğretmenler de oldu. Benzer şekilde Ölçme Değerlendirmede sürecinde de 'Ortalama Seviye' olarak tabir ettikleri ve az miktarda çok kolay ve çok zor sorunun yer aldığını çoğunlukla da orta düzey zorlukta sorularla sınıf içi sınavları yaptıklarını belirttiler.

Öğretmemelerin görüşleri doğrultusunda, öğretmenlerin bazılarında 'sorumluluk reddi' olarak nitelendirebileceğimiz durum gözlemlendi. Öğrenci başarısızlığında veya sınıf içerisinde akademik uçurum oluşmasında, ilkokul öğretmeninin, ailenin ve hatta öğrencinin etkisinin öğretmene nazaran daha fazla olduğunu belirttiler. Öğretmenler lisans öğrenimleri süresince aldıkları eğitimlerin pratiğe dönüşümü konusunda eleştirilerde bulundular ve daha çok öğretmenlik uygulaması ve iş başında eğitim faaliyetlerinin önemini vurguladılar.

Gerek öğrenimleri sürecinde gerekse mesleki gelişim faaliyetleri ile bilgi ile donatıldıklarını ama sınıfta matematik öğretme noktasında bilgiyi uygulamaya dönüştürmekte zorlandıklarını hem matematik öğretiminde hem de heterojen sınıfta kapsayıcı eğitim sunmak için teoride iyi işleyen bilgilerin veya durumların, genel sınıf ortamındaki uygulamaya dönüştürülmesinin zorluğunu belirttiler. Öğretmenlik mesleğinin kazanılan tecrübelerle öğrenildiğinin önemini vurguladılar.

Fakat Matematik öğretiminde başarılı olabilmek için öğretmenin sürekli öğrenen olması gerektiği öğretmenler tarafından ortak bir şekilde sunulan görüştü. Fakat kendi matematik öğretimini geliştirmek istediği halde cesaret ve güç eksikliğinden dolayı veya ‘kapsayıcı matematik öğretimi sunmada yetersiz’ nedeniyle isteksiz davrandığını belirten öğretmen görüşleri de paylaşıldı. Öğretmenliğinin ilk yıllarında matematik öğretimlerinin öğrenci farklılığına yanıt veremeyip kendini geliştirmek için yeni öğretim yöntemleri arayışı içine girdiğini ve bu kapsamda özellikle de işin içine teknoloji entegrasyonunu da katarak öğretim ortamını farklılaştırmaya ve zenginleştirmeye çalıştığını belirten öğretmeneler de oldu.

Matematik öğretiminde kapsayıcı eğitim sunma noktasında en büyük engelin bir noktadan sonra ‘azalan öğretme motivasyonu’ olduğunu belirten öğretmenler de oldu. Gerçekleştirdiği matematik öğretiminin özellikle yavaş öğrenen veya özel eğitim ihtiyacı içindeki öğrencilerde karşılık bulmadığını, bu öğrencilere gerektiğinde bireysel destek sağladığı halde veya konuyu yer geldiğin tekrar tekrar anlattığı halde matematik öğrenmesinin gerçekleşmediğini veya temel konuların ötesine geçemediğini gördüğü için ‘mesleki tatmin/doyum’ sağlanamadığı için ‘tükendiğini’ belirten öğretmenler oldu. Diğer taraftan bakıldığında hızlı öğrenen veya başarılı ve üstün yetenekli öğrencilerin talepleri karşısında oluşan ‘yetersizlik’ hissinin de matematik öğretiminde verimliliğini azalttığını belirten öğretmenler olmuştu. Fakat öğretmenliğin sadece bilgiyi öğretmek veya nasıl edinileceğini göstermekten ibaret olmadığını öğrencilerin sosyal, duygusal psikolojik karakterlerini de değinilmesi gerektiğini belirten, öğrencilere değerli olduğunun hissettirilmesi gerektiğini yeri geldiğinde maddi manevi destek sağlanılması gerektiğini belirten öğretmen görüşleri de oldu.

4.3.5. Öğretmenlerin Öğretimi Farklılaştırmaya İlişkin Yansıtımları

Katılımcı Öğretmenler matematik öğretim sürecinde, sınav baskısı ve müfredatı tamamlama zorunluğundan dolayı, her zaman olmamakla beraber yeri geldiğinde içerikte, yeri geldiğinde öğrencinin sunacağı üründe farklılaştırmalar yaptıklarını belirtmişlerdir. Öğretmenlerle yapılan görüşmelerde, sorulan soruların kolaydan zora doğru gitmesini veya yavaş öğrenen öğrenci gruplarına kolay sorular veya kazanımlar içeren ekstra çalışma kâğıdı hazırlamayı veya üstün yetenekli öğrencilere ders sonunda birkaç adet zor diye nitelendirdikleri sorular sormalarını da öğretimi farklılaştırma kapsamında görmektedirler. Özelleşmiş kurumlarda çalışan MT-SAC Melek ve SET İbrahim, sınıflarında görece az sayıda öğrenci olduğu ve müfredat yetiştirme zorunlukların daha az olduğu ve sınav kaygısını daha az hissettikleri için ve ayrıca öğretimlerinin bireysellik esaslı olduğu için öğretim sürecinde farklılaşma yapmaya daha çok imkân bulabildiklerini aktardılar.

TARTIŞMA VE SONUÇ

Öğretimin odak noktası daha öğrenci merkezli bir yaklaşıma kaydığı için, akademik başarı yönünden çeşitlilik gösteren öğrencilerin bir arada öğrenim gördüğü bir sınıf içerisinde, farklı öğrenenlerin ihtiyaçlarına uygun olarak matematik öğretiminin nasıl yapılacağı hususunda öğretmenler nezdinde giderek artan bir talep vardır. Bu talepler, özellikle başarı skalasında farklı uçlarda yer alan engelli öğrencilerin ve üstün yetenekli öğrencilerin, hali hazırda farklı öğrenme hızlarına sahip olan öğrencilerin yer aldığı heterojen sınıflar içinde öğretimi söz konusu olduğunda daha da belirginleşmektedir. Matematik öğretimine, geleneksel olarak ardışık/kademeli becerilerin gelişimi bir başka ifadeyle yeni bir konunun tam olarak öğrenilebilmesi için önkoşul konuların öğrenilmek zorunda olması varsayımıyla yaklaşılmıştır. Bu durum da matematik müfredatı farklılaştırmanın daha zor olduğunun inanılmasına sebep olmuştur. Fakat, aslında Matematiğin büyük bir kısmı doğuştan gelen yetenekten ziyade doğru zamanda, doğru yerde doğru teşviklere sahip olmak ve doğru şekillerde pratik yapmakla ilgili olduğu için matematik öğretmenlerine bu noktada büyük görevler düşmektedir. Fakat kapsayıcı matematik eğitimi sunabilmek için öğretmenlerin sınıf içerisinde geçirdikleri süreci anlamak ve yaşadıkları sorunları/zorlukları belirleyebilmek önemlidir. Çünkü, başarılı bir matematik öğretimi sunabilmek için nelere ihtiyaç duyduklarını bilmek, çözüm önerileri sunma noktasında referans olacaktır. Bu kapsamda, mevcut çalışmada Ortaokul Matematik Öğretmenleri için, akademik olarak çeşitlilik gösteren öğrencilere öğretim yapmanın anlamının, yapısının ve özünün ne olduğu araştırılmış olup öğretmenlerin bu sınıflardaki öğretim tecrübelerini nasıl algıladıkları ortaya konulmaya çalışılmıştır. Çalışmanın bu bölümünde, elde edilen bulgular ilgili literatür ışığında tartışılacaktır. Ayrıca, bu bulgulara ve sonuca dayalı olarak gelecekteki araştırmalar için öneriler sunulacaktır.

5.1. Öğretim Yaklaşımları

İlk olarak tartışılacak olan bulgu matematik öğretim türüne yöneliktir. Öğretmenler sınıf içerisinde öğrenci çeşitliliğinin hem akademik olarak hem de sosyal olarak çok fazla olduğunu belirtmişlerdir. Bu sebeple ‘ortalamaya göre’ öğretim veya ‘çoğunluğa yönelik’ öğretim olarak adlandırdıkları öğretim gerçekleştirdiklerini belirtmişlerdir. Heterojen bir sınıfta matematik öğretim süreçlerini aktarırken; ‘Problem çözmeye yönelik öğretim (Schroeder & Lester, 1989)’ yaklaşımı içerisinde olduklarını belirttiler. Bu yaklaşım, öğrencinin daha sonra problem çözebilmesi için bir becerinin öğretilmesi olarak özetlenebilir. Problem çözmeye yönelik öğretim, genellikle soyut kavramın öğrenilmesiyle başlar ve daha sonra öğrenilen becerileri uygulamanın bir yolu olarak problem çözmeye geçilir. Ne yazık ki matematik öğretimine yönelik bu yaklaşım, birçok öğrenci için matematik kavramlarını anlama veya hatırlama konusunda başarılı olamamaktadır. Bazı katılımcı öğretmenler, öğrencilere bir dizi problemin nasıl çözüleceğini göstermenin öğrenciler için en faydalı yaklaşım olduğunu, zamandan tasarruf ederken zorluk yaşamayı önlediğini aktarmışlardır. Ancak öğrenmeye yol açan şey mücadeledir, dolayısıyla öğretmenlerin mücadeleyi ortadan kaldırma yönündeki doğal eğilime direnmeleri gerekir. Öğrencilere yardım etmenin en iyi yolu çok fazla yardım etmemektir (Lesh & Zawojewski, 2007). Özetle, Problem çözmeye yönelik öğretim aslında öğrencileri problem çözmede ve matematik yapmada daha iyi değil, daha kötü hale getirebilir. Bu sebeple katılımcı öğretmenlerin akademik çeşitliliğe cevap verememelerinin altında yatan sebep öğrencilere fırsatlar tanıyıp, özgür alan bırakmamalarından kaynaklanıyor olabilir.

Bir diğer yandan, engelli öğrencileri için özellikle de zihinsel engeli olan öğrenciler ve matematik öğrenme güçlüğü olan öğrencilere matematik öğretmek için yaygın olarak önerilen Sistematik Öğretim tekniğidir (Fuchs vd., 2011, Westwood, 2000).

Bu yaklaşım, doğrudan anlatım tekniğinden farklı olarak; yapılandırılmış bir sınıf içerisinde, öğretmenlerin; hedefleri tanıtmak, önceden öğrenilen kavramları gözden geçirmek, yeni becerileri modellemek ve rehberli ve bağımsız uygulama sağlamak sistematik olarak belirli prosedürleri kullanarak matematik dersleri vermesi şekillinde tanımlanabilir (McKenna vd., 2015). Sistematik Öğretim, bazı matematik eğitimi araştırmacıları tarafından önemli bir yaklaşım olarak görülse de tek başına etkili olarak kabul edilmez; araştırmacılar, sayısal tekniklerde açık öğretimin yanı sıra stratejik düşünme ve akıl yürütme fırsatlarını içeren dengeli bir yaklaşım önermektedir (örneğin, Baroody, 2006, 2011). Baroody'e (2011) göre bu öğrenci grubuna yalnızca Sistematik Öğretim ile öğretim yapmak; öğrencilerden beklenen talebin düşmesine ve daha az çeşitlilikte fırsatların sunulmasına sebebiyet verecektir. Bu durumda da daha az beklenti, takiben daha az fırsat sunulması ardından daha da düşük beklenti şeklinde bir kısır bir döngü başlayacaktır.

Bu bilgiler ışığında katılımcı öğretmenlerin, özel eğitim gereksinimli olan öğrencilere yönelik sergilemiş oldukları, sınıf müfredatından farklı daha 'basit' içerikli ekstra çalışma kâğıdı hazırlama veya sadece 'seviyesine uygun' olduğunu belirttikleri problemlerde derse katılmalarını sağlamaları onlardan beklentilerinin düşük olduğunun göstergesidir. Bu süreçte takındıkları 'ayrıştırarak kaynaştırma' yaklaşımı, beklenen akademik matematik başarısının gelmemesine sebebiyet veriyor olabilir.

Bir diğer yandan katılımcı öğretmenlerin görüşleri üstün yetenekli çocukların gelişimi açısından değerlendirildiğinde öğretmenlerin sınıf içerisinde genellikle sadece konu sonunda yer alan 'zorlayıcı' diye nitelendirdikleri problemlerle derse kattıklarını belirtmişlerdir. Bu kapsamda üstün yetenekli çocukların okul yaşantısına ve öğrenme sürecine en çok etki ettiği görülen gelişimsel özellikler asenkronik gelişim, mükemmeliyetçilik ve aşırı duyarlılıktır faktörlerine dikkat edilmesi gerekmektedir (Uyaroğlu, 2022).

5.2. Öğrenci Çeşitliliği ve Heterojen Sınıflar

Katılımcı öğretmenler, Heterojen sınıflarda akademik çeşitliliğin olmasının bazı dezavantajlar barındırdığını aktardı. Bunlar şu şekilde sıralanabilir:

Özellikle maddi ve insan gücü kaynağının sınırlı olduğu okullarda, farklı ihtiyaç ve yeteneklere sahip öğrencilere uygun materyal ve destek sağlamak noktasında katılımcı öğretmenler zorlandıklarını belirten görüşler sundu. Buna ilaveten, bazı fiziksel engeller özel bir sınıf/okul yapılandırması (tekerlekli araba rampası, Braille alfabeli kitap vs.) gerektirdiği için bunun sağlanmasının zor olabileceği aktarıldı. Farklı akademik düzeylerdeki öğrencilerin bir arada bulunması, öğretmenler sınıf yönetimi ve disiplin hususlarında zorluklar yaşayabildiklerini aktardı (Hiperaktivite tanısı olan öğrenciler gibi). Ayrıca, mülteci öğrencilerle yaşanılan iletişim sorunlarının da heterojen sınıfların dezavantajlı yönlerinden birisi olduğunu vurguladılar.

Öğretmenler, tüm öğrencilere adil ve dengeli bir şekilde zaman ayırmanın zor olduğunu aktardılar. Bazı durumlarda, daha fazla desteğe ihtiyaç duyan öğrencilere odaklandıklarında diğer öğrencilerin ihmal edilmesi riskinin olacağını belirttiler. Daha düşük akademik seviyedeki öğrencilerin kendilerini diğer sınıf arkadaşlarıyla kıyaslayarak özgüven eksikliği yaşayabileceklerini yönelik öğretmen görüşleri de oldu. Bazı öğrencilerin ders içinde daha aktif katılım gösterdiklerini, diğerlerinin arka planda kaldığını ve bu durumun öğrenciler arasında etkileşim sorunlarına yol açtığını ifade eden öğretmen görüşleri oldu. Farklı akademik seviyedeki öğrenciler için adil ve etkili değerlendirme yöntemleri geliştirmenin zor ve farklı sınav yapmanın da yasal olarak da neredeyse imkânsız olabileceğini belirttiler.

Bu zorlukların varlığı yadsınamaz bir gerçek olmakla beraber, heterojen sınıfın olumlu yönleri ile kapatılabilecek bir durumdur (Castellon vd., 2011; Seah vd., 2015; Sullivan vd., 2006).

Heterojen sınıf yapısının en büyük olumlu yönü sosyal becerilerin gelişimidir. Öğrencilerin, farklı bakış açılarına saygı duymayı, sabırlı olmayı ve iş birliği yapmayı öğrenmelerine yardımcı olur. Öğrencilerin empati kurma ve başkalarının deneyimlerini anlama yeteneklerini geliştirir (Gervasoni, 2020; Lerman, 2000, Shakespeare; 2013). Sınıf ortamının gerçek yaşamın bir minyatürü olduğu düşünüldüğünde, homojen sınıf yapısının kurulması veya çeşitliliğin az olması, her bir öğrenci grubu için ilerleyen yaşamlarında veya iş hayatında zorluklara sebebiyet verecektir.

Heterojen sınıf yapısının bir diğer olumlu yönü de kapsayıcı matematik eğitimi sunabilmek için 'öğretim yöntemlerini çeşitlendirme' ve 'farklılaştırılmış öğretim' gerçekleştirme imkânı sunmasıdır. Farklı akademik başarı seviyelerdeki öğrencilere matematik öğretimi gerçekleştirebilmek için, matematik öğretmenleri çeşitli öğretim yöntemlerini ve stratejilerini kullanma fırsatı bulabilirler. Öğretmenler, her öğrencinin bireysel ihtiyaçlarına uygun olarak farklılaştırılmış öğrenme fırsatları yaratabilir. Bu unsurlar katılımcı öğretmenler tarafından birer zorluk olarak algılanmış olsa da aslında öğretmenlerin esnekliğini artırır ve mesleki gelişimlerine katkıda bulunur (Guskey, 2002).

Heterojen sınıf yapısının bir diğer olumlu yönü de öğrenciler arasında çeşitli düşünme tarzları ve yaklaşımların ortaya çıkacak olmasından dolayı problem çözme becerilerinin geliştirmesine olanak sağlamasıdır (Lubienski, 2000). Heterojen sınıflarda çeşitli akademik, kültürel ve sosyal arka planlara sahip öğrenciler yer almaktadır. Bu çeşitlilik, öğrencilerin bir problemi kendilerine daha yakın gördükleri yaklaşımlarla değerlendirmelerine ve kendilerine uygun alternatif çözüm yolları bulmalarına yardımcı olur (Fuchs & Fusch, 2005). Örneğin bir öğrenci çizim yaparak çözüm yapmayı önerirken, bir diğeri tablo oluşturmayı tercih edebilir. Bu çözümlerin sınıf ortamında sunulması, her bir öğrencinin farklı çözümleri görmesini sağlar. Farklı sosyal ve duygusal geçmişlere sahip öğrencilerin beyin fırtınası gibi yöntemlerle daha yaratıcı ve yenilikçi problem çözme stratejileri ortaya koyması beklenebilir (Fuchs & Fusch, 2005).

5.3. Farklılaştırılmış Öğretim

Öğretmenlerin akademik çeşitliliğe cevap verecek şekilde öğretimi farklılaştırma yapmayı ana hatları ile bildikleri fakat (teknoloji okur yazarlığının az olması, zaman ve emek ayıramama gibi) çeşitli sebeplerle kullanmayı tercih etmedikleri söylenebilir. Aslında, öğretmenlerin, her derste her konuda veya her kazanımda farklılaştırma yapması tabii ki beklenemez. Fakat öğrencilerin hepsinin dahil olmasını sağlayacak matematik öğretme ortamı oluşturulabilmesi için öğrencilerin ilgileri ve öğrenme stilleri gibi bireysel özelliklerini iyi tanımaları gerekmektedir.

5.4. Müfredat ve Merkezi Sınavlar

Öğretmenlerle gerçekleştirilen mülakatlarda, öğrencileri ortaokulun sonunda girecekleri sınava hazırlama baskısı ve bu kapsamda müfredattaki konuların tamamlanma zorunluluğu öğretmenlerin üzerinde en çok vurgu yaptığı unsurdu. Öğrencileri sınava hazırlamak adına testlere hazırlık sorularından daha çok çözmeleri gerektiğini düşündükleri için, öğrenci çeşitliliğini görmezden gelme ve farklıklara duyuralı bir öğretim sunamamalarını sınav baskısına bağlamaktadırlar. Aslında, derslerinde ‘Problem çözmeye yönelik öğretim’ yaklaşımını tercih etmelerinde ve ‘ortalamaya göre’ anlatım, ‘çoğunluğa yönelme’ gibi eğilimlerde bulunmalarının temelinde sınav baskısı olduğu söylenebilir.

Katılımcıların bu söylemlerinde ciddi bir doğruluk payı bulunmaktadır. Çünkü günümüzde (sadece ulusal değil, aynı zamanda uluslararası düzeyde) matematik eğitimindeki en büyük sorunlardan biri, iyi matematik öğretimi olarak gördüğümüz şeyler ile standart testlerdeki puanları yükseltme talepleri arasındaki gerilimdir. Öğretmenler sıkça, öğrencilere matematiksel fikirleri anlamaları için gereken zamanı verme arzusu ile daha yüksek test puanları elde etme baskısı arasında sıkışıp kalmaktadırlar (Litton & Wickett, 2009; Phelps, 2011).

Öğretmenler, yanlış bilgilendirme ya da ebeveynler veya idareciler tarafından daha az sorunla karşılaşılan kolay bir yol olarak algılandığı için sınav baskısının arkasına saklanıyor olabilirler. Belki de öğretmenlerin eğitimin amacını öğrencileri sınavlara hazırlamak olarak algılamalarının nedeni, kendi eğitim süreçlerinin büyük bir kısmının sınav hazırlığına odaklanmış olmasıdır. Merkezi ve standartlaştırılmış sınavlar var olduğu sürece (ve bunların ortadan kaldırılmasının neredeyse imkânsız olduğu düşünüldüğünde), matematik öğretmenleri yüksek baskılı testlerin stresinden kurtulamayacaklardır. Soru şu ki ‘öğretmenler bu duruma nasıl yanıt verecek?’. Van de Walle vd. (2012), merkezi sınavlarda başarılı olmanın en iyi yolunun matematik müfredatındaki büyük fikirleri öğretmek olduğunu tavsiye eder. Kavramsal olarak öğretilen ve matematiksel süreçleri ve pratikleri anlayan öğrenciler, sınavların formatına veya hedeflerine bakılmaksızın sınavlarda iyi performans göstereceklerdir.

5.5. Öneriler

Matematik öğretmenlerinin akademik çeşitlilik barındıran sınıf ortamlarında kapsayıcı eğitim sunmaya yönelik görüşlerinin araştırıldığı bu çalışmadan elde edilen en büyük çıkarım öğretmenlerin ‘inançlarına’ etki edecek mesleki gelişim faaliyetlere duyulan ihtiyaçtır. Bu çalışmadan çıkan sonuçlar bağlamında, sırf bilgi aktarımı yoluyla gerçekleşen ve öğretmenlerin pasif oldukları bir mesleki gelişim faaliyetine değil, daha çok uygulama içeren, öğretmemelerin aktif katılım sağladıkları mesleki gelişim faaliyetlerinin geliştirilmesi gerekmektedir.

Bu çalışmadan yapılabilecek bir diğer çıkarım ise merkezi sınavların kapsayıcı eğitim gerçekleştirilmesine yönelik olumsuz etkisidir. Merkezi sınavların kaldırılamayacağı gerçeği aşikardır fakat matematik eğitiminin hatta genel olarak eğitimin, tamamen merkezi sınav odaklı hale getirilmesi, bir nevi "aynı kalıptan çıkmış" öğrenciler yetişmesine sebebiyet vermektedir (Pandina Scot vd., 2009). Merkezi sınavlara hazırlık, öğretim programlarını ve ders içeriklerini sınırlamamalıdır. Merkezi sınavların varlığı, öğretmenleri sınavlara yönelik öğretim yapmaya ittiği için öğretimdeki çeşitliliği ve yaratıcılığı sınırlayıcı etkileri olmaktadır. Fakat, ölçme ve değerlendirme öğrencilerin öğrenip öğrenmediğini analiz etmek için yapılmalıdır, sınavlara hazırlık için değil (Pandina Scot vd., 2009). Öğrenciler için matematik öğretiminin amacı sadece 'bir kutucuğun içini karalamak' olmamalıdır. Merkezi sınavların formatı farklı öğrenme stilleri ve ihtiyaçları olan öğrencileri de dikkate alacak şekilde genişletmek önemlidir. Örneğin, açık uçlu sorular içeren değerlendirme yöntemleri kullanılabilir.

Son ve belki de yapılacak olan diğer her şeyin temelinde yatan öneri ise öğretmenlerin 'Özverili' olması gerekliliğidir. Öğretmenlerin kendilerince birçok eleştirdiği husus illaki olacaktır. 'Suçu' ve 'yükümlülüğü' başka kişilere ve durumlara atfediyor olabilir (ki bu çok kolay bir yoldur.). Öğretmenlerin zaman ve emek ayırmadığı hiçbir eğitim yaklaşımı sadece matematik öğretiminde değil diğer branşlarda da başarılı olamayacak gibi durmaktadır. Bu nedenle, öğretmenlerin öğrencilerine dokunabilmesi için özverili bir şekilde çalışmaktan başka hiçbir çıkar yol görülmemektedir.

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