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Examining the factors affecting Turkey's 4th grade mathematics achievement according to Timms 2019 final report

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Abstract

With scientific and technological development, mathematics is becoming more and more important in all aspects of life. Starting from the basic education level, mathematics education must be made more effective and efficient to produce people who can meet the social demands of our time. In this respect, international comparative examinations are considered important to monitor the current situation and allow comparison with previous examinations and compare the current situation with that of other countries. This study aims to investigate and evaluate the factors affecting mathematics achievement in 4th-grade in Turkey in TIMSS 2019 results. The study was conducted using the qualitative research method. In the research, which was designed according to the principle of case study, the data were obtained from the TIMSS 2019 international report. Because economic resources and attitudes are important to mathematics learning and success in this area, related issues were explored in the study. The headings related to home resources for learning, income levels, impairment due to lack of resources in schools, students' preference for learning mathematics, and self-confidence were included. The data obtained according to the given themes were analyzed descriptively. As a result of the study, it was found that reading habits affect mathematics achievement, problems arising from socioeconomic differences and income inequality, and effective use of instructional resources affect mathematics achievement.

Keywords: TIMSS, mathematics, primary school

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1. Introduction

Building educational policy in parallel with technological change in the world is a difficult process because educational outcomes change over a long period and very quickly (T.C. Kalkınma Bakanlığı, 2018). With increasing digitalisation, the exchange of information is growing rapidly (Bütüner & Güler, 2017), influencing people's lives and the social and economic structure of societies in all areas (Ersoy, 1997). While social and economic competition between countries is increasing, the characteristics expected from people are changing accordingly (Eş & Sarıkaya, 2010). Raising the skilled workforce needed to meet the changing needs of society can only be achieved through education (Çevik & Yiğit, 2009). In order to meet the diverse needs of society, changes are taking place in the field of education, as in many other fields (Dewey, 2010). Depending on this situation, (İncibakı, Mercimek, Ayanoğlu, Aliustaoğlu, & Tekin, 2016) there are changes in both learning areas and teaching styles based on (Olkun & Toluk Uçar, 2020) research about mathematics and how it should be taught (Van De Valle, Karp, & Bay-Williams, 2014).

Today, it is necessary to apply mathematical knowledge and mathematical thinking in many fields and professions (Olkun & Toluk Uçar, 2020). In the digital age, where civilization is advancing according to technological developments, this trend will increasingly continue in the future (Mullis & Martin, 2017). Individuals will face situations in their lives where they will have to apply mathematics and make mathematical decisions (Yenilmez & Duman, 2008). Accordingly, the goal of teaching mathematics changes (Murphy, 2021), and it is indispensable to give children the good future they deserve (Güler Selek, 2020). In addition to transferring mathematical

knowledge to daily life, learning basic concepts and skills related to mathematics, mathematical thinking, understanding problem-solving strategies, having a positive attitude toward mathematics, and understanding the relationship between mathematics and real-life are gaining importance (Yıkmış, 2007). In basic education, students are expected to acquire knowledge and skills that enable them to make decisions based on knowledge and reason, adapt to changes in the social and natural environment in a short period, and set priorities that are beneficial to themselves and others (Baykul, 2021). Because it is possible for children to develop strong mathematical skills with a deep understanding of mathematics (Lindquist, Philpot, Mullis, & Cotter, 2019).

Continuous evaluation studies are needed to determine the effectiveness of the instruction countries provide to students and whether goals are being met (Çobanoğlu & Kasapoğlu, 2010). For this reason, it is noted that comparative education research has increased in recent years (Bütüner & Güler, 2017). International studies allow countries to see their situation in different areas and make comparisons with other countries' situations. (MEB, 2019) They guide in developing current goals and methods in education (MEB, 2016, s. 7). In addition, these studies provide scientific data that enable the review of policies, curricula, teacher competencies, course equipment, and materials, especially in basic education (Büyüköztürk, Çakan, Tan, & Akar, 2014). Reports published by international organizations in recent years facilitate such studies and provide education systems with opportunities for self-evaluation.

The International Research on Mathematics and Science Trends (TIMSS) is the most comprehensive international test (Mullis & Martin, 2017) assessing the knowledge and skills of students in 4th and 8th grades (Erdoğan, Hamurcu, & Yeşiloğlu, 2016). Turkey

participated in TIMMS in the 8th grade in 1999, 2007, 2011, 2015, 2019, and the 4th-grade in 2011, 2015 and 2019 (MEB, 2020).

The content of TIMSS 4th-grade mathematics instruction was assessed within the framework of 17 basic topic areas in the learning domains of numbers (7), measurement and geometry (7), and data (3). The distribution of assessed topics in mathematics education by learning area is shown in Table 1.

Table 1. Percentage Distribution of TIMSS 2019 Mathematics Assessment by Grade 4 Learning Areas

Learning Areas	Subject Field	%
Number	Concepts of whole numbers, including place value and ordering Adding, subtracting, multiplying, and dividing with whole numbers Concept of multiples and factors; odd and even numbers Number sentences (finding the missing number, representing problem situations with number sentences) Number patterns (extending number patterns and finding missing terms) Concepts of fractions, including representing, comparing and ordering, adding and subtracting simple fractions Concepts of decimals, including place value and ordering, adding and subtracting with decimals	50
Measurement and Geometry	Solving problems involving length, including measuring, and estimating Solving problems involving mass, volume, and time Finding and estimating perimeter, area, and volume Parallel and perpendicular lines Comparing and drawing angles Elementary properties of common geometric shapes Three-dimensional shapes, including relationships with their two-dimensional representations	30
Data	Reading and interpreting data from tables, pictographs, bar graphs, line graphs, and pie charts Organizing and representing data to help answer questions Drawing conclusions from data displays	20
	Total	100

Source: (MEB, 2020; Mulis, Martin, Foy, Kelly, & Fishbein, 2020)

In order to more meaningfully interpret the results of the achievement tests used in TIMSS (Akkuş, 2014), student competencies are defined as advanced (625 and above),

high level (550-625), intermediate (475-550), and low level (400-475) (Büyüköztürk, Çakan, Tan, & Akar, 2014). In addition, using data collected from students, parents, teachers, and school administrators, home environment, school composition and resources, school climate, school discipline and safety, teacher preparation, professional development, and job satisfaction, teaching, and learning that affect student achievement in science and mathematics, factors such as difficulty, student attitude, curriculum and mathematics instruction, and technology in the classroom are examined. (Mulis, Martin, Foy, Kelly, & Fishbein, 2020; Büyüköztürk, Çakan, Tan, & Akar, 2014).

With scientific and technological development, mathematics is becoming more and more important in all aspects of life. Starting from basic education, it is necessary to make mathematics education more effective and efficient in order to raise people who can meet the social demands of our time. In this respect, international comparative examinations are considered important, both to monitor the current situation and allow comparison with previous examinations, and to compare the current situation with that of other countries. In the research, it is found that TIMMS scores are generally treated with variables such as achievement in learning and cognitive areas, (İncibakı, Mercimek, Ayanoğlu, Aliustaoğlu, & Tekin, 2016; Bütüner & Güler, 2017; Akkuş, 2014), region(Ölçülüoğlu & Çetin, 2016), school climate (Buluç, 2014; Sarı, Arıkan, & Yıldızlı, 2017), teacher and student characteristics (Çavdar, 2015; Aydın M. , 2015), home and school environment, student attitude towards mathematics(Ertürk & Erdinç Akan, 2018; Abazaoğlu, Yatağan, Yılmaz, Arifoğlu, & Umurhan, 2015; Sarı, Arıkan, & Yıldızlı, 2017; Aydın M. , 2015). In addition, the relationship between TIMSS mathematics achievement and national examinations (Wiberg, 2019)as well as the relationship

between misconceptions and misunderstandings in science and mathematics (Neidorf, Arora, Erberber, Tsokodayi, & Mai, 2020), profiles of skills used in solving TIMSS mathematics tasks (Munaji & M, 2021)teacher preparation (Öz, 2021), motivational characteristics of students (Winberg & Palm, 2021; Vesić, Džinović, & Mirkov, 2021), the effect of TIMSS mathematical confidence scale items (Oyar & Atar, 2021), family involvement (Cui, Zhang, & Leung, 2021), gender (Ghasemi & Burley, 2019), self-concept (Mejía-Rodríguez, Luyten, & Meelissen, 2020), age difference (Bjerke, Smestad, Eriksen, & Rognes, 2021) and socioeconomic level (Suna & Özer, 2021) and TIMSS mathematics achievement were examined.

Considering that education is an ecosystem, it can be said that many factors influence students' mathematics achievement. Since economic resources and attitudes are important to mathematics learning and success in this area, the issues related to these topics were explored in the research. The study of these factors and their evaluation in terms of success in mathematics at the elementary level will be a guide to overcome the problems in mathematics education in Turkey. This study, which aims to investigate various factors affecting mathematics achievement in 4th-grade in Turkey according to the results of TIMMS 2019, is important to provide suggestions to educators, researchers, and policymakers and contribute to the literature.

1.1. Aim

This study aims to investigate and evaluate the factors that influence mathematics achievement in 4th-grade in Turkey in terms of TIMMS 2019 results. For this purpose, answers to the following questions were sought.

Turkey's TIMMS 2019 mathematics success rates;

a) Home Resources for learning
b) Socioeconomic background of the student body,
c) Instruction affected by resource shortages,
d) Students like learning mathematics,
e) How are students confident in mathematics according to their titles?

2. Method

The method of this research is qualitative; the pattern is a case study. Qualitative research provides an opportunity to develop, describe and evaluate possible explanations for a situation. (Büyüköztürk, Çakmak, Akgün, Karadeniz, & Demirel, 2017). In the case study, the context is evaluated with an in-depth, detailed, and holistic perspective, and the differences that occur depending on the context and the possible underlying causes are explained and described (Akar, 2019). Because this study examined and assessed in detail the mathematical achievement of 4th-grade students in various contexts, the case design was preferred.

2.1. Working Group / Reviewed Documents

The documents for this study were taken from the TIMSS International Report 2019. One of the purposive sampling methods, criterion sampling, was used in the study. In criterion sampling, a study group can be formed according to the criteria created or given by the researcher (Yıldırım & Şimşek, 2008). The criteria of this study were taken as the Turkish and international averages of 4th-grade mathematics scores.

2.2. Data Collection Tools

The TIMMS 2019 International Mathematics and Science Final Report, which the International Association prepared for the Evaluation of Educational Assessment (IEA), was retrieved from the official websites as the primary source for the study.

2.3. Data Collection and Analysis

The TIMMS 2019 final report was examined in the research, and the 4th-grade mathematics results were separated. Subsequently, five subtitles identified from the 14 main titles of the report were examined and interpreted over four weeks. Turkish and international data for 4th-grade mathematics were extracted from tables within the examined headings and compiled into tables. The tables were prepared according to the criteria of the TIMSS report and provided with explanatory notes.

All data were analyzed descriptively. The data obtained were summarized and interpreted according to the given themes of descriptive analysis. The purpose of this analysis is to present the results by organizing and interpreting them. The data are described systematically and clearly (Yıldırım & Şimşek, 2008). In this study, the data compiled from the TIMSS 2019 final report were presented in tables and explained in detail.

2.4. Validity and Reliability

The researchers took some measures to increase the validity and reliability of the study (Aslan & Bektaş, 2019). These measures are outlined below.

In qualitative research, validity refers to the fact that the researcher observes the phenomenon under study as it is, as unbiased as possible. Internal validity looks for an answer to the question "Do the interpretations of the results correspond to the truth?" (Yıldırım & Şimşek, 2008). To ensure internal validity in this study, the data included in the TIMMS report will be directly included in the findings section.

External validity refers to the generalizability of the research findings. The ability to generalize and apply research findings to similar environments and situations is an indicator of external validity (Aslan & Bektaş, 2019; Yıldırım & Şimşek, 2008). In order to increase the external validity, information about the research design, the study group, the data collection instruments, the analysis of the obtained data, and the organization of the results are explained in detail in the corresponding sections.

To increase the external reliability of the research, the research findings have been discussed in detail in the conclusion section using other research data. There was a

discussion among the researchers on whether the results and findings section were consistent, and a consensus was reached.

3. Findings

In this section, the data on the areas to be explored in Turkey in the 2019 TIMSS report are tabulated and interpreted.

Table 3. Data on Home Resources for Learning

	Home Resources Level						
	Many Resources		Some Resources		Few Resources		Average Scale Score
	%	$\bar{X}$	%	$\bar{X}$	%	$\bar{X}$	
Turkey	6	625	68	543	26	450	8.7
International	17	562	75	498	8	433	
Cut Scores		11.8		7.4			

Source: (Mulis, Martin, Foy, Kelly, & Fishbein, 2020)

Home resources in learning were assessed based on student and parent reports of the presence of five resources for learning. The number of books in the home, Internet access and the presence of a study room, parent's educational level, and their occupation was included in the assessment. According to the cut-off scores resulting from the assessment, home resources for mathematics learning were addressed at three levels. Students with a cut-off score of 11.8 in home resources in learning were rated as many resources level, between 11.8 and 7.4 points as some resources level, and those with a score below 7.4 as few resources home resources. Students who have more than 100 books, more than 25 children's books, their room, and Internet access at home, where at least one parent has a college degree and has a job, were rated as having many home resources in learning. Students who have fewer than 25 books and fewer than ten children's books at home, who do not have their room and Internet access, whose parents have a secondary school degree or less, and who do not have a job are rated as having few home resources for

learning. Other students were categorized as having moderate home resources for learning.

While the rate of all students who participated in the TIMSS international mathematics exam was 17%, the average mathematics achievement was 562 points, the average possession rate was 75%, the average mathematics achievement was 498 points, the low possession rate was 8%, and the average mathematics achievement was 433 points. While the rate of Turkish students who participated in the study was 6%, the average of mathematics achievement was 625 points, the average possession level was 68%, the average of mathematics achievement was 543 points, the rate of low possession was 26%, and the average of mathematics achievement was calculated as 450 points. Using the cut-off points, it can be seen that Turkish students have a medium level of home resources in learning with an average score of 8.7.

Table 4. Data on the Socioeconomic Background of the Student Body

	Socioeconomic Background					
	More Affluent		Neither More Affluent nor More Disadvantaged		More Disadvantaged	
	%	$\bar{X}$	%	$\bar{X}$	%	$\bar{X}$
Turkey	27	565	29	519	44	501
International	41	521	34	499	25	479

Source: (Mulis, Martin, Foy, Kelly, & Fishbein, 2020)

The schools that participated in the TIMSS examination were classified as socioeconomic according to the report prepared following the opinions of school administrators about the percentage of low-income and high-income students. Schools in which more than 25% of the students are from high-income households and less than 25% are from low-income households are defined as more affluent schools. Schools with more than 25% of their students from low-income households and less than 25% from moderate-income households were defined as

more disadvantaged schools. Schools outside of these categories are defined as neither more affluent nor more disadvantaged schools.

Among those who participated in the TIMSS international 4th-grade mathematics assessment, the average mathematics score for high-income students (41%) was 521 points, the average mathematics score for middle-income students (34%) was 499 points, and the average mathematics score for low-income students (25%) was 479 points. Among Turkish students who participated in the study at the same level, the average mathematics achievement of those with high income (27%) was calculated as 565 points, the average mathematics achievement of those with middle income (29%) was calculated as 519 points, and that of those with low income (44%) was calculated as 501 points in mathematics.

Table 5. Data on Instruction Affected by Resource Shortages (Administrator opinions)

	Affect Level						
	Not Effected		Somewhat Affected		Affected A Lot		Average Scale Score
	%	$\bar{X}$	%	$\bar{X}$	%	$\bar{X}$	
Turkey	5	556	72	524	23	513	8.1
International	26	514	68	499	6	473	
Cut Points		11.3		6.7			

Source: (Mulis, Martin, Foy, Kelly, & Fishbein, 2020)

The state of impairment due to lack of resources in teaching was assessed according to the opinions of school administrators as teaching aids such as books, materials such as pencil and paper, school buildings, heating, cooling and lighting systems, educational departments of the school, technological competence of school staff, interactive audio-visual resources, computer technologies owned by the school, general school resources. In addition, teachers who are experts in mathematics, computer software and applications used in mathematics education, written sources about mathematics education, calculation materials, concrete objects, and materials that help students understand quantities and operations are evaluated as resources for mathematics education.

According to the cut-off points determined based on the data obtained from the school resources for teaching, the situation of being affected by a lack of resources for teaching mathematics was treated in three categories. According to the situation of being affected by lack of resources for teaching, students with a cut-off score of 11.3 were included in the group not affected by lack of resources for teaching mathematics. In contrast, students with a cut-off score of 11.3 and 6.7 were included in the somewhat affected group. Those who scored less than 6.7 were included in the affected a lot group. Students in schools that were not at all affected by the lack of 7 of the 13 instructional resources and were partially affected by the lack of the remaining six instructional resources were assessed as the group that was not affected by the lack of resources in mathematics achievement. The students in the schools that were affected by the absence of 7 of the 13 educational resources mentioned and relatively affected by the absence of the remaining six resources were rated as the group most affected by the lack of resources in mathematics achievement. The students to whom these criteria do not apply are

considered to be the group partially affected by the lack of 13 educational resources that the schools have.

The average of mathematics achievement of students (26%) who were not affected by the lack of resources in mathematics education in schools participating in the TIMSS international mathematics examination in the 4th-grade was calculated as 514 points, the average of those who were partially affected (68%) was calculated as 499 points, and the average of mathematics achievement of those who were severely affected (6%) was calculated as 473 points. For the Turkish students who participated in the study at the same level, the average of the mathematics performance of those who were not affected by the lack of resources in the classroom (5%) was calculated at 556 points, the average of the mathematics performance of those who were partially affected (72%) was calculated at 524 points, and the average of the mathematics performance of those who were severely affected (23%) was calculated at 513 points. Using the cut-off points, it can be seen that Turkish students are partially affected by the lack of resources for teaching mathematics in schools with an average score of 8.1.

Table 6. Data on Students Like Learning Mathematics (Student Opinions)

	Level of Enjoying Learning Mathematics						
	Very Much Like Learning Mathematics		Somewhat Like Learning Mathematics		Do Not Like Learning Mathematics		Average Scale Score
	%	$\bar{X}$	%	$\bar{X}$	%	$\bar{X}$	
Turkey	66	540	25	491	9	495	10.9
International	45	520	35	491	20	479	
Cut Points		10.2		8.4			

Source: (Mulis, Martin, Foy, Kelly, & Fishbein, 2020)

The level of students' liking for learning mathematics was assessed using the criteria of enjoying learning mathematics, not liking mathematics, boredom with mathematics,

interest in mathematics, liking mathematics, liking schoolwork related to numbers and solving problems, looking forward to mathematics classes, and liking mathematics as a favorite subject.

Using the cut-off points established based on the data collected, students' preference for mathematics was discussed in three categories. According to students' liking for mathematics, students with a cut-off score of 10.2 belonged to the group that very much like learning mathematics. In contrast, students between 10.2 and 8.4 cut-off scores belonged to the group that somewhat like learning mathematics. Those who scored below 8.4 belonged to the group that do not like learning mathematics.

Students who scored on five of the nine items of the scale on liking mathematics and partially scored on the other four items were rated as the group that liked learning mathematics. Those who did not partially agree with any of the five items and partially agreed with the other four were rated as students who dislike learning mathematics. All other students to whom these criteria did not apply were classified as those who liked mathematics a little.

Of the students who participated in the TIMSS international mathematics assessment in the 4th-grade level, those who like learning mathematics (45%) have a mathematics achievement average of 520 points, those who like it a little (35%) have a mathematics achievement average of 491 points, and those who do not like it at all (20%) have a mathematics achievement average of 479 points. For the Turkish students who participated in the study at the same level, the average mathematics success (66%) was calculated as 540 points, the average mathematics success of those who liked it a little (25%) was calculated as 491 points, and the average mathematics success of those who

did not like it at all (9%) was calculated as 495 points. Based on the cut-off points, it can be seen that Turkish students belong to the category who like mathematics with an average score of 10.9.

Table 7. Data on Students Confident in Mathematics (Student Feedback)

	Confidence Level in Mathematics						
	Very Confident In Mathematics		Somewhat Confident In Mathematics		Not Confident In Mathematics		Average Scale Score
	%	$\bar{X}$	%	$\bar{X}$	%	$\bar{X}$	
Turkey	34	575	42	513	23	468	10.1
International	32	545	44	497	23	456	
Cut Points		10.7		8.5			

Source: (Mulis, Martin, Foy, Kelly, & Fishbein, 2020)

Students' confidence in mathematics was assessed using the criteria that they are good at mathematics, that they find mathematics difficult for themselves, that they do not consider mathematics to be one of their strengths, that they learn quickly in mathematics, that they find mathematics more difficult than other subjects, that they are confident about difficult mathematics problems, that teachers have a positive opinion of students, that they are confused by mathematics, and that they are anxious about mathematics.

The assessment was based on the criteria of confusion and fear of mathematics. Those with scores above 10.7 belonged to the category of students who were very confident in mathematics, while those with cut-off scores between 10.7 and 8.5 belonged to the group of students who were somewhat confident in mathematics. Those with scores below 8.5 belonged to the group who were not confident in mathematics.

I strongly agree with all five items of the 9-point scale on self-confidence in mathematics, and the students who partially agree with the other four items form the

group with high self-confidence in mathematics. Those who did not partially agree with any of the five items and slightly agreed with the other four were assessed as having no self-confidence in mathematics. All other students to whom these criteria did not apply were classified as having some confidence in mathematics.

Among the students who participated in the TIMSS international mathematics assessment in the 4th-grade level, the average mathematics score of those who were very confident in mathematics (32%) was 545 points, the average mathematics score of those who were not very confident (44%) was 497 points, and the average mathematics score of those who were not confident (23%) was 456 points. For the Turkish students who participated in the study at the same level, the average mathematics performance of those who were very confident (34%) was 575 points, the average mathematics performance of those who were not very confident (42%) was calculated as 513 points, and the average mathematics performance of those who were not confident (23%) was calculated as 468 points. Based on the cut-off points, it can be seen that the Turkish students with an average of 10.1 falls into the category of those who have little confidence in mathematics.

4. Discussion and Conclusions

This study aimed to investigate the factors affecting mathematics achievement in 4th-grade in Turkey according to the results of TIMMS 2019. The performance of students who participated in the TIMMS examination was examined in terms of variables such as home resources, socioeconomic level, educational resources, students' level of love for learning mathematics, and students' level of self-confidence in mathematics.

Home learning resources were assessed using the information on the number of books in the home, access to the Internet and the presence of a study room, parents' educational level, and their occupation. Regarding home resources in learning, among the students who participated in both the TIMSS international mathematics examination at the 4th-grade level and the examination of average mathematics scores in Turkey, there is a decrease from the students who had many resources to the students who had fewer resources. However, it can be seen that Turkey's average score at all levels is higher than the international average in terms of domestic resources. While 17% of students who participated in the TIMMS mathematics exam have "a lot," 75% have "moderate," and 8% have "little" home resources, it is seen that 6% of students from Turkey have "a lot," 68% have "moderate" and 26% have "little" home resources. While there is an international average difference of 129 points between "a lot" and "little" resources in mathematics learning, the difference in Turkey is 175 points. While the rate of those who have a lot of home resources in learning mathematics is lower in Turkey than the international average, the rate of those who have fewer resources is high. Considering that home resources are a factor highly correlated with student learning success, limited home learning resources are a significant disadvantage for students in Turkey (TEDMEM, 2021, s. 26).

While the home environment reflects the family's current situation, it includes many human and material resources that affect the student's education and life, such as the parent's educational level, occupation, socioeconomic status, and socialization opportunities at home (Egunsola, 2014, s. 47). These resources have a significant impact on student success (Yenilmez & Duman, 2008). Home resources in learning, the extent to

which parents provide their children with the financial resources necessary for learning, and the practical and psychological support for academic success relate to potential advantages or disadvantages they may provide (Thomson, Wernert, O'Grady, & Rodrigues, 2017). There is a strong relationship between parents' educational attainment, which ranks high in home resources, and the occupation they hold, and their children's academic success (Slusser, Ribner, & Shusterman, 2018). In general, families with a high level of education provide their children with more career opportunities, while household resources that play a role in learning increase with a high socioeconomic level (Büyüköztürk, Çakan, Tan, & Akar, 2014). Depending on the educational level of parents, their interest in education and awareness are also positively influenced. This situation creates a difference in families' perspectives towards education. With the financial advantage that comes from the increase in the family's educational level, the opportunities provided to the students also increase. The fact that the children of parents with higher socioeconomic status and educated parents are more successful on the TIMSS exam (Wiberg, 2019; Suna & Özer, 2021) indicates that home resources are much more effective in learning mathematics. Studies have shown that mathematical ability, a strong predictor of academic success from early childhood, (Slusser, Ribner, & Shusterman, 2018) is at risk among students of low socioeconomic status, (Friedman-Krauss & Raver, 2015; Murphy, 2021; Fyfe, Rittle-Johnson, & Farran, 2019; Galindo & Sonnenschein, 2015; Pan, Yang, Li, Liu, & Liu, 2018) that there is a positive relationship between high socioeconomic status (Bodovski, Munoz, Byun, & Chykina, 2020) and mathematical achievement and those poor students who have the opportunity to take advanced mathematics courses (Byun, Irvin, & Bell, 2015) are more successful than rich

students Looking at the TIMMS criteria, we find that the number of books at home, the student's access to the Internet, and having their room is also among the criteria for learning mathematics. The number of books at students' homes is an important household resource that is effective in learning mathematics. Studies show that owning more than 100 books at home makes a difference of 30 to 80 points in students' success in international examinations (Entorf & Tatsi, 2009; Türkan, Üner, & Alcı, 2015). In the Coleman Report published in 1966, it was found that the number of books at home, which are home resources for learning, has a significant impact on students' reading and mathematics achievement (Akt. Aydın, 2015). In addition, parents' educational and cultural status increases the number and variety of books at home, and there is an experience of reading together at home. This ensures that children acquire the habit of reading, and accordingly, the level of literacy at home and the academic achievement of children increase (Üstün, 2007; Soysal, 2019). Based on research findings, it can be said that the number of books at home has a significant impact on students' mathematical achievement. The number and variety of books in the home vary, especially according to the socioeconomic and cultural status of the family. It is found that the habit of reading books increases children's literacy and reading comprehension, which positively impacts their performance in mathematics.

Another home source for learning mathematics is the student's access to the Internet. Especially since the mid-20th century, developments in information technologies have ushered in a new era of information acquisition, storage, processing, and transmission and have greatly accelerated the process of transformation into an information society (Kalkınma Bakanlığı, 2015). The use of computers in all fields and the indispensable

facilitation of life, the expansion of the transmission range of networks/networks, the increase in Internet speed and use have brought many opportunities to the agenda (Aydeniz, 2017). In Turkey, where household Internet access reached 90.7% in 2020, (TUIK, 2020) children aged 6-13 access the Internet via computers, tablets, or smartphones and use it mainly for homework (TÜİK, 2013). The Internet makes a great contribution to the educational development of children, and it is used extensively, especially for schoolwork, it helps children acquire new information, learn about new environments and make friends by surfing the websites (Tuncer, 2000). It can be said that Internet access is an important home resource that contributes to students' mathematics learning, considering that access to information through the Internet has become very easy and documents and applications that support learning on the Internet are widely available. Moreover, the high level of Internet access in Turkish households is important in facilitating children's access to information.

When we look at the international and Turkish averages for 4th-grade, in relation to school resources, we find that mathematics achievement decreases from students who are not affected by the lack of resources in schools to severely affected students. We also find that Turkish average mathematics scores at all levels are higher than the international average concerning school resources. However, compared to the international averages, it can be seen that the proportion of students affected by the lack of resources in schools in Turkey is much higher, and the proportion of students who are not affected is quite low. These results show again that schools in Turkey need to be improved in terms of available resources (TEDMEM, 2021). Increasing resources in school and qualifying these resources play an important role in achieving educational goals and increasing

success in mathematics (Aydın M., 2015). This is because, in order for learning to take place effectively and success to be ensured, school resources should be sufficient in quantity and quality, as well as students' personal and socioeconomic characteristics (Önder, 2016). On the other hand, although the lack of physical infrastructure and school resources have a negative impact on learning, there is little evidence that these resources have a strong direct impact on learning outcomes. It is also noted that how effectively resources are used and how equitably they are distributed to schools is more important for student learning outcomes (OECD, 2016). Similar studies show that the impact of school resources on student achievement varies by countries' level of development. It has been observed that the effect of mathematics achievement and student-teacher ratio, level of training and experience of teachers, quantity, and quality of teaching materials and physical components of school are more pronounced in developing countries than in developed countries and that the effect of school resources on academic achievement increases when the income level of the country decreases (Önder, 2016). In addition, concrete materials have been found to increase student engagement and understanding in mathematics classrooms, (Quigley, 2021; Swanson & Williams, 2014) teacher characteristics predict student motivation, (Winberg & Palm, 2021) and have a positive and high-level impact on mathematics achievement (Dursun & Dede, 2004).

The preference for learning mathematics among Turkish students who participated in the TIMSS international examination was discussed in three categories. Turkey is generally in the category of students who like to learn mathematics. It was found that the average score of Turkish students who like to learn some mathematics is similar to the international figures. The average scores of Turkish students in the category who like to learn mathematics and do not like to learn mathematics are higher than the

international averages. Looking at the ratios, it is clear that the Turkish 4th-grade students who participated in the TIMSS exam like to learn mathematics with a significant difference from the international average, and those who do not like it at all are significantly less. It is seen in the studies that many factors can determine the direction of attitude towards learning mathematics. Studies conducted in various countries show that elementary school students enjoy learning mathematics, (Mazana, Montero, & Casmir, 2019; Hacıömeroğlu, 2019), have a low anxiety (Deringöl, 2018), have high self-efficacy perceptions (Türkmenoğlu & Yurtal, 2020), are mostly positive (Nicolaidou & Philippou, 2004; Tezer & Karasel, 2010; Gülburnu & Yıldırım, 2015) and enjoy learning through collaborative problem solving (Russo & Minas, 2020). However, there are some situations that can cause liking learning mathematics to be perceived as difficult, such as difficulty in solving arithmetic problems in elementary school students (Sakilah, Rini, Magdalena, & Unaenah, 2018), a decreasing positive attitude as grade level increases (Deieso & Fraser, 2019), high anxiety (Medikoğlu, 2020), family pressure, test anxiety (Aydın & Doğan, 2012) and the belief that mathematics is complex (Rikhosto, 2015). In one study, 70% of teachers said that elementary school students have a high math load, 50% of parents believe that students are under much stress, and 70% of students believe that this leads to a reduction in sleep time, which seriously affects their physical and mental health (Wang, 2021). Teaching and learning unwillingly is a very costly and tedious process, especially (Povey, Boylan, & Adams, 2021) since elementary mathematics focuses on step-by-step instruction based on fragmented objectives. While Helmane (2016) stated that emotions mobilize the mental and physical strength needed to achieve the goal and participate in vital activities; he explained that the factors arousing positive emotions in learning mathematics in primary school are the program, learning-teaching strategies, and assessment. For this reason, one of the goals that should be addressed in a multidimensional way is to get those students who are not sufficiently interested in mathematics in primary school to love this lesson.

According to the TIMSS results of 2019, it can be seen that students' confidence in learning mathematics is decreasing, ranging from students who are very confident to students who have no confidence at all, both in the international and Turkish

mathematics results. When classified according to the level of confidence, it can be seen that the Turkish scores are similar to the international scores. In learning mathematics, self-confidence, which is the totality of the student's thoughts about himself, greatly influences the desire to engage in mathematical operations and attain mathematical disposition as an ultimate goal (Altun, 2006). In addition, students' self-confidence in their mathematical abilities and learning is an important predictor of their mathematical achievement, (Çiftçi & Yıldız, 2019) low self-confidence makes it difficult to achieve goals (Zan & Di Martino, 2014). Introducing students to mathematics in elementary school (Kyriacou, 2010), linking it to real life (Zan & Di Martino, 2014), enriching classroom activities (Şahan, 2008), positive reinforcement (Rodrigues, 2012) and cooperative learning (Khun-Inkeeree, Omar-Fauzee, & Othman, 2017) positively impact developing confidence in mathematics. Therefore, developing confidence in learning mathematics will contribute to students' success in school and improve Turkey's international mathematics performance.

The study results show that the habit of reading at home positively impacts students' TIMSS mathematics achievement. The reading habit, which does not require a high cost, can be encouraged at the family level and contribute to students' mathematical achievement. However, the problems that arise from income inequality have always been present in education. Ensuring equal opportunity in education through the proper and efficient use of resources will ensure that success in mathematics, as in any other area of education, is as universal as possible. In this way, more concrete successes are achieved in the mathematics course that the students love and have high self-confidence. In the final report of TIMSS 2019, various factors were discussed and assessed in different studies on mathematics achievement. Other variables can also be discussed in detail.

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