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DO PRIMARY SCHOOL MATHEMATICS TEXTBOOKS CONNECT TO REAL LIFE?: THE CASE OF GERMANY AND TURKEY

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ABSTRACT

The main purpose of this research is to analyze the relationship between real-life activities in German and Turkey primary school 4th-grade mathematics textbooks, according to the classification proposed by Gainsburg (2008). For this purpose, document analysis, one of the qualitative research methods, was used in the research. The data source of the research is "Fredo 4 Mathematics" in Germany and "Primary School 4th Grade Mathematics Textbook" in Turkey. In the research, descriptive analysis was used in the analysis of the data, and the results were reflected in frequency and percentage tables. The results of the research show that the activities in the mathematics textbooks of both countries are mostly "classical word problems" and the problems include real contexts. It has been revealed that the mathematics textbooks of both countries are strong in terms of activities such as "applied mathematical representations", and the number of activities in the type of real data analysis should be increased.

Key Words: Primary school textbooks, Germany, Turkey, Real life connections, Mathematics.

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İLKOKUL MATEMATİK DERS KİTAPLARI GERÇEK HAYATLA İLİŞKİLİ Mİ ? ALMANYA VE TÜRKİYE ÖRNEĐİ

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ÖZET

Bu araştırmanın temel amacı, Almanya ve Türkiye ilkokul 4. sınıf matematik ders kitaplarındaki etkinliklerinin gerçek yaşamla ilişkisinin Gainsburg (2008) tarafından önerilen sınıflandırmaya göre incelenmesidir. Bu amaçla araştırmada nitel araştırma yöntemlerinden doküman incelemesi kullanılmıştır. Araştırmanın veri kaynağı Almanya'da "Fredo 4 Matematik" ve Türkiye'de "İlkokul 4. Sınıf Matematik Ders Kitabı"dır. Araştırmada verilerin analizinde betimsel analiz kullanılmış ve sonuçlar frekans ve yüzde tablolarına yansıtılmıştır. Araştırmanın sonuçları, her iki ülkenin matematik ders kitaplarındaki etkinliklerin çoğunlukla "klasik kelime problemleri" olduğunu ve problemlerin gerçek bağlamları içerdiğini göstermektedir. Her iki ülkenin matematik ders kitaplarının "matematiksel kavramların uygulamalı temsilleri" türünde etkinlikler açısından güçlü olduğu ve gerçek veri analizi türündeki etkinliklerin sayısının artırılması gerektiği ortaya çıkmıştır.

Anahtar Kelimeler: İlkokul ders kitapları, Almanya, Türkiye, Gerçek hayat ilişkisi , Matematik

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Introduction

One of the aims of mathematics education is to transfer mathematical knowledge and skills to other fields and to develop mathematical skills. "Association skill", which plays a key role in the development of this skill, is one of the important skills that students should acquire (Den Heuvel-Panhuizen, 2003). As the digital world has impacted education, the ability to associate with the concept of "doing mathematics" has become more important, and different dimensions of associating in curricula have been discussed. Because it has been stated that relational skills affect students' understanding and interpretation of mathematics, their ability to do mathematics, their development of a positive attitude toward mathematics, and their persistence in learning (Ball, Hill & Bass, 2005; Bosse, 2003; Rasila, Malinen & Tiitu, 2015). Connecting is often referred to as a skill in mathematics. This skill helps the student be aware of the connections between mathematical ideas and activate them; using mathematical ideas in their relationship with another discipline allows mathematical ideas to reveal new ideas (National Council of Teachers of Mathematics [NCTM], 2000). Therefore, it has been seen that mathematics is evaluated in two different frameworks regarding the relation of mathematics within itself and the relation of mathematics with other disciplines or real life (Bull, Galbraith, Henn & Niss, 2007). This research focuses on the relationship between mathematics and real life.

Bingölbali and Coşkun (2016) stated the conceptual framework regarding the relationship between mathematics and real life as "using mathematical concepts in real life situations" and "showing examples of the use of mathematical concepts in real life".

Activities offered to students play a key role in integrating mathematics education in schools with real life. Therefore, it is necessary and important to investigate how much textbooks, which are the students' first and basic information materials, contain real life.

Since lessons such as life studies and social studies are directly related to real life in primary school, studies are carried out on the connection of textbooks with real life. However, studies examining the relationship between mathematics textbooks and real life have gained importance in recent years. As a matter of fact, the real-life mathematics textbooks of literature studies (Altay, Erhan & Batı, 2020; Bingölbali & Özđiner, 2022; Cabassut & Wagner, 2011; Gainsburg, 2008; Haas, Kreis & Lavicza, 2020; Pepin & Haggarty, 2007; Yekrek & Özgeldi, 2019; Yılmaz & Özyiğit, 2016).

It was observed that the studies mostly analyzed secondary school textbooks. Therefore, researchers comparatively examined the activities in primary school mathematics textbooks in Greece and Turkey, whose mathematics skill scores are close to each other in international exams (Bekirođlu & Ütkür-Güllühan, 2022). The results obtained from the research also encouraged the examination of the activities in the textbooks of the countries with high scores in the international exams. Therefore, this research focuses on the comparative analysis of the activities in the primary school mathematics textbooks of Germany (OECD, 2019), which is ranked before Turkey in the Program for International Students Assessment (PISA) exam results as of 2019. According to the researchers, this study will give an idea of the future comparative education studies of the two countries, which will increase their success in

international exams, and to what extent mathematics textbooks are relevant to real life for both countries. In this respect, it is hoped that the study is important and will contribute to the literature. Based on these considerations, the main purpose of the research is to analyze the relationship between Turkey and German primary school 4th-grade mathematics textbook activities and real-life according to the Gainsburg (2008) classification. There is a similarity in unit order between Turkey and Germany in the fourth grade, which is why it was chosen for the textbooks. Based on this main purpose, the research questions are listed as follows;

1. How are the Turkish primary school 4th-grade Mathematics textbook activities related to real life?
2. How is German primary school 4th-grade Mathematics textbook activities related to real life?
3. How are the relationship between Turkey and German primary school 4th-grade Mathematics textbooks and real-life comparatively?

Methodology

Research Design

This research was carried out with the document analysis method based on qualitative research. Document analysis is a qualitative research method used to analyze the content of written documents meticulously and systematically (Wach & Ward, 2013).

Data Sources and Data Collection Process

The data source of this research consists of Germany and Turkey 4th grade mathematics textbooks for the 2021-2022 academic year. In the selection of data sources, easily accessible sampling of purposeful sampling methods was taken as the basis. The German primary school 4th-grade mathematics textbook has been accessed from the official website of Cornelsen Publishing in the form of an e-book from the Oldenbourg publishing house. The Turkish primary school mathematics 4th-grade textbook was accessed through the EBA (Education and Informatics Network) system of the Ministry of National Education.

In the scope of the research; For Germany, the textbook named “Fredo 4 Mathematics (2019)” by Oldenbourg publications for 2019, and the textbook named “Primary School 4th Grade Mathematics (2019)” was published by the Ministry of National Education for Turkey were analyzed.

Data Analysis

The relationship between the activities in the three units included in the research and real-life was examined according to the classification made by Gainsburg (2008). Gainsburg (2008) classified the relationship between mathematics activities and real life as shown in Figure 1.

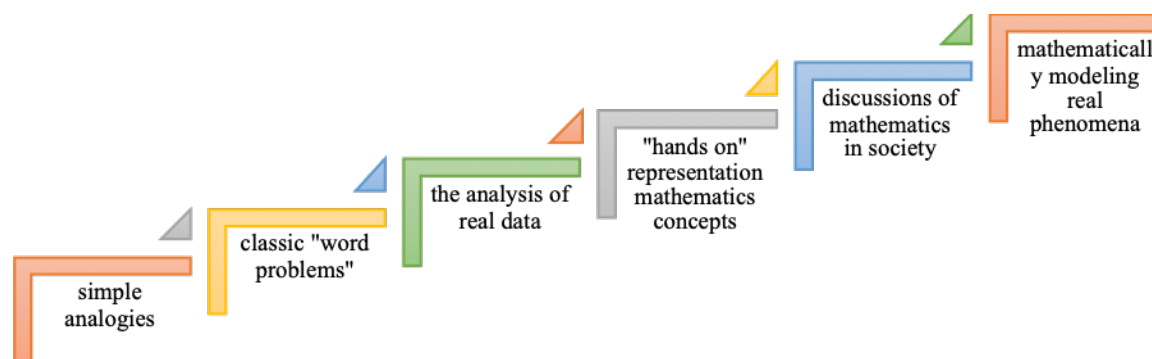


Figure 1. Classification the relationship between mathematics activities and real-life (Gainsburg, 2008).

As seen in Figure 1, real-world connection sequences of Mathematics activities are “simple analogies (associating negative numbers with subzero temperatures)”; “word problems, (two trains leave from the same station...)”; analysis of real data (mean and median height of classmates); “hands-on” representations of mathematical concepts (models of normal solids); discussions of mathematics in society (the media’s misuse of statistics to influence public opinion); mathematically modeling real phenomena (for example, writing a formula to express temperature as an approximate function of the day of the year). In the data analysis part of the research, the activities in each unit were classified according to their content and related category, and the results were presented in the form of frequency.

Validity and Reliability

To ensure the reliability of the research, the “intercoder reliability” formula developed by Miles and Huberman (1994), which is used to increase credibility in qualitative studies, was used. Regarding the credibility of the research, help was received from an expert who continues to teach mathematics at a public school in Istanbul Beylikdüzü during the 2021-2022 academic year. The type of activity discussed in the reconciliation between researchers and coders was activities belonging to the category of “classical verbal problems”. For example, a problem related to calculating “rent expense, electricity bill”, which is a daily life situation, belongs to a classical verbal problem situation, and operations such as reading and calculating “rent expenses, electricity bill” involve a situation related to daily life. Researchers and coders discussed this situation with the activity, and based on the literature review and Gainsburg’s (2008) classification, it was seen that the activities consisted of activities that presented the real data analysis directly or in the form of an example context that would be felt by the child, and finally, in the fictional activities that integrate daily and real life with the problem, it was seen that the activities consisted of real data analysis. It was agreed that it should be included in the data analysis category. As a result of the final examination of the activities in the research, the agreement rate between the encoders of the Miles & Huberman (1994) reliability formula ($\text{Reliability} = \frac{\text{Consensus}}{\text{Agreement} + \text{Disagreement}}$) was 0.97.

Findings

The Relationship of Turkey Primary School 4th Grade Mathematics Textbook Activities with Real Life

As a result of the data analysis, the findings regarding the relationship between the activities of the 4th-grade mathematics textbook in Turkey and real life are shown in Table 1.

Table 1. The relationship between Turkish Primary School 4th grade textbook activities and real life

Real-Life Relationship Categories	<i>f</i>	%
“Simple Analogies”	3	0,73
“Real data analysis”	59	14,43
“Classic "word problems"”	224	54,77
“Hands-on representations of mathematical concepts”	79	19,32
"Mathematical Modeling"	44	10,76
“Discussions of mathematics the society”	-	-
Total	409	100

Table 1 shows that the 4th-grade mathematics textbook activities in Turkey are mostly in the type of "classical verbal problems" ($f=224$, 54.77%) among the categories related to real life. A descending order of frequency: 19.32% of the activities ($f=79$) are in the type of "hands-on representations of mathematical concepts", "real data analysis" with 14.43% of the activities ($f=59$), and "mathematical modeling" activities ($f=44$) 10.76%, “simple analogies” ($f=3$) 0.73% . There is no activities related to “discussions of mathematics in society” ($f=0$).

Examples of 4th-grade mathematics textbook activities in Turkey are given in Figures 1, 2, and 3.

1 Okulda sınıflar arası yapılan engelli koşu yarışında Mehmet, her 100 metrede bir engelin üzerinden atlıyor. Yarış içinde 5 engel atladığına göre engellerin bulunduğu mesafeleri noktaların üzerine yazınız.



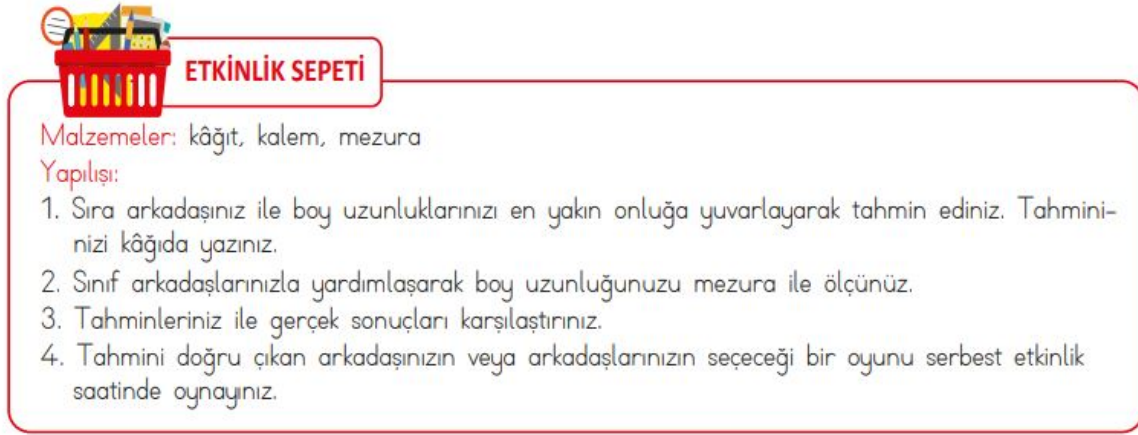
2 Minik köpeğin gücünü koruyup kulübesine gidebilmesi için her 100 metrede 1 kemik yemesi gerekiyor. Aşağıdaki görsele göre kemikleri yiyerek kulübesine gidebilmesi için kaç metre gitmesi gerektiğini bulunuz.



Figure 1. The sample activity: Classic word problems (Kayapınar, Şahin, Erdem, & Şentürk-Leylek, 2019, p.29).

As seen in Figure 1, in the first of the activities on the subject of fractions, students were asked to calculate the distances that an athlete named Mehmet jumped in the obstacle course race. The activity, which belongs to the category of "classic word problem" in terms of content, was presented in the context of the running race organized between classes at school, which children are aware of.

The second activity is an exemplary activity belonging to the type of classical verbal problems supported by a visual that can attract the attention of students.



ETKİNLİK SEPETİ

Malzemeler: kâğıt, kalem, mezura

Yapılışı:

1. Sıra arkadaşınız ile boy uzunluklarınızı en yakın onluğa yuvarlayarak tahmin ediniz. Tahmininizi kâğıda yazınız.
2. Sınıf arkadaşlarınızla yardımlaşarak boy uzunluğunuzu mezura ile ölçünüz.
3. Tahminleriniz ile gerçek sonuçları karşılaştırınız.
4. Tahmini doğru çıkan arkadaşınızın veya arkadaşlarınızın seçeceği bir oyunu serbest etkinlik saatinde oynayınız.

Figure 2. The sample activity: Real data analysis (Kayapınar et al., 2019, p.51).

As shown in Figure 2, in the activity about measuring and rounding numbers, students were asked to measure the height of their classmates with a tape measure in the classroom and to compare the actual results. Thus, it can be said that the activity is in the "real data" type of calculation.

9 Aşağıda yer alan görsel üzerinde eşyaların fiyatları gösterilmiştir. Bu fiyatlardan yola çıkarak toplama işlemi kullanacağınız bir problem kurunuz ve problemi çözünüz.



₺379

₺3850

₺239

₺899

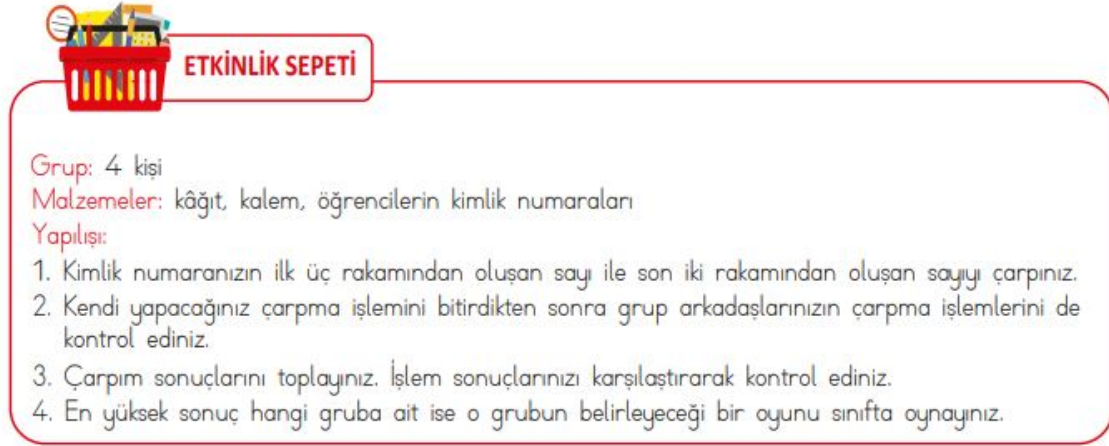
₺2349

₺1150

₺3275

Figure 3. The sample activity: Mathematical modeling (Kayapınar et al., 2019, p.59)

In the activity in Figure 3, visuals were presented and students were asked to create a problem according to the visuals and formulate it. With this feature, it is clear that the activity belongs to the modeling type.



ETKİNLİK SEPETİ

Grup: 4 kişi
Malzemeler: kâğıt, kalem, öğrencilerin kimlik numaraları
Yapılışı:

1. Kimlik numaranızın ilk üç rakamından oluşan sayı ile son iki rakamından oluşan sayıyı çarpınız.
2. Kendi yapacağınız çarpma işlemini bitirdikten sonra grup arkadaşlarınızın çarpma işlemlerini de kontrol ediniz.
3. Çarpım sonuçlarını toplayınız. İşlem sonuçlarınızı karşılaştırarak kontrol ediniz.
4. En yüksek sonuç hangi gruba ait ise o grubun belirleyeceği bir oyunu sınıfta oynayınız.

Figure 4. The sample activity: Real data analysis (Kayapınar et al., 2019, p.79)

As seen in Figure 4, students were asked to do the multiplication using their ID numbers in the activity. Since students use their identity layers as material, it can be said that it is an activity related to the real data analysis type because it contains a real context.

The Relationship of German Primary School 4th Grade Mathematics Textbook Activities with Real Life

As a result of the data analysis, the findings regarding the relationship between the German primary school 4th-grade mathematics textbook activities and real life are shown in Table 2.

Table 2. The relationship between German primary school 4th-grade textbook mathematics activities and real life

Real-Life Relationship Categories	<i>f</i>	%
“Real data analysis”	51	10,87
Classic "word problems"	285	60,77
“Hands-on representations of mathematical concepts”	85	18,12
“Mathematical modeling”	48	10,23
“Simple Analogies”	-	-
“Discussions of Mathematics”	-	-
Total	469	100

As seen in Table 3, the German primary school 4th-grade mathematics textbook activities are mostly in the type of "classical WORD problems" ($f=285$, 60.77%) among the real-life categories. In the second 10.87% of the activities ($f=85$) are in the type of "hands-on representations of mathematical concepts", in the third 18.12% of the activities ($f=51$) are "real data analysis", and in the fourth are the "mathematical modeling" ($f=48$) 10.23%. There are no activities related to "simple analogies and discussions of mathematics".

Examples of 4th-grade mathematics textbook activities in Germany are given in Figures 5, 6, and 7.



7 Ein guter Handel?
Fredo kauft von Fips ein gebrauchtes Fahrrad für 20 Euro.
Er verkauft es weiter an Frida für 30 Euro.
Einige Zeit später kauft er das Fahrrad von Frida für 40 Euro zurück.
Drei Tage später verkauft er das Fahrrad dann doch wieder für 50 Euro.
Wie viel Geld hat Fredo insgesamt gewonnen oder verloren?

a) Rechne und notiere deinen Lösungsweg.
b) Vergleiche eure Lösungswege und erkläre sie euch.
c) Stelle eure Lösungen und Lösungswege in der Klasse vor.

Denke dir selbst eine Rechengeschichte wie bei Aufgabe 7 aus.

Figure 5. The sample activity: Classical word problems (Ballins et al., 2019, p. 107).

As shown in Figure 5, "He bought a bicycle from Fredo Fispny for 20 Euros. After a while, he sold this bike to Frida for 30 Euros. He then bought a bike from Frida for 40 Euros. 3 days later he sold this bike for 50 Euros. Do you think Fedo gained in this transaction? Or did he lose? Build your solutions and share them with your classmates. Then, "classical daily problems" were asked in the form of "write your situation as in this question". The problem is more than just a classical problem, first an individual solution and then solutions were discussed and the students were asked to formulate a problem from their real situations. In this respect, it can be stated that this activity is both a classical problem type and a modeling type because it formulates calculations in a real situation for students.

- 2 Neben Leitungswasser, Mineralwasser und ungesüßten Tees sind auch Saftchorlen aus einem Teil Fruchtsaft und zwei Teilen Wasser als Getränke geeignet. Aber leider ist Saft nicht gleich Saft!

Getränke	Fruchtsaftanteile
1 l Apfelsaft	1000 ml
1 l Birnendirektsaft	1000 ml
1 l Orangenfruchtnektar	500 ml
1 l Aprikosenfruchtnektar	400 ml
1 l Johannisbeerfruchtnektar	250 ml
1 l Maracujafuchtsaftgetränk	100 ml
1 l Zitrusfruchtsaftgetränk	60 ml



- a) Lies aus der Tabelle ab, wie viele Milliliter Fruchtsaft die Getränke tatsächlich enthalten. Erstelle ein passendes Diagramm.
- b) Vergleiche eure Diagramme. Findet ihr auch eine Möglichkeit das Verhältnis von Fruchtsaft und Zuckerwasser darzustellen?



Ein Apfel und eine Karotte wiegen ungefähr je 150 g.

- 3 Schreibe einen Tag lang auf, wie viel du trinkst.

- 4 Robin hat einen Tag lang notiert, wie viel er getrunken hat und wie viel Obst und Gemüse er gegessen hat. Hat Robin an diesem Tag ausreichend Wasser zu sich genommen? Begründe.

2 Tassen Tee,
200 g Erdbeeren,
1 Glas Saftchorle,
300 ml Mineralwasser,
2 Karotten,
1 Apfel



Figure 6. The sample activity: Real data analysis type (Balins et al., 2019, p. 99).

As shown in Figure 6, the ratio of fruit juice and sugar in fruits and vegetables is given in the diagram in the activity related to measurement in the German primary school 4th-grade mathematics textbook. The students were asked to make calculations about how much of the vegetables and fruits they ate during the day were real fruit, how much sugar, and how much was real water, and they were asked to write these calculations in the form of a diagram. In this respect, it can be said that this activity is a type of real data analysis.

Welche Brüche sind gleich groß?

Wie musst du die Pizzas aufteilen, damit du sie gerecht an die Kinder verteilen kannst? Zeichne in dein Heft.

5

6

7

Figure 7. The sample activity: Hands-on representations of mathematical concepts (Balins, et al., 2019, p. 101).

As seen in Figure 7, in the activity related to the subject of fractions, the children shown in the pictures were asked how the pizzas would be distributed equally, and they were asked to draw

their evenly divided shapes in their notebooks. In this respect, it can be stated that this activity is in the type of representation of mathematical concepts.

Comparison of Turkish and German Primary School 4th-Grade Mathematics Textbooks Activities Connected to Real Life

As a result of the data analysis, the findings related to the comparison of the 4th-grade textbook activities in Turkish and German with real life are shown in Figure 8.

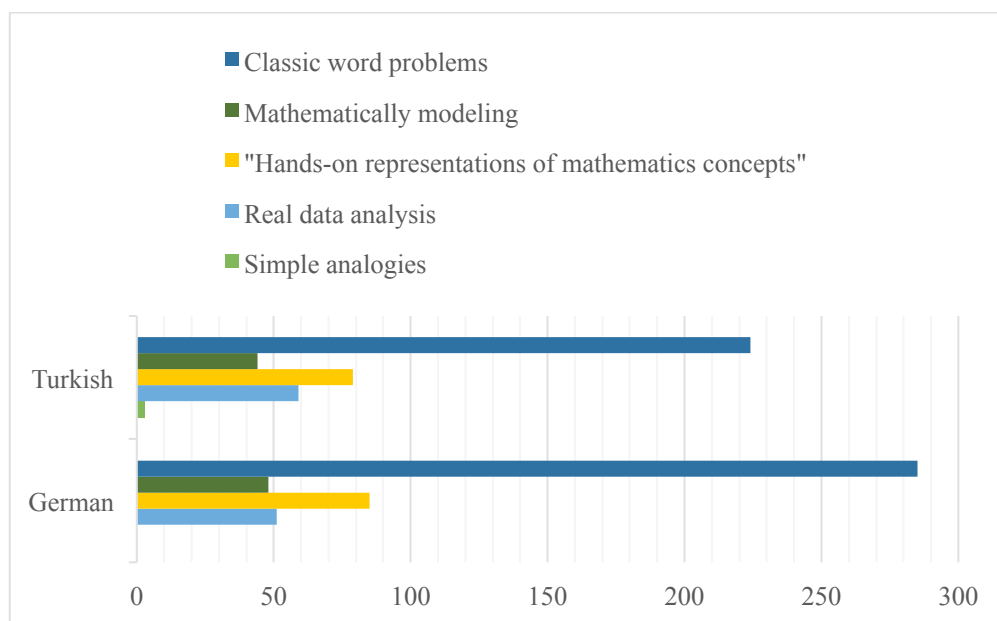


Figure 8. The relationship between Turkey and German primary school 4th-grade textbook activities and real life

As seen in Figure 8, Germany is the country where the activities of the primary school 4th-grade mathematics textbook have the highest correlation with real life. In second place is Turkey. This result is related to the total number of activities in the textbook. However, it is seen that the real-life representations of the activities in the primary school 4th-grade mathematics textbooks in Turkey and Germany follow in the same order. In the activities of both countries, classical word problems come first, application representations of mathematical models second, and real data analysis second. While the simple analogy type was included in the primary school mathematics textbook activities in Turkey, no simple analogy type activity was found in the German textbook.

Discussion and Conclusion

This research analyzes how the activities in the 4th-grade mathematics textbooks of Turkey and Germany are associated with real life based on the classification proposed by Gainsburg (2008). The findings of the study revealed that the number of activities in the primary school mathematics textbooks of both countries was different, and therefore showed that there were quantitative differences in associating activities with real life. According to the findings, a total of 469 activities in the German primary school 4th-grade mathematics textbook; A total

of 409 activities were analyzed in the Turkish primary school 4th-grade mathematics textbook.

Findings related to the first sub-purpose of the research showed that the activities in the 4th-grade Turkish primary school textbook were mostly "classical verbal problems" activities. However, it can be said that the problems are related to real life. In the second place, "application representations of mathematical concepts"; It was determined that "real data analysis" activities came in the third place. In light of these findings, it is clear that the activities in the Turkish primary school 4th-grade mathematics textbook present classical problems in real contexts. However, according to Gainsburg's (2008) classification, the fact that "real data analysis" type activities are not in the first place indicates that Turkey primary school 4th-grade textbook activities are partially related to real life. According to Greer (1997), word problems relate mathematics at school to the real world, but numerically presented information to children encourages them to solve the problem using appropriate data at hand. Therefore, although it includes the real context, it is a type of activity that can be analyzed in a school whose data are already given. With this feature, they can suspend students from making sense of a real-life problem. According to the literature studies supporting the findings of the first sub-purpose of the research (Altay, Erhan & Batı, 2020; Huang, 2004; Özgeldi & Osmanoglu, 2017; Lee, 2012; Mosvold & Fauskanger, 2013; Sawyer & McDonald, 2008), the actual contexts of the activities used in mathematics teaching Inclusion alone is not enough, the real-world connections in the activity should encourage children to take higher-order thinking skills.

Findings related to the second sub-purpose of the study show that in German primary school 4th-grade mathematics textbook activities, "classical verbal problems" type activities come first, "application representations of mathematical concepts" come second, and "real data analysis" activities come in third place. In light of these findings, it is concluded that there are activities similar to the activities in the 4th-grade mathematics textbook in Turkey. Another remarkable finding was that the activities included more than one variety. For example, the child was asked to formulate an activity belonging to a classical type of verbal problem in another question root at the same time. In this respect, activities belonging to the classical word problem type also include a skill that includes high-level thinking skills such as modeling. Literature studies (Altay, Yalvaç & Yeltekin, 2017; Hasbi, Lukito & Sulaiman, 2019; Smith & Morgan, 2016) or a realistic model in the activity help students connect mathematical thinking skills with real-world problems. Therefore, since Germany includes more than one type of activity in 4th-grade mathematics textbook activities, it can be said that it is partially related to real life. Pepin and Haggarty (2007) found in their study that the activities in German mathematics textbooks are of a type that can support children's perspectives on real-life connections, but that these connections should be supported to be more realistic and stronger.

Findings regarding the third sub-objective of the study show that although there are quantitative differences in primary school 4th-grade mathematics textbook activities in Turkey and Germany, they mostly have similar types of activities in terms of associating the activities with real life. This finding may be because the subjects of associating skills and basic concepts that should be taught to children at the primary school level in both countries

are the same. However, the fact that the number of activities in the German primary school 4th-grade mathematics textbook is high has directly led to an increase in the number of activity types. From this point of view, it would not be realistic to make an inference that real-life connections are presented more in German primary school 4th-grade mathematics activities. The point emphasized in this study is that the activities in the 4th-grade textbooks of primary schools in Turkey and Germany are in the "classical word problems" type, but the contents are supported by the real context. This result raises an important question that needs to be resolved again: "Can it be considered as a "real life related" activity type when real-life examples are presented in classical word problems? According to Gainsburg (2008), since the connection with real life is not fully determined, the activities must support the skills of associating and high-level thinking skills that can transfer knowledge to real life, such as "modeling". From this point of view, it can be said that the activities in the primary school 4th-grade mathematics textbooks of both countries are strong in terms of activities that will improve the student's association skills, such as the application representations of mathematical concepts.

Recommendations

The results obtained in this research are limited to the analysis of the activities in the 4th-grade textbooks of primary schools in Turkey and Germany. Within the framework of these limitations, the results of the research draw attention to the following suggestions for future studies;

- Enrichment of the activities in the primary school mathematics textbooks of both countries in the type of "modeling and real data analysis" that will improve the ability to relate
- More detailed examination of "modeling" type activities in the textbooks of both countries. Some problem activities can be created in such a way that modeling can be done.
- It is important to carry out studies on how students perceive the relationship of mathematics courses to real life to reach more specific findings.

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