



Research

DOI: 10.7822/omuefd.1646331

OMU Journal of Faculty of Education

2026, 45 (1), xxx-xxx

Evaluation of 5th Grade Mathematics Textbook in terms of Visual and Content

5.Sınıf Matematik Ders Kitabının Görsel ve İçerik Açısından Değerlendirmesi

Derya ZENGİN¹, Menekşe Seden TAPAN BROUTIN²

Received: 24.02.2025

Reviewed: 26.03.2026

Online Yayınlanma Tarihi: 30.06.2026

ABSTRACT

This study aims to evaluate the 5th-grade mathematics textbook, prepared with a student-centered and skill-oriented approach in line with the Century of Turkish Education Model, in terms of visual design, content depth, and TIMSS cognitive domains. Conducted within a case study design, data were collected via the systematic document review method and examined using the content analysis approach. According to the research findings, it was determined that 94.28% of the visuals in the textbooks were consistent with the content; however, this rate dropped to 89.36% in the "Natural Numbers" theme, and erroneous visuals capable of causing mathematical misconceptions (e.g., representing a line segment with a ray model) were found in the "Geometric Shapes" theme. Content analysis results show that the most frequently used task types in the books are "Examples" and "Activities," whereas metacognitive tasks such as "Mind Maps" and "Learning Diaries" remained limited. When the distribution of questions according to TIMSS cognitive domains was examined, it was determined that the "Applying" level was dominant at 59.44%, while the "Knowing" level remained at 16.73%, significantly below the targeted rate (40%). Regarding technology use, it was found that information access tools such as QR codes and e-content were prevalent (approximately 78%), but dynamic mathematics software (approximately 8%) and artificial intelligence applications were insufficient. Additionally, it was revealed that it is important to consider students' cognitive and physiological needs in the selection and design of visual elements. The obtained results indicate that while the textbooks support mathematical skill development, they need to be enriched in terms of conceptual depth and higher-order thinking skills.

Keywords: 5th-grade mathematics textbook, TIMSS cognitive domains, Task design, Visual design analysis, Document review.

Published: 30.06.2026

¹ Dr. Derya ZENGİN, Halil İnalçık Science And Art Center, derya_bilir@windowslive.com, ORCID: <https://orcid.org/0000-0001-9854-9664>

² Prof.Dr. Menekşe Seden TAPAN BROUTIN, Bursa Uludağ University, tapan@uludag.edu.tr, ORCID: <http://orcid.org/0000-0002-1860-852X>

Zengin, D. & Tapan Broutin, M.S. (2026). Evaluation of 5th Grade Mathematics Textbook in Terms of Visual and Content. *Ondokuz Mayıs University Journal of Faculty of Education*, xx(x), xxx-xxx. DOI10.7822/omuefd.1646331

ÖZ

Bu araştırmanın amacı, Türkiye Yüzyılı Maarif Modeli doğrultusunda öğrenci merkezli ve beceri odaklı bir yaklaşımla hazırlanan 5. sınıf matematik ders kitabını görsel tasarım, içeriksel derinlik ve TIMSS bilişsel alan düzeyleri açısından değerlendirmektir. Durum çalışması deseninde yürütülen araştırmada, veriler sistematik doküman incelemesi yöntemiyle toplanmış ve içerik analizi yaklaşımıyla incelenmiştir. Araştırma bulgularına göre; ders kitaplarındaki görsellerin %94,28 oranında içerikle uyumlu olduğu, ancak "Doğal Sayılar" temasında bu oranın %89,36'ya düştüğü ve "Geometrik Şekiller" temasında matematiksel kavram yanlışlığına (örn. ışın modeli ile doğru parçası gösterimi) yol açabilecek hatalı görsellerin bulunduğu tespit edilmiştir. İçerik analizi sonuçları, kitaplarda en sık kullanılan görev türünün "Örnek" ve "Etkinlik" olduğunu; ancak "Zihin Haritası" ve "Öğrenme Günlüğü" gibi üst bilişsel görevlerin sınırlı kaldığını göstermektedir. Soruların TIMSS bilişsel alanlarına göre dağılımı incelendiğinde; "Uygulama" düzeyinin %59,44 ile baskın olduğu, buna karşın "Bilme" düzeyinin %16,73 ile hedeflenen oranın (%40) oldukça altında kaldığı belirlenmiştir. Teknoloji kullanımında ise QR kod ve e-içerik gibi bilgiye erişim araçlarının (yaklaşık %78) yaygın olduğu, ancak dinamik matematik yazılımlarının (%8) ve yapay zekâ uygulamalarının yetersiz kaldığı saptanmıştır. Ayrıca, görsel öğelerin seçimi ve tasarımında, öğrencilerin bilişsel ve fizyolojik ihtiyaçlarının dikkate alınmasının önemli olduğu ortaya konmuştur. Elde edilen sonuçlar, ders kitaplarının matematiksel beceri gelişimini desteklemekle birlikte, kavramsal derinlik ve üst düzey düşünme becerileri açısından zenginleştirilmesi gerektiğini ortaya koymaktadır.

***Anahtar Sözcükler:** 5. sınıf matematik ders kitabı, TIMSS bilişsel alanları, Görev tasarımı, Görsel tasarım analizi, Doküman incelemesi.*

INTRODUCTION

Educational curricula and textbooks play a fundamental role in shaping society. In line with a country's educational policies, curricula not only define the knowledge, skills, and values expected of students but also directly shape the content and structure of textbooks. In this context, while educational curricula serve as a "user's manual" that guides society and determines individual development, textbooks function as "implementation guides" that give concrete form to these objectives. As the most important tool in mathematics education, textbooks therefore play a central role in implementing curricula within the scope of educational reforms (Amit & Fried, 2002). Moreover, it can be argued that textbooks are not merely materials for conveying content but rather didactic tools that determine how knowledge is structured. Consequently, their primary purpose is not to present information directly but to enable students to construct knowledge by placing them at the center through specific tasks and problem situations. Thus, the content of textbooks is one of the fundamental elements that determine the quality of the learning process (Brousseau, 1997).

In line with today's evolving understanding of education, the "Century of Turkish Education Model" published by the Ministry of National Education and based on the philosophical framework of the "virtue-value-action" trinity, represents a paradigm shift in the educational process (MoNE, 2024). This model adopts a "holistic educational approach" that views students as complete individuals, considering their cognitive, social, and emotional characteristics. Consequently, updating this model and its programs in a manner consistent with society's cultural codes and contemporary dynamics plays a critical role in managing social change (Demirel, 2009). However, textbooks prepared without this new theoretical framework and skills-based approach may mislead students. Textbooks serve not only as instructional tools but also play an influential role in students' holistic development (Başaran, 2007). Therefore, analyzing textbooks academically from both scientific and pedagogical perspectives, identifying potential implementation shortcomings, and implementing necessary measures are crucial for improving educational quality (Güder & Tutak, 2012).

A country's educational policies and teaching paradigms are of great importance in shaping the teaching process. The three fundamental elements identified as criteria within the Theory of Didactic Situations are the educator, the student, and knowledge. According to Brousseau's (1997) Theory of Didactic Situations, the learning process is viewed not as a process in which the teacher directly transmits knowledge, but rather as one in which the student constructs knowledge by interacting with a learning environment designed by the teacher. In this context, textbooks serve as a fundamental reference source

that defines the boundaries of the didactic contract between teacher and student. This established process not only ensures the functioning of the educational system but also enhances the efficiency of learning. Scientific knowledge is transformed into instructional content within a specific framework. Within this framework, textbooks represent one of the most effective resources used worldwide, including in Türkiye, for creating instructional content (Işık, 2008). Textbooks used in mathematics teaching are particularly important as they serve as guides for educators and play an instructional role for students (Thomson & Fleming, 2004).

While teachers play the most important role in the mathematics teaching process, one of the most fundamental tools they use is textbooks. This is because textbooks guide teachers' instructional decisions through "scenarios" that shape classroom practices (Remillard, 2005). For this reason, it is essential that the textbook writing process ensures effective mathematics instruction (Semerci & Semerci, 2004). Unlike other instructional tools, textbooks play a significant role in fostering lasting learning. Consequently, textbooks must possess the necessary qualities both visually and in terms of content to fulfill their intended functions (Çakır, 2009). Textbooks serve as a bridge between the intended curriculum and the curriculum as implemented in the classroom. Research indicates that textbooks not prepared in accordance with curriculum objectives are less effective than intended in the learning process (Incikabi, 2011). Consequently, it is emphasized that textbooks must be fully aligned with the established curriculum in all aspects and must comprehensively reflect the curriculum's objectives (Arslan & Özpınar, 2009; Ubuz et al., 2010).

An analysis conducted to determine whether mathematics textbooks meet the necessary criteria enables emphasis on the knowledge component within the Theory of Didactic Situations. Additionally, international standards such as TIMSS (Trends in International Mathematics and Science Study) and PISA are used as references to assess the competitiveness of textbooks at the international level (Severin & Capota, 2011; Törnroos, 2005). Consequently, TIMSS standards provide an international framework for classifying mathematical proficiency while also offering a strong theoretical foundation that allows for the analysis of cognitive processes within a hierarchical structure (Mullis et al., 2017). A similar approach has been adopted in mathematics teaching practices in Türkiye, as reflected in the explanations regarding the general vision of the MoNE curriculum (MoNE, 2009). In this context, the content of mathematics textbooks is evaluated within the framework of mathematical domains, based on the questions included in TIMSS. According to TIMSS, the cognitive domains which correspond to the revised version of Bloom's Taxonomy (1956) and denote the depth of knowledge processing are categorized as "knowing," "applying," and "reasoning," and are examined under these three main headings. According to TIMSS 2019 data, the cognitive domain percentages for 5th-grade students in mathematics target 40% for "knowing," 40% for "applying," and 20% for "reasoning." The first cognitive domain, "knowing," encompasses fundamental operations that students frequently use, such as recall, ordering/classifying, performing calculations, reading information, and measuring. The second cognitive domain, "applying," involves students transferring their conceptual understanding to standard problems. The third cognitive domain, "reasoning," focuses on solving problems that go beyond routine tasks: more complex, multi-step, and non-routine problems (Mullis et al., 2012). The "higher-order thinking skills" and "deep learning" objectives of the Century of Turkish Education Model show a strong overlap with TIMSS's "application" and "reasoning" domains.

Various question types in mathematics textbooks serve distinct educational purposes. Consequently, the strategic use of diverse question formats such as examples, problems, activities, and assessment items optimizes the teaching process. These questions not only allow students to practice but also contribute to the systematic development of their conceptual frameworks. Knowledge-level questions help students establish connections between mathematical operations and develop their practical skills. Additionally, application-level questions enable students to draw inferences and formulate

independent solution strategies. Furthermore, textbooks must incorporate non-routine, real-world problems to cultivate students' reasoning skills. Textbooks must include examples, problems, activities, and assessment materials that encourage inquiry, support creative thinking, and establish connections with real-life contexts (Yeğit, 2020). These pedagogical requirements underscore the need for a more in-depth examination and analysis of textbooks.

It is well known that differences in the learning opportunities presented to students in mathematics textbooks lead to differences in their academic achievement (Törnroos, 2005). This finding underscores the need for a more in-depth analysis of textbooks (Ginsburg & Leinwand, 2005; Zhu & Fan, 2004). Research on textbooks generally focuses on topics such as content distribution, question types, tools used, and forms of representation (Floden, 2002; Törnroos, 2005). However, a review of the literature reveals that no study has been conducted on the 5th-grade mathematics textbook developed based on the "conceptual learning" and "holistic development" approaches adopted by the Century of Turkish Education Model. It is anticipated that this study will help address this gap in the literature partially. The purpose of this study is to conduct a multidimensional evaluation of the 5th-grade mathematics textbooks developed in line with the Century of Turkish Education Model in terms of visual design principles, alignment with the curriculum, TIMSS cognitive domain levels, depth of mathematical content, and use of technology. Within the scope of this study, the types of tasks (sample questions, problems, exercises, activities, and assessments) and visual-textual elements in the 5th-grade mathematics textbooks 1 and 2 were examined in detail to determine the extent to which the textbooks reflect the "skills-based" vision of the targeted education model. In this context, the study aims to answer the questions: "What are the visual design elements of 5th-grade mathematics textbooks?" and "What are the content elements of 5th-grade mathematics textbooks?" It is expected that the findings from this study will serve as an important foundation for developing more effective and comprehensive textbooks, thus improving the quality of the teaching and learning process while enhancing students' mathematical thinking skills.

METHOD

The methods section of the study provides information on the research model, the data collection process, data analysis, and issues related to validity and reliability.

Research Model

In this study, the case study design – one of the qualitative research methods – was adopted to evaluate a 5th-grade mathematics textbook in terms of its visuals and content. A case study is an approach that delimits a phenomenon in terms of time and space and analyzes it holistically and in depth through multiple data sources (Creswell & Poth, 2018). Within the scope of this design, document analysis was used as the data collection technique. Document analysis, which allows for the systematic examination of sources, is a process that involves selecting, organizing, interpreting, and synthesizing data (Sak et al., 2021). In this context, the visual and textual elements contained in the textbooks were collected and analyzed through systematic document review.

Data Collection Tools

In line with the study's objective, the 5th-grade Mathematics-1 and Mathematics-2 textbooks published by the Ministry of National Education (MoNE) Publications and distributed in schools during the 2023–2024 academic year were used as data collection tools. These textbooks were selected using "criterion sampling," one of the purposeful sampling methods. The criteria established were that these textbooks must have been approved by the MoNE's Board of Education and accepted as official textbooks; they must have been prepared in line with the core vision of the Century of Turkish Education Model; and they must serve as the most widely used core instructional material in public schools nationwide.

Data Analysis

In analyzing the data obtained within the scope of this research, the content analysis technique was used, which refers to the process of systematically processing of the collected data and organizing and interpreting it within the framework of specific concepts and themes (Yıldırım & Şimşek, 2013). Accordingly, the analysis process was conducted along two main dimensions: visual and content-based. In the visual analysis dimension, the visuals included in the textbooks were classified in terms of pedagogical appropriateness (appropriate, inappropriate, erroneous) and their functional necessity in the problem-solving process, and were described using frequency and percentage values. In the content and mathematical analysis dimension, the texts and questions were coded in terms of alignment with the curriculum, TIMSS cognitive domain levels (knowing, applying, reasoning), and the use of technology. Furthermore, the precision of mathematical definitions, conceptual accuracy, use of terminology, and potential conceptual misunderstandings were examined in-depth from a qualitative perspective; the identified mathematical and pedagogical limitations were tabulated and interpreted.

The 5th-grade Mathematics-1 and Mathematics-2 textbooks published by the Ministry of National Education (MoNE) were analyzed in accordance with the cognitive domain criteria defined within the TIMSS assessment framework. Turkey first participated in TIMSS 2011 at the 4th-grade level, and the TIMSS criteria were updated and revised in 2019. As part of the analysis, all examples, problems, questions, and exercises included in the subject explanations within the 5th-grade Mathematics-1 and Mathematics-2 textbooks were considered as units of analysis within the cognitive domain framework. These units of analysis were classified according to the TIMSS cognitive domains (Knowledge, Application, Reasoning). Each unit of analysis was coded using the sub-behavioural indicators listed in Tables 1 and 2 as a reference and categorized accordingly.

Table 1.
Percentage Distribution of Behaviours by Cognitive Domain

Cognitive Domain	Percentage (%)
	Grade 5 Mathematics
Knowledge	40%
Application	40%
Reasoning	20%

Table 2.
Behaviours Measured in Knowledge, Application, and Reasoning Domains

Knowledge	Application	Reasoning
<ul style="list-style-type: none"> • Recall • Description • Definition • Giving examples • Using tools, processes, and methods 	<ul style="list-style-type: none"> • Comparison/Classification • Using models • Making connections • Interpreting information • Finding solutions • Explanation 	<ul style="list-style-type: none"> • Analysis • Synthesis • Hypothesis formation • Design/Planning • Drawing conclusions • Generalization • Evaluation • Proving

Validity and Reliability

The validity and reliability of the study were addressed within the framework of the criteria of credibility, transferability, dependability, and confirmability proposed by Lincoln and Guba (1986). Accordingly, the measures taken during the process are explained below:

Dependability: Dependability refers to the alignment of results with the data collected, rather than the reproducibility of findings (Merriam, 2018). The primary goal of ensuring dependability in research is to ensure that research questions are formulated clearly, comprehensibly, and accurately. In this context, care was taken to ensure that the research questions were consistent with the research methods used. Additionally, expert opinions were utilized during the research process, thereby contributing to the assurance of dependability.

Confirmability: Confirmability refers to establishing a logical connection between the data obtained during the research process and the research findings, as well as ensuring that the research process can be verified retrospectively (Yıldırım & Şimşek, 2013). In line with this, the process was regularly documented in this study, and confirmability was ensured by recording the accuracy of the data obtained. Furthermore, to ensure the reliability of the data analysis, the coding was reviewed by an independent expert, and the inter-rater agreement coefficient calculated using the formula by Miles and Huberman (1994) was found to be 87%. This rate, which exceeds the 70% threshold accepted in the literature, demonstrates that the analysis process was consistent and reliable.

Credibility: To ensure credibility, in-depth data collection methods were used during the research process; the collected data were examined from various perspectives, and different strategies, such as expert opinions, were employed (Yıldırım & Şimşek, 2013). During the research, the opinions of a faculty member specializing in the field were sought, and the data collected throughout the research process were continuously monitored and analyzed to ensure they were accurately understood.

Transferability: In qualitative research, it is important to conduct the description process in detail to ensure transferability. Accordingly, the data obtained during the research process were organized in a manner appropriate to their nature and presented clearly and in detail within the framework of various concepts and themes.

FINDINGS

The findings were analyzed in detail under two main headings: an examination of mathematics textbooks in terms of visual elements and an examination of their content.

1. *An Analysis of Mathematics Textbooks in Terms of Visual Elements*

When examining the mathematics textbooks from a visual perspective, the themes and their relationship to visual design were analyzed first. Table 3 presents the main themes and subtopics found in the 5th-grade Mathematics Textbook 1 and Textbook 2.

Table 3.

Mathematics Topics in the 5th Grade Mathematics-1 and Mathematics-2 Textbooks

Theme 1: Geometric Shapes	Content (Conceptual Framework)
<ul style="list-style-type: none"> • Basic Geometric Shapes and Properties • Properties of Basic Geometric Constructions • Measuring Angles • How Are Angles Measured? • The Journey of Lines 	<ul style="list-style-type: none"> • Point • Circle • Perpendicular • Intersection of Two Lines • Lines that Do Not Form Angles in a Plane • Coincidence of Two Lines • Parallelism of Three Lines • Intersection of Three Lines at a Point

<ul style="list-style-type: none"> • From Lines to Polygons • Basic Elements of Polygons • Triangle • Triangle Construction 	<ul style="list-style-type: none"> • Mind Map Creation • Pairwise Intersection of Three Lines • Two Parallel Lines and a Transversal
<p>Theme 2: Numbers and Quantities (1): Natural Numbers and Operations</p> <ul style="list-style-type: none"> • Natural Numbers and Operations 	<ul style="list-style-type: none"> • Reading and Writing Multi-digit Natural Numbers • Solving Real-life Problems
<p>Theme 3: Geometric Quantities</p> <ul style="list-style-type: none"> • Perimeter of a Rectangle • Area of a Rectangle • Perimeter and Area of a Rectangle 	<ul style="list-style-type: none"> • Perimeter of a Rectangle • Area of a Rectangle • Perimeter and Area of a Rectangle
<p>Theme 4: Numbers and Quantities (2): Fractions</p> <ul style="list-style-type: none"> • Fractions 	<ul style="list-style-type: none"> • Representing Fractions in Different Forms • Comparing Fractions
<p>Theme 5: Statistical Research Process</p> <ul style="list-style-type: none"> • Statistical Research Process • Data Visualization Tools • Statistical Literacy • Data Variability 	<ul style="list-style-type: none"> • What is Statistics? • Steps in Statistical Research • Writing Survey Questions Appropriate to Research Questions • Column Chart • Pie Chart
<p>Theme 6: Algebraic Thinking with Operations</p> <ul style="list-style-type: none"> • Conservation of Equality and Operation Properties • Order of Operations • Number and Shape Patterns 	<ul style="list-style-type: none"> • Order of Operations • Number Patterns • Shape Patterns • Pattern Creation
<p>Theme 7: From Data to Probability</p> <ul style="list-style-type: none"> • Probability of Events • Probability Spectrum 	<ul style="list-style-type: none"> • Probability Spectrum • Certain Event • Pattern Creation

Table 3 presents the seven main themes found in 5th-grade Mathematics textbooks 1 and 2 and the subtopics covered by these themes. The table shows that the textbook content follows a structure aligned with the curriculum, ranging from the "Geometric Shapes" theme to the "From Data to Probability" theme.

The themes in 5th-grade Mathematics textbooks 1 and 2 were examined in terms of the visuals associated with the topics within these themes. In this analysis, the extent to which the visuals supported the learning objectives of the topics within the themes, their contribution to problem-solving processes, and their appropriateness to the content were evaluated. As part of the visual analysis, the pedagogical appropriateness (appropriate, inappropriate, incorrect) of the visuals used in these themes was examined. The numerical data obtained are presented in Table 4.

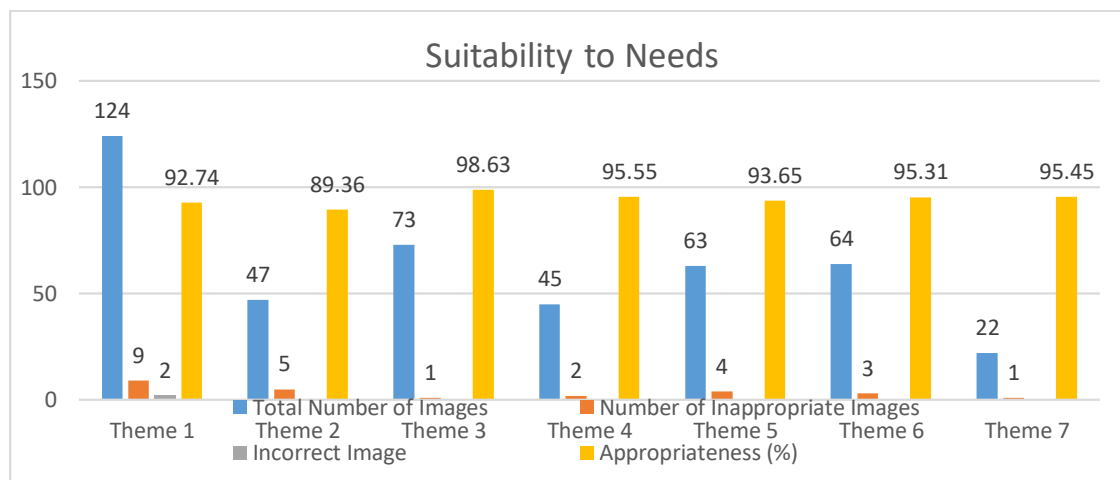
Table 4.

Numerical Distributions of the Images in the 5th-Grade Mathematics Textbooks 1 and 2 Based on Their Appropriateness

Images	Theme -1	Theme -2	Theme -3	Theme -4	Theme -5	Theme -6	Theme -7	Percentage (%)
Appropriate Images	115	42	72	43	59	61	21	94.29%
Inappropriate Images	7	5	1	2	4	3	1	5.25%
Incorrect Images	2	0	0	0	0	0	0	0.46%
Total	124	47	73	45	63	64	22	100%

As shown in Table 4, the analysis of image appropriateness indicated that 94.29% of the images were appropriate, 5.25% were inappropriate, and 0.46% were incorrect. Inappropriate images were observed across all themes, whereas incorrect images were identified only in Theme 1.

The results of the analysis conducted to determine the role of visuals in the problem-solving process are presented in Figure 1.

**Figure 1.**

Suitability of Visuals for the Problem-Solving Process

Upon examining the images included in each theme, as shown in Figure 1, it was determined that the vast majority of the images were consistent with the relevant content (with a consistency rate ranging from 85% to 98%). In Theme 1, which covers Geometric Shapes, the alignment rate was 92.74%; in Theme 2, which covers Natural Numbers and Operations, it was 89.36%; in Theme 3, which covers Geometric Quantities, it was 98.63%; 95.55% in Theme 4, which covers “Fractions”; 93.65% in Theme 5, which covers the “Statistical Research Process”; 95.31% in Theme 6, which covers “Algebraic Thinking Through Operations”; and 95.45% in Theme 7, which covers the “From Data to Probability” topic. It was observed that the greatest inconsistency in the visuals was in the “Natural Numbers and Operations” theme, while the highest consistency was in the “Geometric Quantities” theme.

The assessment of visual suitability, as quantitatively presented in Figure 1, is illustrated below with specific examples. Examples are provided for each category: appropriate visuals, inappropriate visuals, and incorrect visuals.

Example of a Conceptually Incorrect Image (Theme 1): In Image 1, a pencil figure used in teaching the "Geometric Shapes" theme is shown being used to concretize the concept of a "line segment." Mathematically, in Euclidean geometry, a line segment is a concept with two finite endpoints that consists of a measurable set of points. However, it has been determined that the pencil figure used in the image with one open end (the writing tip) and the other closed is closer to the model of a "ray," which has a starting point but extends indefinitely in the other direction, and may lead to conceptual misunderstanding. For this reason, the pencil figure in question has been evaluated as a conceptually incorrect image, as it causes cognitive confusion among students regarding the mathematical modelling of the concepts of "line segment" and "ray." Image 1 is presented below.

Örnek 5

Aşağıdaki her bir görselde birer doğru parçası modeli belirleyiniz. Belirlediğiniz doğru parçası modellerini isimlendirerek sembolle gösteriniz. Bu doğru parçalarının uzunluklarını cetvel ile ölçüp ölçüm sonuçlarınızı doğru parçalarının altına santimetre cinsinden yazınız.



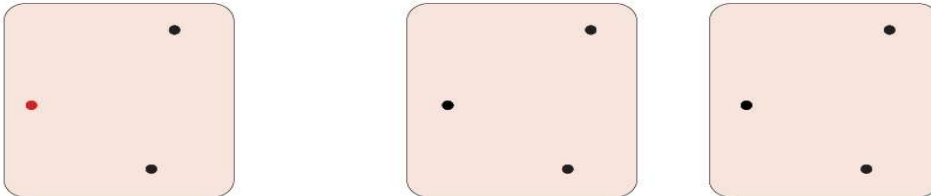
Image 1.

Incorrect Use of an Image (Fifth-Grade Textbook, Vol. 1, p. 23)

Visually Inaccurate from a Physiological Perspective (Theme 1): In Image 2, it can be seen that the colour red was chosen to represent the dots. It has been determined that the use of red dots could pose difficulties, particularly for students with colour blindness, and that this violates "universal design principles." Therefore, the image used as teaching material has been deemed flawed because it negatively affects the perceptual processes of students with physiological disabilities. Image 2 is presented below.

Etkinlik 5 Açık Oluşturma

Aşağıdaki noktaları isimlendiriniz. Daha sonra ilk kutuda kırmızı noktadan, diğer kutularda da sizin seçtiğiniz herhangi bir noktadan diğer noktalara ayrı ayrı ışınlar çiziniz.



Yaptığınız işlemin sonunda ortaya çıkan şekli arkadaşlarınızla karşılaştırarak düşüncelerinizi paylaşınız.

Image 2.

Incorrect Use of Images (Fifth-Grade Textbook, Vol. 1, p. 23)

Pedagogically Appropriate Image (Theme 6): Image 3, used in the book within the framework of the "Algebraic Thinking Through Operations" theme, was designed based on the concepts of a balance scale and equilibrium to emphasize algebraic thinking. In the mathematics teaching process, the "scale model" is one of the most effective structures for illustrating that the concept of equality in algebraic expressions is not a "calculation" but a "state of balance," and for concretizing the principle of maintaining balance on both sides. For this reason, it has been determined that the image used is effective in helping students make sense of abstract algebraic concepts, and it has been academically evaluated as pedagogically functional and appropriate. Image 3 is presented below.

1) Aşağıdaki kefeli terazinin sol kefesinde 42 adet bilye, sağ kefesinde ise 10 adet bilye bulunmaktadır.



Remzi, terazinin sol kefesinden önce 1, sonra 3, daha sonra 5 adet bilye olacak şekilde her defasında bir öncekinden 2 bilye fazla alarak terazinin sağ kefesine aktarıyor.

Her bir bilyenin kütlesi eşit olduğuna göre aşağıdaki soruları cevaplayınız.

a) Remzi, sağ kefeye kaçınıcı kez bilye aktardığında terazinin dengesi sağlanmış olur?

A) 3

B) 4

C) 5

D) 6

Image 3.

Appropriate Use of Images (Fifth-Grade Textbook, Vol. 2, p. 160)

Pedagogically Inappropriate Image (Theme 4): Image 4 describes the purchasing process for pens from different brands that have the same features and prices, as well as the discount offered during this process. However, it was observed that the image in question does not contain any data that contributes to the problem-solving process (e.g., modeling, grouping, or identifying patterns). Furthermore, it was determined that the problem could be solved using only the data provided in the problem text, without the need for the image. Therefore, it is believed that the image distracts the student's attention and causes an "unnecessary cognitive load." Consequently, it was concluded that the image should be evaluated as inappropriate. Image 4 is presented below.

Etkinlik 7 Uygun Fiyat



Umay, öncesinde inceleyerek beğendiği, özellikleri ve fiyatları aynı olan farklı markalara ait iki kalemden birini almak için kırtasiyeye gidiyor.

A marka kalemin fiyatına %40, B marka kalemin fiyatına ise %30 zam geldiğini öğreniyor.

1) Sizce Umay, daha uygun fiyatlı kalemi almak için hangi markayı tercih etmelidir? Karar verme sürecinizi açıklayarak arkadaşlarınızla paylaşınız.

Image 4.

Inappropriate Use of Images (Fifth-Grade Textbook, Vol. 2, p. 43)

2. Analysis of Mathematics Textbooks in Terms of Content Elements

As part of the analysis of mathematics textbooks in terms of content elements, the following were examined: the space allocated to themes in the curriculum and in the textbook; the distribution of task types; TIMSS cognitive domain levels; the depth of mathematical content; conceptual analysis; and the use of technology.

Comparison of the Allocation of Space to Themes in the Curriculum and Textbooks:

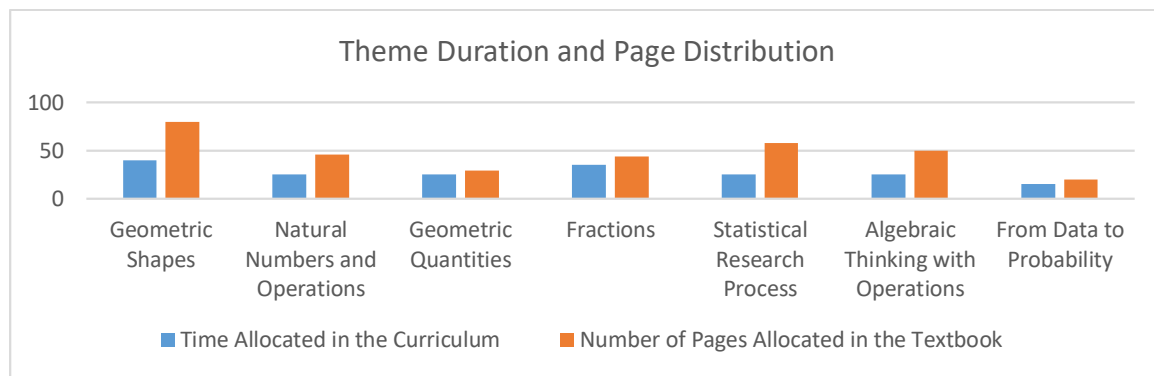
The distribution of themes in textbooks in line with the curriculum's objectives was examined, as well as the alignment between the time allocated to themes in the textbook and the time prescribed in the curriculum. A comparison of the number of pages allocated to themes in the textbook with the number of class hours prescribed in the curriculum is presented in Table 5.

Table 5.
Space Allocated to Themes in the Curriculum and Textbooks

Themes	Curriculum Content		Textbook Coverage	
	Class Hours	%	Pages	%
Geometric Shapes	40	21.05%	80	24.46%
Numbers and Quantities (1): Natural Numbers and Operations	25	13.15%	46	14.06%
Geometric Quantities	25	13.15%	29	8.86%
Numbers and Quantities (2): Fractions	35	18.42%	44	13.45%
Statistical Research Process	25	13.15%	58	17.73%
Algebraic Thinking with Operations	25	13.15%	50	15.29%
From Data to Probability	15	7.89%	20	6.11%

According to Table 5, the first introductory theme, "Geometric Shapes," spans 80 pages, accounting for 24.46% of the book. This theme has the largest volume and, with 40 class hours, covers 21.05% of the fifth-grade curriculum. It is the theme with the highest number of pages in the book compared to other themes. The "Numbers and Quantities (1): Natural Numbers and Operations" theme is presented over 46 pages, constituting 14.06% of the book's content and 13.15% of the curriculum content with 25 class hours. The "Numbers and Quantities (2): Fractions" theme spans 44 pages, constituting 13.45% of the book, and accounts for approximately 18.42% of the curriculum content, corresponding to 35 class hours. The "Statistical Research Process" theme is the second-largest in terms of page count, comprising 58 pages, which make up 17.73% of the book. It corresponds to 13.15% of the curriculum, with 25 class hours. The "Algebraic Thinking Through Operations" theme comprises 50 pages, accounting for 15.29% of the book, and 25 class hours, accounting for 13.15% of the curriculum. The final theme, "From Data to Probability," consists of 20 pages representing 6.11% of the book and 15 class hours representing 7.89% of the curriculum; it is the theme with the fewest pages and class hours in both the book and the curriculum. The fifth-grade math course consists of a total of 190 hours and 327 pages.

Figure 2 compares the number of pages allocated to each theme in the 5th-grade mathematics textbooks with the instructional time allocated to these themes in the curriculum, and presents the results in percentages.

**Figure 2.**

A Comparison of Themes in Terms of Time Allocated in the Curriculum and Pages Allocated in the Textbooks

As shown in Figure 2, there is a noticeable discrepancy between the number of pages allocated to the themes “Geometric Shapes,” “Statistical Research Process,” and “Algebraic Thinking Through Operations” in the textbook and the time allotted to these themes in the curriculum. In other themes, however, a consistent distribution is observed between the number of pages in the textbook and the time allocated in the curriculum.

In the 5th Grade Mathematics Textbook-1 and Mathematics Textbook-2, each theme was examined in detail, and the results of the analysis of the types of tasks included in these themes, along with the corresponding numerical distributions, are presented in Table 6.

Table 6.

Frequency Distributions of Task Types in the 5th-Grade Mathematics Textbooks 1 and 2

Task Types	Theme-1	Theme-2	Theme-3	Theme-4	Theme-5	Theme-6	Theme-7
Preparatory Questions	30	14	6	7	6	12	3
Example	40	7	7	14	22	20	4
Activities	28	8	8	16	21	24	7
Performance Task	1	1	1	1	3	1	1
Mind Map Creation	2	0	0	0	0	0	0
Progress Test	3	6	0	9	0	5	2
Problem	0	26	5	0	0	0	0
Learning Log	1	0	0	0	0	0	0
Assessment and Evaluation	13	3	5	6	11	5	6
Total	118	65	32	53	63	67	23

An examination of Table 6 reveals that, in the numerical distribution of task types found in the 5th-grade Mathematics textbooks 1 and 2, the most common task types are examples (114), activities (112), and assessment and evaluation questions (49), while the least common task types are mind mapping and learning logs. It was found that the tasks involving learning logs (1) and mind mapping (2) were limited in number and appeared only in the "Geometric Shapes" theme.

TIMSS Cognitive Domain Analysis:

Based on the questions included in TIMSS, the content of Mathematics textbooks is classified under three main headings: The cognitive domains in mathematics (knowing, applying, and reasoning). In this context, all questions examined in the textbooks were evaluated according to these cognitive

domains, and the number of questions and their percentage distributions for each cognitive domain are presented in Table 7.

Table 7.
Distribution of Questions by Theme and Cognitive Domain

Cognitive Domains	Theme-1		Theme-2		Theme-3		Theme-4		Theme-5		Theme-6		Theme-7		TIMSS %
	Q.n	Q.%	Q.n	Q.%	Q.n	Q.%	Q.n	Q.%	Q.n	Q.%	Q.n	Q.%	Q.n	Q.%	
Knowing	93	35.90	18	9.18	14	18.42	18	8.45	9	5.96	32	17.77	10	11.90	40
Applying	113	43.62	149	76.02	25	32.89	164	76.99	87	57.61	111	61.66	40	47.61	40
Reasoning	53	20.46	29	14.79	37	48.68	31	14.55	55	36.42	37	20.55	34	40.47	20
Total	259	100	196	100	76	100	213	100	151	100	180	100	84	100	100

Number of Questions: Q.n. Question Percentage: Q.%

Table 7 organizes the questions according to cognitive domains and compares them with the percentages determined by TIMSS for cognitive domains. TIMSS cognitive domain ratios are 40% for the knowing domain, 40% for the applying domain, and 20% for the reasoning domain.

When the questions in Theme 1 are compared with the TIMSS cognitive domain distribution, they generally align with the expected proportions for knowing, applying, and reasoning. The percentages for Theme 1 are 35.90% for the knowing domain, 43.62% for the applying domain, and 20.46% for the reasoning domain.

For Theme 2, the percentages are 9.18% in the knowing domain, 76.02% in the applying domain, and 14.79% in the reasoning domain. Notably, the applying domain is significantly overrepresented (approximately 36% higher than the TIMSS standard of 40%), while the knowing domain is considerably underrepresented.

In Theme 3, the knowing domain accounts for 18.42%, the applying domain for 32.89%, and the reasoning domain for 48.68%. This distribution deviates substantially from TIMSS cognitive domain percentages.

In Theme 4, the knowing domain represents 8.45%, the applying domain 76.99%, and the reasoning domain 14.55%. The knowing domain is 31.55% lower than the expected value, while the applying domain is 36.99% higher. The reasoning domain ratio, however, approximates the expected value.

In Theme 5, the knowing domain accounts for 5.96%, the applying domain for 57.61%, and the reasoning domain for 36.42%, revealing a significant imbalance among the cognitive domains.

In Theme 6, the reasoning domain fully met the TIMSS standard (20%) with a rate of 20.55%. However, while the knowing domain (17.77%) fell short of the target rate, the applying domain (61.66%) significantly exceeded the 40% standard and emerged as the dominant domain.

In Theme 7, the applying domain showed a distribution close to the expected value (40%) at 47.61%. In contrast, the knowing domain, which should have been 40%, was represented by only 11.90%, while the reasoning domain, expected to be 20%, reached 40.47%, doubling the standard.

Based on all this information, all questions in the 5th-grade Mathematics textbooks 1 and 2 were examined according to the specified cognitive domains, and the percentage distribution of the questions was analyzed. In this context, the percentage distributions of the questions examined in the textbooks within each cognitive domain are presented in Table 8.

Table 8.*Number and Percentage Distribution of Questions by Cognitive Domain*

Cognitive Domains	Number of Questions Across All Themes by Cognitive Domain	%	TIMSS %
Knowing	194	16.73%	40%
Applying	689	59.44%	40%
Reasoning	276	23.81%	20%
Total	1159	100%	100%

Upon examining Table 8, it is evident that the distribution of questions across cognitive domains differs considerably from the proportions proposed by TIMSS. Although the expected proportion for the knowing domain is 40%, only 16.73% of the questions fall into this category, representing a deficit of 23.27 percentage points. In contrast, the applying domain accounts for 59.44% of the questions, which is 19.44 percentage points higher than the TIMSS benchmark of 40%. Similarly, the reasoning domain constitutes 23.81% of the questions, exceeding the expected 20% by 3.81 percentage points. Overall, these findings indicate that the cognitive distribution of questions in the textbooks does not align with TIMSS standards.

Depth of Mathematical Content and Conceptual Analysis:

In mathematics education, the Century of Turkish Education Model aims to foster discovery, in-depth understanding, and mathematical literacy rather than a rote-learning approach. To achieve these goals, the mathematical content in textbooks must be error-free and possess conceptual depth. However, upon examining the textbooks, various mathematical and pedagogical limitations were observed in the way certain topics are addressed. These limitations are detailed in Table 9.

Table 9.*Mathematical Limitations Identified in 5th Grade Mathematics Textbooks*

Theme/Topic	Page	Identified Issue	Mathematical Limitations
THEME 1: Geometric Shapes (Point)	p. 17	Defining a point as "dimensionless" and immediately stating it is "the trace left by a pencil."	The distinction between the abstract (dimensionless) mathematical concept and the concrete (dimensional) physical model has not been clarified. This situation may lead students to think of a point as a "small circle" (a shape with area).
THEME 1: Geometric Shapes (Definition of Parallelism)	p. 36	Parallel lines are defined as "lines with constant distance between them"; the property of "non-intersecting lines" remains in the background.	While the definition of "equidistance" is appropriate, mathematically, the fundamental property of parallelism is "having no common point." The property of non-intersecting lines should be emphasized.
THEME 1: Geometric Shapes (Modelling)	p. 16	Depicting airplane routes on the map of Türkiye as "straight lines" (line model).	The shortest distance on a spherical surface like Earth is not the same as a straight line on a plane. Although presented in a simplified manner, it carries the risk of misconception because the "limitation of the model" is not specified.

THEME 1: Geometric Shapes (Definition of Polygon)	p. 58	A polygon is defined as "a closed shape formed by the intersection of lines." However, a polygon is "a combination of line segments."	The definition of intersection of lines may cause confusion in the student's mind between the boundaries of the shape and the extensions of the lines. The concept of combination of line segments should be used.
THEME 1: Geometric Shapes (Diagonal and Convexity)	p.69	All diagonal examples are selected from convex polygons.	This situation may cause students to develop an incorrect generalization that "diagonals are only inside the polygon." It should be demonstrated that with concave polygons, diagonals can extend outside.
THEME 2: Numbers (Place Value)	p. 100- 102	Teaching the concept of place value predominantly through "multiplication operations"; a weak connection between "empty" rods on the abacus and zero.	The emphasis that zero is not "nothingness" but positionally a "placeholder" remains weak. This situation may lead to place value shifting errors.
THEME 2: Numbers (Estimation Strategies)	p.120	The "rounding" strategy is used in price estimates, but the risk of rounding up and down on the budget is not addressed.	In real-life problems, when calculating budgets, not only the "round to the nearest ten" rule should be taught, but also the "round up" strategy according to the situation by making safe estimates.
THEME 2: Problem Solving (Strategy)	p. 111- 113	Presenting problem-solving strategies as a 10-step, intensive, and complex process.	Over-detailing Polya's 4-step model is complex for 5th-grade students and may alienate students from the problem-solving process.
THEME 2: Problem Solving (Shortcut Operations)	p. 125	Multiplication/division by 10, 100, 1000 is presented as the "adding/removing zeros" rule.	Although this approach provides operational convenience, it conceptually hides the logic of "changing place value."
THEME 3: Geometric Quantities (Definition of Area)	p. 146	Defining the concept of area as "counting unit squares" and "rows x columns."	Area is a continuous quantity. Rather than counting units, it makes it difficult to understand the area of shapes whose side lengths are rational and decimal numbers.
THEME 3: Geometric Quantities (Language)	p. 152- 153	Persistent use of the expression "Area Measure" in texts and tables.	In mathematical language, "measure" refers to the unit (m^2 , cm^2). Instead of calling the quantity itself "area measure," the expression "Area" or "Area value" should be used.
THEME 3: Context (Reality)	p. 150	Providing examples with extreme dimensions unsuitable for home use, such as 2m x 12m in carpet problems.	According to realistic mathematics education principles, unrealistic dimensions can distance students from modeling.
THEME 4: Fractions (Ordering)	p. 43	Lack of specific misconception-correcting strategies for comparing decimal numbers with different numbers of digits, such as 0.5 and 0.45.	To correct the misconception students bring from whole numbers that "the one with more digits is larger" (overgeneralization error), the strategy of "equalizing digits by adding zeros" should be emphasized more.

THEME 5: Data Analysis (Graphs)	p. 90	Coding categories in graphs using only colours.	This poses a risk of data loss for colour-blind individuals.
---------------------------------	-------	---	--

Analysis of the data in Table 9 reveals various limitations in the mathematical content structure of the textbooks. Therefore, textbooks must be re-examined not only to address curriculum objectives but also to adopt an approach that ensures accurate use of mathematical language and models while preventing conceptual misconceptions.

Use of Technology:

As a result of the analyses conducted, when evaluating the content of textbooks in terms of technological compatibility, the first step was to determine which types of instructional technologies were used. The types of instructional technologies used in textbooks to facilitate the learning of mathematical concepts are presented in Table 10.

Table 10.
Type and Percentage of Technological Tools Used/Recommended

<i>5th Grade Elementary Mathematics Textbook-1 and Mathematics Textbook-2</i>								
Technological Tools	Theme-1	Theme-2	Theme-3	Theme-4	Theme-5	Theme-6	Theme-7	(%)
Dynamic Software	9	0	0	0	0	0	0	8.33
Differentiated Activities	1	0	1	1	1	1	1	5.56
Calculator	0	1	0	0	0	0	0	0.93
E-content	2	4	6	4	11	3	4	31.48
Web 2.0	2	0	2	1	2	0	1	7.41
Artificial Intelligence	0	0	0	0	0	0	0	0.00
QR Code-directed Activities	12	3	8	5	13	4	5	46.30
Total	26	8	17	11	27	8	11	108
Total (%)	24.07	7.41	15.74	10.19	25.00	7.41	10.19	100

When examining the frequency of instructional technology use in the 5th-grade Mathematics textbooks 1 and 2, it was found that dynamic software was used 8.33%, differentiated activities 5.56%, calculators 0.93%, e-content 31.48%, Web 2.0 tools 7.41%, artificial intelligence 0%, and QR code-guided activities 46.30%. Based on these findings, the technological tool that was not used at all was artificial intelligence, while the least-used technological tool was the calculator. The most frequently used technologies were QR code-guided activities and e-content.

When the themes in which instructional technologies were used were examined, their frequencies of use were determined as follows: Theme 1, 24.07%; Theme 2, 7.41%; Theme 3, 15.74%; Theme 4, 10.19%; Theme 5, 25.00%; Theme 6, 7.41%; and Theme 7, 10.19%. The themes in which instructional technologies were used most intensively were Theme 1 (Geometric Shapes) and Theme 5 (Statistical Research Process), while the themes in which they were used the least were Theme 2 (Numbers and Quantities (1): Natural Numbers and Operations) and Theme 6 (Algebraic Thinking with Operations).

The evaluation of the textbooks in terms of the frequency of instructional technology use aimed to determine which types of instructional technologies were used and how frequently. The types of instructional technologies used throughout the textbook are shown in Figure 3.

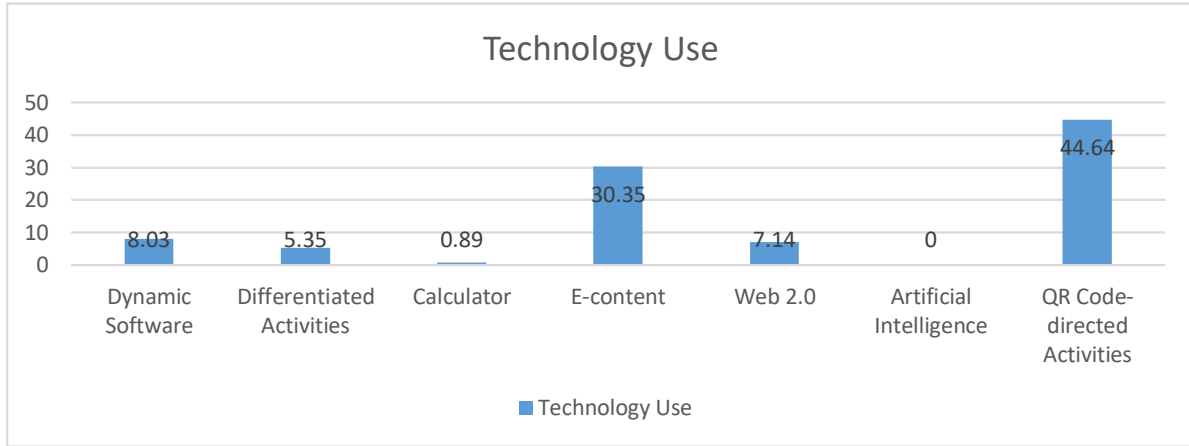


Figure 3.
Frequency of Instructional Technology Use

The findings indicate that the technological tools used in textbooks are mostly “QR code-guided activities” and “e-content.” The least-used tool is the calculator. The technological tool that is never used is artificial intelligence. As a result of the analysis of textbooks, Table 11 presents various examples of the instructional technologies used and their usage percentages, as well as analyses based on the specific application areas of these technologies.

Table 11.
Examples of Instructional Technology Use

Usage Area	Examples of Instructional Technology Use
Dynamic Software & Concept Building	

Differentiated
Activities
&
Practice

Her basamağa uygun miktarda top bırakarak aşağıda verilen sayıyı modelleyiniz.

İki yüz seksen beş milyon altmış beş

İLERİ

Yüz milyonlar basamağı
On milyonlar basamağı
Milyonlar basamağı
Yüz binler basamağı
On binler basamağı
Binler basamağı
Yüzler basamağı
Onlar basamağı
Birler basamağı

KONTROL ET YENİLE

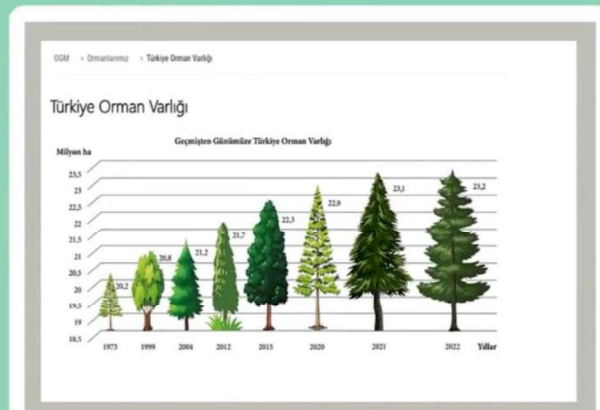
1. görev kartındaki sayının basamak adlarını ve değerlerini belirleyen Recep ve Suzan, tüm sayıların basamak değerlerini hesap makinesi kullanarak topladılar ve aşağıdaki sonucu elde ettiler.

Calculator
&
Computation
$$9 + 30 + 200 + 5000 + 10\ 000 + 0 + 6\ 000\ 000 + 0 + 800\ 000\ 000 + 7\ 000\ 000\ 000 = 7\ 806\ 015\ 239$$

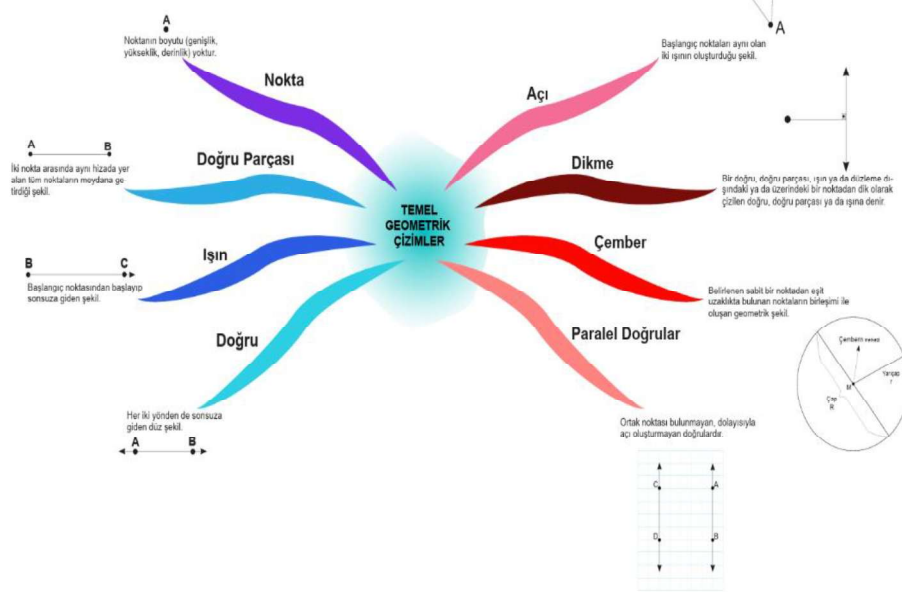
7 8 9 + x
4 5 6 - /
1 2 3 0 =

E-content
&
Explaining
Information

Açılan sayfada geçmişten günümüze Türkiye orman varlığı ile ilgili verilere ulaşabiliriz.



Web 2.0
&
Organizing
Information



2.TEMA SAYILAR VE NİCELİKLER: DOĞAL SAYILAR VE İŞLEMLER EK ÖLÇME VE DEĞERLENDİRME SORULARI

ÖRNEK - 1

- Koray, arkadaşlarıyla "İsmimin sayısı" oyunu oynamaktadır. Oyunun kuralları şu şekildedir:
- Her öğrenci isminin harflerinin yerine, alfabedeki sırasını gösteren sayıyı yazacaktır.
 - Elde edilen sayının okunuşu söylenecektir.

Örnek: "Koray" isminin sayısı aşağıda verilmiştir.

Tablo: Koray İsminin Oyundaki Sayısı

İsimdeki harfler	K	O	R	A	Y
Harflerin alfabedeki sırası	14	18	21	1	28
Sayı ve okunuşu	141 821 128 Yüz kırk bir milyon seküzyüz yirmi bir bin yüz yirmi sekiz				

QR Code-directed
Activities
&
Quick and
Effective Access to
Information

When examining the examples of instructional technology use in textbooks presented in Table 11, it is evident that QR code-based activities are used to provide quick and effective access to information; Web 2.0-supported activities are used to organize information; e-content is used to explain information; calculators are used to perform calculations; differentiated activities are used for practice; and dynamic software is used to build concepts.

DISCUSSION, CONCLUSION, AND SUGGESTIONS

In this study, an examination of the general structure of mathematics textbooks revealed that activities are designed around specific skills and that the content structure progresses within a specific systematic framework, following a repetitive cycle (routine). For example, topics begin with the heading "Are We Ready?" and continue with the section "Let's Get Started." In the subsequent process, as required by the constructivist approach (MoNE, 2024), it was determined that the content is structured around examples, problems, and activities. In addition, elements such as performance tasks, progress tests, and learning journals are included, and the themes conclude with assessment questions. It was observed that the textbooks are organized into two separate volumes per semester to facilitate easier access and use by students. Upon examining the content of the mathematics topics, it is evident that a practice-oriented and simplified approach has been adopted with the aim of reducing students' cognitive load. During the presentation of the topics, the goal was for students to encounter numerous examples and

activities, thereby supporting their active participation in the learning process (Güzel et al., 2021). An examination of the book's overall structure reveals that it aligns with a constructivist learning framework and aims to develop students' mathematical thinking skills. However, it should be noted that structurally following a similar pattern in every unit may, over time, lead to routine and a loss of motivation among students (Fan et al., 2013). Therefore, it is expected that the effectiveness of textbooks will be further enhanced by supporting the content with activities that incorporate more interdisciplinary connections, are relevant to real life, and foster students' higher-order thinking skills.

A detailed analysis of the number of pages allocated to each theme in textbooks and the time allotted to each theme within the curriculum has yielded noteworthy findings. When comparing the time allocated in the curriculum with the number of pages dedicated to each theme in the textbook, the first theme, geometric shapes, stands out. This theme has the largest volume, comprising 80 pages (24.46% of the textbook) and covering 21.05% of the total content, with 40 class hours allocated to it in the fifth-grade curriculum. The significant discrepancy between the number of pages allocated in the textbook and the time allotted to this theme in the curriculum can be explained by the intensity of visual elements and examples used in the process of applying basic geometric concepts (point, line, plane, angle) and developing spatial thinking skills. However, no notable discrepancy was observed between the number of pages allocated to other themes in the textbook and the time allotted for them in the curriculum. It is stated that there is an inseparable link between textbooks and curricula, and that textbooks are regarded as a representation of the curriculum (Arslan & Özpınar, 2009; Başer, 2012; Mayer, 2009). In this context, the importance of alignment between textbooks and the curriculum is emphasized. Accordingly, it is recommended that textbook authors and relevant decision-makers develop more balanced content and time allocations by taking into account the curriculum's objectives, the intensity of learning outcomes, and the time allocated for classroom implementation.

Upon examining the numerical distribution of task types included in the mathematics textbook, it was found that the most common task types were examples, activities, and assessment questions. In the study by Korkutan and Oflaz (2024), an analysis of the types of tasks included in textbooks also highlighted that examples were the most commonly used mathematical tasks. In contrast, mind mapping and learning journal activities were among the least frequently included task types, and it was determined that these types of activities were found only in Theme 1. However, it is believed that activities such as mind mapping and learning journals, which allow students to visualize abstract information and ideas, develop innovative ideas during problem-solving processes, and engage in reflective evaluation, should be expanded to include other themes as well. In this context, Çakır (2009) noted in his study that textbooks should include questions designed to develop skills such as critical, creative, and metacognitive thinking, and that it is insufficient for the tasks in textbooks merely to guide students toward carrying out the stages of instruction through research and inquiry. Similarly, when Tuna and Biber (2017) examined the types of tasks in middle school mathematics textbooks, they noted that these tasks mostly remained at the "knowing and applying" cognitive levels, which are based on procedural knowledge, and therefore failed to prepare students for reasoning processes involving conceptual understanding and mathematical reasoning. Therefore, when designing textbook tasks, it is crucial that they be connected to real life, foster creative thinking skills, and give greater prominence to non-routine problems.

The research findings, based on an evaluation of the images in mathematics textbooks in terms of their necessity and appropriateness for solving problems, determined that the vast majority are consistent with the relevant content. These consistency rates range from 85% to 98%. However, when the pedagogical quality of these visuals is evaluated within the context of Mayer's (2009) "Multimedia Learning Theory," areas for improvement become apparent. Furthermore, when the visual structure in these books is compared to strong international examples such as Math Connects, published in the U.S.

in terms of aesthetics, guidance, and pedagogy, the visuals in the examined books remain simpler and largely exist only in a "representational" dimension that merely depicts the subject. The functions of the "organizing" and "interpretive" dimensions – which help students construct their mental schemas were found to be weak. In particular, the identification of visuals that contradict the principle of mathematical precision and could lead to conceptual misunderstandings such as the use of a pencil with one open end and one closed end to explain the concept of a line segment in Theme 1 is thought to cause unnecessary cognitive load in students, as noted in Sweller and colleagues' (2011) "Cognitive Load Theory". At the same time, Clark and Lyons (2010) emphasize that visuals in textbooks should be tools that support students' cognitive processes, rather than merely decorative frames used to embellish the text. When discussing visual elements in textbooks, Cuoco (2000) states that these visuals serve not only an informational purpose but also function as a kind of "thinking tool" by engaging students' minds. For this reason, the appropriate design of visuals used in textbooks is of great importance. These visuals are expected to possess characteristics such as conveying necessary information to students, capturing students' interest, aligning with the content of activities, facilitating the mental visualization of the subject matter, and simplifying complex connections (Dursun & Eşgi, 2008). Literature reviews indicate that when textbooks contain effective and contextually relevant visual elements, they significantly contribute to student learning by making it easier for students to make sense of the material during the learning process. However, it has been noted that if these visual elements are not designed appropriately, they may negatively impact the learning process (Clark & Lyons, 2010; Sweller et al., 2011). Therefore, during the design process of visual elements, students' cognitive and physiological needs must be taken into account when selecting appropriate visuals, and care must be taken to ensure that the visuals are relevant to the questions.

The tasks included in the textbook were categorized according to the TIMSS cognitive domains and compared with the distribution across these domains. Upon examining the number and percentage distribution of questions in the textbooks by cognitive domain, it was found that while the proportion of questions in the "knowing" domain should have been 40% according to TIMSS, it was actually 16.73%; thus, the distribution in this domain was 23.27% lower than expected. In the applying domain, the expected proportion of 40% was actually 59.44%, indicating a 19.44% increase in this domain. In the reasoning domain, the expected proportion of 20% was calculated as 23.81%, revealing a 3.81% excess in this domain. These results reveal that the distribution of questions across cognitive domains in textbooks differs from TIMSS standards. This finding is consistent with Tuna and Biber's (2017) observation that middle school mathematics textbooks place excessive emphasis on "procedural knowledge" and "computational skills." However, textbooks prepared in accordance with the Ministry of National Education's educational model adopt a priority-based approach to mathematical skills (MoNE, 2023). Given the high density of skills-based activities, it can be stated that the textbooks were designed with a practice-oriented approach, and consequently, the results obtained exhibit a practice-oriented characteristic. In their study, Toptaş, Elkatmış, and Karaca (2012) stated that it might be beneficial to align the content and types of tasks in textbooks with TIMSS standards. Ildırı (2009) noted that when the activities in a 5th-grade mathematics textbook were examined, they generally followed a practice-oriented approach, and it was pointed out that this did not encourage students to think creatively. Stein, Smith, Henningsen, and Silver (2000), using the concept of "mathematical tasks" pointed out that requiring students to perform specific tasks step by step may hinder higher-order thinking skills and turn students into individuals who merely follow instructions. For this reason, determining the appropriate level of exercises to include in textbooks is a critical issue that requires careful consideration (Bingölbali & Özđiner, 2022; Clark & Lyons, 2010; Sweller et al., 2011). Consequently, considering the "skills-focused" vision of the Century of Turkish Education Model, while a practice-oriented structure may appear to be an advantage, intensive practice without a conceptual foundation (knowing) may not go beyond developing "rote procedural skills".

It is evident that, in the textbooks examined, a balance between ensuring mathematically error-free content and providing conceptual depth is not always maintained. Particularly in the teaching of geometric concepts, the contradiction between the principle of a point's "dimensionlessness" and the concrete model of a "pencil mark," as well as the confusion caused by the phrase "intersection of lines" in the definition of a polygon, create a mathematically flawed foundation. Furthermore, defining the concept of parallelism in the textbook as "equal distance" leads to various errors; using the "non-intersection" axiom instead is crucial for correcting this error. Similarly, in the area of numbers and operations, the use of place value concepts such as "adding zeros at the end" to simplify procedural steps weakens mathematical understanding. Moreover, treating the concept of area as merely counting discrete unit squares rather than as a continuous quantity limits conceptual depth. At the same time, selecting examples of diagonals only from convex polygons causes students to overlook the properties of diagonals in concave shapes. Therefore, the consistent use of mathematical language in textbooks, the error-free use of symbols and models, the prevention of conceptual misunderstandings, and ensuring the consistency of mathematical structure are crucial for high-quality mathematics education (MoNE, 2024; NCTM, 2020).

An analysis of the findings regarding technology use reveals that technologies focused on QR codes and e-content, which are based on the "access to information" dimension, predominate (approximately 78%), while dynamic math software, which is a tool focused on "structuring information," remains limited (approximately 8%). This finding aligns with the results of Sevimli and Kul (2015), who found that textbooks use technology not as a "teaching tool" but as a "storage space." Additionally, artificial intelligence was identified as the technological tool that was never used, while the calculator was identified as the least-used technological tool. Given current technological developments, the low frequency of calculator use is a predictable outcome. However, the complete absence of artificial intelligence use is considered a noteworthy finding. This complete absence of artificial intelligence applications is considered a significant shortcoming in terms of the digital requirements of the modern era when compared to the teaching materials of highly successful countries such as Singapore and South Korea (Mersin & Karabörk, 2021). The themes in which instructional technologies were used most frequently were identified as Theme 1 (Geometric Shapes) at 24.07% and Theme 5 (Statistical Research Process) at 25.00%. In contrast, the lowest usage was observed in Theme 2 (Numbers and Quantities (1): Natural Numbers and Operations) at 7.41% and Theme 6 (Algebraic Thinking Through Operations) at 7.41%. These findings reveal that the use of instructional technologies varies in intensity across the themes in the textbook content. However, the literature emphasizes that technology must be integrated in a balanced manner across all areas of learning to enable students to develop higher-order thinking skills such as discovery, correlation, modelling, analysis, and synthesis (Engström, 2004). It has been noted that the integration of content with technology could be a key factor in Turkey's success in international assessments. One of the best examples of this is the high mathematics achievement in exams such as TIMSS and PISA by countries like Singapore and South Korea, which have kept their education policies up to date in line with developments in information technology (Mersin & Karabörk, 2021; Severin & Capota, 2011). In this context, ensuring that instructional materials are equally supported by technology across all subject areas is crucial both for developing students' higher-order thinking skills and for improving performance on international assessments.

The findings from this study indicate that there is a need to improve both the content structure and the visual and pedagogical design elements of mathematics textbooks in the context of TIMSS cognitive domain levels and technology integration. First, the mismatch between the time allocated in the curriculum and the page density in the textbooks which is particularly evident in the "Geometric Shapes" theme (24.46%) paves the way for increased cognitive load and time management issues. Therefore, it is crucial to streamline the textual and visual content in the curriculum by removing unnecessary details and to establish a balanced content plan that enables the teaching process to be

conducted more efficiently. When the textbooks were analyzed in terms of task types, it was determined that 59.44% of the questions were concentrated at the "Applying" level, whereas tasks at the "Reasoning" (23.81%) and "Knowing" (16.73%) levels remained limited. Furthermore, it was observed that metacognitive tasks such as "Learning Journals" and "Mind Maps" were also limited. Accordingly, it is necessary to increase the variety of task types, include non-routine problems, and give greater emphasis to activities that highlight students' thinking processes.

Furthermore, it was observed that some of the visuals examined in the study (e.g., the ray model) could lead to conceptual misunderstandings because they contradicted geometric definitions. Therefore, visuals must be designed not merely as aesthetic embellishments but as instructional tools that possess mathematical precision, trigger cognitive processes, and support conceptual understanding. Additionally, while the use of QR codes and e-content (approximately 78%) was found to be widespread in textbooks, it was determined that contemporary technological tools such as artificial intelligence, dynamic math software (approximately 8%), and Web 2.0 tools were underrepresented. It is recommended that the learning process include more activities that utilize AI-supported personalized learning tools and dynamic software such as GeoGebra, which develop higher-order thinking skills like analysis, modelling, and discovery, rather than passive tools that merely provide students with access to information. In line with the demands of the modern era, it is recommended that technology be integrated in a balanced manner across all themes not merely as a presentation tool, but as an interactive component that supports the processes of analysis, modelling, and discovery. In future research, conducting longitudinal observational studies on textbook use and examining new curriculum textbooks for other grade levels (grades 6, 7, and 8) using similar criteria will contribute to the evaluation of the program's spiral structure.

CONFLICT OF INTEREST

There is no personal or financial conflict of interest between the authors of the article within the scope of the study.

AUTHOR CONTRIBUTIONS

Research design: DZ(%50), MSTB(%50)

Data collection: DZ(%50), MSTB(%50)

Statistical analysis: DZ(%50), MSTB(%50)

Preparation of the Article: DZ(%50), MSTB(%50)

REFERENCES

- Amit, M., & Fried, M. (2002). Research, reform and times of change. In L. D. English (Ed.), *Handbook of international research in mathematics education* (pp. 355-382). LEA Publishers.
- Arslan, S., & Özpınar, İ. (2009). Evaluation of 6th grade elementary mathematics textbooks in line with teacher opinions. *Dicle University Ziya Gökalp Education Faculty Journal*, (12), 97-113. <https://dergipark.org.tr/tr/pub/zgefd/issue/47955/606752>
- Başaran, İ. E. (2007). *Eğitim psikolojisi [Educational psychology]*. Nobel Publishing.
- Başer, N. (2012). *Elementary teachers' ways of using mathematics textbooks and their views about students' ways of using mathematics textbooks and mathematics textbooks* (Publication No. 321085) [Master's thesis, Bursa Uludağ University]. Council of Higher Education Thesis Center.
- Bingölbali, E., & Öz diner, M. (2022). Examination of primary and secondary school mathematics textbook activities in terms of real-life connections. *Afyon Kocatepe University Journal of Social Sciences*, 24(1), 45-65. <https://doi.org/10.32709/akusosbil.885878>

- Bloom, B. S. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain*. David McKay Company.
- Brousseau, G. (1997). *Theory of didactical situations in mathematics: Didactique des mathématiques, 1970–1990* (N. Balacheff, M. Cooper, R. Sutherland, & V. Warfield, Eds. & Trans.). Kluwer Academic.
- Clark, R. C., & Lyons, C. (2010). *Graphics for learning: Proven guidelines for planning, designing, and evaluating visuals in training materials*. John Wiley & Sons.
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE Publications.
- Cuoco, A. (2000). Meta-problems in mathematics. *College Mathematics Journal*, 31(5), 373-378. <https://doi.org/10.1080/07468342.2000.11974176>
- Çakır, İ. (2009). *Evaluation of fifth grade elementary mathematics textbooks in line with teacher and student opinions* (Publication No. 228935) [Master's thesis, Çukurova University]. Council of Higher Education Thesis Center.
- Demirel, Ö. (2009). *Eğitimde program geliştirme: Kuramdan uygulamaya [Curriculum development in education: From theory to practice]*. Pegem Academic Publishing.
- Dursun, F., & Eşgi, N. (2008). Evaluation of 4th and 5th-grade social studies textbooks according to visual design principles. *Gazi University Journal of Industrial Arts Education*, 22, 21-34. <https://dergipark.org.tr/tr/pub/cusosbil/issue/32277/353146>
- Engström, L. (2004, July). Examples from teachers' strategies using a dynamic geometry program in upper secondary school. Paper presented at ICME-10, Copenhagen, Denmark.
- Fan, L., Zhu, Y., & Miao, Z. (2013). Textbook research in mathematics education: Development status and directions. *ZDM Mathematics Education*, 45, 633-646. <https://doi.org/10.1007/s11858-013-0539-x>
- Floden, R. E. (2002). The measurement of opportunity to learn. In A. C. Porter & A. Gamoran (Eds.), *Methodological advances in cross-national surveys of educational achievements* (pp. 231-266). National Academy Press.
- Ginsburg, A., & Leinwand, S. (2005, November 11–13). *Singapore math: Can it help close the U.S. mathematics learning gap?* Paper presented at CSMC's First International U.S. Conference on Mathematics Curriculum, Chicago, IL.
- Güder, Y., & Tutak, T. (2012). Views and thoughts of 5th grade elementary teachers about mathematics textbook. *Dicle University Ziya Gökalp Education Faculty Journal*, 19, 16-28. <https://izlik.org/IA68DD42YL>
- Güzel, M., Bozkurt, A., & Özmantar, M. (2021). Examination of mathematics teachers' evaluations and interventions in activity design and implementation processes. *Journal of Computer and Education Research*, 9(18), 513-545. <https://doi.org/10.18009/jcer.880304>
- Ildırı, A. (2009). *Examination of problems in fifth grade elementary mathematics textbook and student workbook and determination of teacher opinions regarding these problems* (Publication No. 241522) [Master's thesis, Çukurova University]. Council of Higher Education Thesis Center.
- Incikabi, L. (2011). *Analysis of grades 6 through 8 geometry education in Turkey after the reform movement of 2004* [Doctoral dissertation, Teachers College, Columbia University].
- Işık, C. (2008). Factors affecting mathematics teachers' use of mathematics textbooks and their expectations in elementary second level. *Kastamonu Education Journal*, 16(1), 163-176. <https://dergipark.org.tr/tr/pub/kefdergi/issue/49101/626569>
- Korkutan, E., & Oflaz, G. (2024). Analysis of topics in geometry and measurement learning areas in secondary school textbooks according to realistic mathematics education principles. *Journal of Uludag University Faculty of Education*, 37(1), 1-30. <https://doi.org/10.19171/uefad.1302294>
- Lincoln, Y. S., & Guba, E. G. (1986). But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *New Directions for Evaluation*, (30), 73-84. <https://doi.org/10.1002/ev.1427>

- Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge University Press.
- Merriam, S. B. (2018). *Qualitative research: A guide to design and implementation* (S. Turan, Trans.). Nobel Publishing. (Original work published 2009)
- Mersin, N., & Karabörk, M. A. (2021). The comparison of math textbooks in Turkey and Singapore in terms of technology integration. *International Journal of Curriculum and Instruction*, 13(1), 552-573. <https://eric.ed.gov/?id=EJ1285814>
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Sage.
- Ministry of National Education [MoNE]. (2009). *Elementary mathematics curriculum*. Komisyon.
- Ministry of National Education [MoNE]. (2023). *Century of Turkish Education Model: Mathematics domain skills*. <https://tymm.meb.gov.tr/beceriler/matematik-alan-becerileri>
- Ministry of National Education [MoNE]. (2024). *Century of Turkish Education Model: Common text*. MoNE Publications. https://hoshaberio.meb.k12.tr/meb_iys_dosyalar/76/01/721342/dosyalar/2024_06/11_231346_2024programortakmetinonayli.pdf
- Mullis, I. V. S., & Martin, M. O. (Eds.). (2017). *TIMSS 2019 Assessment Frameworks*. TIMSS & PIRLS International Study Center. <http://timssandpirls.bc.edu/timss2019/frameworks/>
- Mullis, I. V., Martin, M. O., Foy, P., & Arora, A. (2012). *TIMSS 2011 international results in mathematics*. TIMSS & PIRLS International Study Center.
- National Council of Teachers of Mathematics. (2020). *Catalyzing change in early childhood and elementary mathematics: Initiating critical conversations*.
- Remillard, J. T. (2005). Examining key concepts in research on teachers' use of mathematics curricula. *Review of Educational Research*, 75(2), 211-246. <https://doi.org/10.3102/00346543075002211>
- Sak, R., Şahin Sak, İ. T., Öneren Şendil, Ç., & Nas, E. (2021). Document analysis as a research method. *Kocaeli University Journal of Education*, 4(1), 227-256. <https://doi.org/10.33400/kuje.843306>
- Semerçi, Ç., & Semerçi, N. (2004). A general evaluation of elementary (1st-5th grade) mathematics textbooks. *National Education Journal*, 162, 1-5. https://dhgm.meb.gov.tr/yayimlar/dergiler/Milli_Egitim_Dergisi/162/semerci.htm
- Severin, E., & Capota, C. (2011). *The use of technology in education: Lessons from South Korea*. Inter-American Development Bank.
- Sevimli, E., & Kül, Ü. (2015). Evaluation of mathematics textbook contents in terms of technological suitability: Secondary school example. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education*, 9(1), 308-331. <https://doi.org/10.17522/nefemed.11253>
- Stein, M. K., Smith, M. S., Henningsen, M. A., & Silver, E. A. (2000). *Implementing standards-based mathematics instruction: A casebook for professional development*. Teachers College Press.
- Sweller, J., Ayres, P., & Kalyuga, S. (2011). *Cognitive load theory*. Springer.
- Thomson, S., & Fleming, N. (2004). *Summing it up: Mathematics achievement in Australian schools in TIMSS 2002*. Australian Council for Educational Research.
- Toptaş, V., Elkatmuş, M., & Karaca, T. (2012). Examination of learning areas of the 4th-grade elementary mathematics curriculum and mental areas of questions in the mathematics student workbook according to TIMSS. *Ahi Evran University Journal of Kırşehir Education Faculty*, 13(1), 17-29. <https://dergipark.org.tr/tr/pub/kefad/issue/59493/855089>
- Törnroos, J. (2005). Mathematics textbooks, opportunity to learn and student achievement. *Studies in Educational Evaluation*, 31(4), 315-327. <https://doi.org/10.1016/j.stueduc.2005.11.005>
- Tuna, A., & Biber, A. Ç. (2017). Comparative analysis of learning areas in secondary school mathematics books according to Bloom's taxonomy. *Ondokuz Mayıs University Journal of Education Faculty*, 36(1), 161-174. <https://doi.org/10.7822/omuefd.327396>

- Ubuz, B., Erbağ, A. K., Çetinkaya, B., & Özgeldi, M. (2010). Exploring the quality of the mathematical tasks in the new Turkish elementary school mathematics curriculum guidebook: The case of algebra. *ZDM Mathematics Education*, 42, 483-491. <https://doi.org/10.1007/s11858-010-0258-5>
- Yeğit, H. (2020). *Examination and comparison of mathematics textbooks taught in Turkey and Germany in terms of mathematical literacy* (Publication No. 640256) [Master's thesis, Bursa Uludağ University]. Council of Higher Education Thesis Center.
- Yıldırım, A., & Şimşek, H. (2013). *Sosyal bilimlerde nitel araştırma yöntemleri [Qualitative research methods in social sciences]* (9th ed.). Seçkin Publishing.
- Zhu, Y., & Fan, L. (2004, July 4-11). *An analysis of the representation of problem types in Chinese and US mathematics textbooks*. Paper presented at ICME-10 Discussion Group 14, Copenhagen, Denmark.