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DIGITAL PATHWAYS IN TURKEY CENTURY EDUCATION MODEL: DOCUMENT ANALYSIS OF 5TH GRADE MATHEMATICS CURRICULUM FOR ICT ORIENTATION

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Abstract

This study aims to examine the current status of ICT orientation (Information and Communication Technologies) in the 5th grade secondary school mathematics curriculum introduced in 2024 under the Turkish Century Education Model, along with the corresponding Ministry of National Education (MoNE) textbook. The Turkish Century Education Model emphasizes a comprehensive skill framework, including conceptual, domain-specific, social-emotional, and literacy skills—particularly digital and data literacy. As ICT increasingly influences all disciplines, its integration into mathematics education has become essential. This research employs document analysis as one ofthe qualitative methods to evaluate the presence and purpose of ICT learning outcomes, ICT tool types, its intenteded use in the current curriculum and textbook. The analysis focuses on identifying ICT-related activities, performance tasks, and QR codes in the textbook, and categorizes them by the type and intended use of ICT tools. Findings reveal that the theme “Geometric Shapes” includes the highest number of ICT-oriented learning outcomes, while “Geometric Quantities” lacks any ICT emphasis. When we look at the findings obtained in the study, there is observed only eight number of activities and performance tasks in which ICT is emphasized. This number is considered this number is quite low when compared to the overall curriculum. Among curriculum themes in which ICT tools are emphasized the most is “Statistical Research Process” in terms of ratio. Overall, it appears that the distribution of ICT integration across themes is uneven and that there is a need for further high-quality research in ICT to fully support the development of 21st century digital competencies.

Keywords: QR code in maths education, Information and communication technologies in maths, Turkey Education Model

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Türkiye Yüzyılı Maarif Modelinde Dijital İz Yolları: Bilgi Ve İletişim Teknolojileri Açısından 5. Sınıf Matematik Öğretim Programının Doküman Analizi

Öz

Bu çalışmanın amacı, Türkiye Yüzyılı Maarif Modeli kapsamında 2024 yılında uygulamaya konulan ortaokul 5. sınıf matematik öğretim programında ve ilgili Milli Eğitim Bakanlığı (MEB) ders kitabında Bilgi ve İletişim Teknolojileri yöneliminin mevcut durumunu incelemektir. Türkiye Yüzyılı Maarif Modeli kavramsal beceriler başta olmak üzere alana özgü, sosyal-duygusal ve okuryazarlık becerilerini -özellikle dijital ve veri okuryazarlığını- içeren kapsamlı bir beceri çerçevesini vurgulamaktadır. Tüm disiplinleri giderek daha fazla etkilemesi nedeniyle ortaokul matematik öğretim programının BİT'e yönelimini incelemek önemli görülmektedir. Bu araştırmada, BİT içeren öğrenme çıktılarının varlığını, programda yer verilen BİT araçlarının türlerini, mevcut programda ve ders kitabında kullanım amaçlarını değerlendirmek için nitel yöntemlerden biri olarak doküman analizi kullanılmaktadır. Analiz, ders kitabındaki BİT ile ilgili etkinlikleri, performans görevlerini ve QR kodlarını belirlemeye odaklanmakta ve bunları BİT araçlarının türüne ve kullanım amacına göre analiz etmektedir. Bulgular, "Geometrik Şekiller" temasının en fazla sayıda BİT odaklı öğrenme çıktısı içerdiğini, "Geometrik Nicelikler" temasında ise herhangi bir BİT vurgusu olmadığını ortaya koymaktadır. Araştırmada elde edilen bulgulara bakıldığında, BİT'in vurgulandığı etkinlik ve performans görevlerinin sayısının sadece sekiz olduğu görülmektedir. Bu sayının matematik öğretim programının geneliyle kıyaslandığında oldukça düşük olduğu sonucuna varılmaktadır. BİT araçlarının vurgulandığı içerik çerçevesi ve temalar arasında ise oran olarak en fazla "İstatistiksel Araştırma Süreci" yer almaktadır. Genel olarak, BİT entegrasyonunun temalar arasındaki dağılımının dengesiz olduğu ve 21. yüzyıl dijital yetkinliklerinin gelişimini tam olarak desteklemek için BİT alanında nitelikli çalışmalara ihtiyaç olduğu ortaya çıkmaktadır.

Anahtar Kelimeler: Matematik eğitiminde QR kod, Matematikte bilgi işlem teknolojileri,Türkiye Yüzyılı Maarif Modeli

Introduction

In the modern era, technology is developing rapidly and is utilized across every field, including education an curriculum development. Developing digital literacy among both educators and students is essential for effective learning environments, as it directly supports meaningful technology integration into teaching practices. Technologies such as computers, tablets, smartphones, the internet, and virtual reality are increasingly integrated into educational settings (Martinovic & Zhang, 2012). For instance, Cummings (2008, p. 83) noted that the rate of digital

tool use in foreign language classes had increased significantly in the preceding decade. The introduction of technology into education and policies prompts changes in schools, classrooms, teacher and student roles, and even curriculum and textbooks (MEB, 2024, p. 1). Curriculums play a crucial role in both equipping students with basic Information and Communication Technology (ICT) skills and effectively integrating technology into teaching process. The use of ICT in classes transforms traditional teaching methods by promoting interactive learning environments, improving access to educational resources, and fostering digital skills essential for the 21st century. As suggested by Aggarwal (2020), the integration of ICT in mathematics education enhances student engagement, facilitates conceptual understanding through dynamic visualizations, and supports individualized learning by providing interactive tools and real-time feedback. It is also indicated by the developmental framework for the Turkish Century Education Models Secondary School Mathematics Curriculum that the model has been developed with an understanding that reflects the sensitivity of the Turkish National Education System to the digital age and technological developments, and the desire and potential to lead these developments when appropriate. It is also aimed to create learning opportunities for students to master digital platforms and produce content on these platforms with digital literacy skills (MoNE, 2024, p. 8).

The rapid evolution of Information and Communication Technologies has also changed the requirements, for instance static content of Web 1 could no longer meet user expectations for dynamic communication, paving the way for the development of Web 2.0. Web 2.0 introduced dynamic web pages that facilitated online communication, information sharing, and content creation (Kolbitsch & Maurer, 2006, p. 187). Subsequently, Web 3.0 was developed to meet rising expectations of new generation learners. The key difference between Web 2.0 and Web 3.0 is the latters ability to process semantic queries, allowing computers to understand and answer complex questions (Doğan & Kesken, 2007, p. 44). Theres

a strong and direct relationship between Information and Communication Technologies (ICT) and the evolution of the Web 2.0 & Web 3.0 which are a manifestation of the advancements and increasing sophistication of ICT itself. The emergence of Web 2.0 and Web 3.0 marked a significant shift, driven by advancements in ICT that enabled dynamic communication, information sharing, and content creation as claimed by Kolbitsch & Maurer (2006). The entire progression from Web 1.0 to Web 3.0 is a testament to the continuous evolution of ICT. Each stage leverages increasingly advanced ICT tools, protocols, and paradigms. In Turkey, efforts to integrate technology into education accelerated with the World Bank-supported Basic Education Project in 1998. Later, the Movement for Increasing Opportunities and Improving Technology (FATİH) Project, initiated in 2010, aimed to advance infrastructure, provide hardware, and implement IT-supported teaching (MEB, 2012). More recently, the Secure Schooling and Distance Education Project, led by YEĞİTEK (General Directorate of Innovation and Educational Technologies), has developed a new digital education platform and content ecosystem capable of serving five million concurrent users (YEĞİTEK, 2024).

It is emphasized in literature that the benefits of ICT in teaching mathematics are significant (Tural Sönmez and Aytekin, 2021). For example, using simulations to explore the relationship between experimental and theoretical probability can have a major impact on students comprehension. Aspinwall and Tarr (2001) stated t he importance of conducting a large number of simulations and experiments when teaching probability. Probability simulations support this by enabling teachers to perform numerous experiments quickly, which can shorten the time students need to grasp the concepts (Tural Sönmez & Aytekin, 2021). Such dynamic visualizations are crucial for abstract concepts, a point further elaborated by Roschelle et al. (2010), who highlight how interactive simulations can bridge the gap between concrete experiences and mathematical abstractions. Drijvers (2015) explains that the effectiveness of technology integration depends on several key factors, including the

technologys design, the educational context, and the nature of the learning activities and tasks. This perspective is defended by Niess (2005), who introduced the concept of Technological Pedagogical Content Knowledge (TPACK), underscoring that effective integration of ICT requires teachers to understand how technology, pedagogy, and content intertwine.

In a comparative study, Demir-Ataş (2022) analyzed the secondary school mathematics curriculum of Taiwan and Turkey. They noted that the GeoGebra application was found to be effective for teaching geometry and algebra at the fifth, sixth, and eighth-grade levels, emphasizing the role of instructional technologies in facilitating learning. Similarly, Hohenwarter and Hohenwarter (2009) detailed how GeoGebras dynamic environment allows students to explore mathematical concepts visually and interactively, making it a powerful tool for both teachers and learners. This document analysis reveals that the GeoGebra program is referenced in the 2024 fifth-grade mathematics textbook via QR codes in the section on geometric shapes. In a separate thesis, Erbilge (2019) compared the mathematics curriculum of Turkey, Canada, and Hong Kong. They found no learning outcomes specifying ICT use in Hong Kongs curriculum, whereas Canadas curriculum included direct references to ICT tools. This disparity in curriculum integration is a crucial research topic to focus on; for instance, Ertmer and Ottenbreit-Leftwich (2010) discussed the various barriers and enablers to technology integration in classrooms, emphasizing the role of curriculum and policy. Furthermore, Albro and Mucheru (2018) highlighted how specific curriculum guidelines that mandate or encourage ICT use can significantly influence its adoption and effective implementation in mathematics education.

Building on this literature review, this study aims to examine the newly developed Turkey Century Education Model 5th-grade mathematics textbook in terms of its emphasis and guidance for ICT use in maths, approved by the Board of National Ministry of Education as the new curriculum. The research is guided by the following questions:

1. What is the distribution of ICT-related learning outcomes across the themes in the Turkish Century Education Model 5th grade mathematics curriculum (textbook)?
2. Which specific ICT tools are emphasized or referenced within the Turkish Century Education Model 5th grade mathematics curriculum textbook (in the maths activities, performance tasks, and QR codes)?
3. What are the claimed purposes for using ICT tools within Turkey Century Education Model 5th grade mathematics curriculum textbook (in the maths activities, performance tasks, and QR codes)?

Method

This study used document analysis method, one of the qualitative research methods. Qualitative research designs determine the approach of the research and also direct the stages of the research (Yıldırım & Şimşek, 2018). The design of this study was determined as document analysis from qualitative research methods. Mostly the word "text" represents the data range. Document analysis accepts these texts as the primary data source. Documents are audio recordings, visual recordings and artifacts, the main feature of which is that they usually have a written text (Scott, 1990). Document analysis is a systematic research method used to analyze, interpret, evaluate and interpret documents. It provides a systematic research method used to examine, interpret, evaluate and interpret documents (Sak et al., 2021). Merriam (2009) lists the steps of document analysis as finding appropriate documents, checking the authenticity of these documents, coding and cataloguing, and data analysis. In this study, the aim is to examine the secondary school 5th grade mathematics curriculum and textbook in terms of Information and Communication Technologies usage and the emphasis given to it.

Data Collection

In the study, the 5th grade secondary school mathematics textbook published by the Ministry of National Education Board of Education was selected for the 5th grade level. The themes in the book are 'Geometric Shapes, Numbers and Quantities,

Geometric Quantities, Statistical Research Process, Algebraic Thinking with Operations and From Data to Probability'.

Firstly, the QR codes, performance tasks and activities in the book were analysed. Then, the learning outcomes in the Turkish Century Education Model Secondary School Mathematics Curriculum were examined in terms of guiding the use of ICT. In the 5th grade middle school mathematics textbook, the QR codes related to the subject summary on the first page of each theme and the QR codes used for subject expression were not included as research data since there was no ICT tool emphasis. Table 1 presents the 5th grade mathematics textbook used by the Ministry of National Education:

***Table 1**: Imprint of the Reviewed Books*

Grade Level	Grade 5	Grade 5
Book Tag	Book 1 (5th Grade Mathematics Textbook, MEB publications)	Book 2 (5th Grade Mathematics Textbook, MEB publications)
Number of Pages	171	189
Year of publication Access online:	2024 https://tymm.meb.gov.tr/ders-kitaplari	2024 https://tymm.meb.gov.tr/ders-kitaplari

Data Analysis

The researcher summarized and interpreted the data obtained through document analysis using descriptive analysis, and the data obtained were discussed under specific themes that are similar to each other in a way that the reader can understand (Yıldırım & Şimşek, 2008: 227; Neuman, 2012: 663). The researcher investigated whether ICT was emphasized in the process components, teaching-learning practices and the learning outcomes designed for 5th grade students in the Turkish Century Education Model Middle School Mathematics Curriculum. For the analysis, learning outcomes related to the terms "*technology, digital, artificial intelligence, math software, video, computer, dynamic geometry software*" were selected from the process components and learning-teaching practices. The

frequency of 5th grade middle school math curriculum learning outcomes involving ICT use was calculated according to themes and presented in a table. Performance tasks, QR codes, and activities where ICT use was identified were classified according to the themes in the Turkish Century Education Model Middle School 5th Grade Mathematics Curriculum and related to learning outcomes. Subsequently, QR codes, performance tasks, and activities with an ICT emphasis were identified in the 5th grade mathematics textbook. Within the scope of document analysis, the criteria "theme, related learning outcomes, type of ICT tool, purpose of ICT tool" were looked for classifications within the scope of the analysis. As an exclusion criterion, the subject content, subject summary, and theme assessment questions found on the first page of each theme in the textbook, along with the related QR codes, were not included in the study because they were not appropriate in terms of ICT focus and emphasis. The results of the criteria applied in the analysis are presented in tables in the findings section.

Validity and Reliability of the Study

For the reliability of the study, two independent researchers specialised in mathematics education independently examined the QR codes, ICT tool types, the purpose of ICT in detail. In order to ensure reliability, the data findings were evaluated by two independent researchers and reliability was determined by Kappa analysis. As a result of the Kappa analysis, which indicates the level of agreement between the evaluators, the Kappa coefficient was found to be 0.90. The value of the Kappa coefficient as a result of the review of the evaluators shows the reliability of the scoring tool. The coefficient shows that the inter-rater reliability is high and there is a strong degree of agreement (McHugh, 2012). Additionally, in order to enrich the accuracy of the findings and increase validity during the document analysis, attention was paid to the honesty, criticality and openness which are viewed as the validity criteria put forward by Whittemore, Chase and Mandle (2001). To enhance validity, thick description is provided for rich, detailed descriptions of the documents

including the pages, coding process, the emergent QR codes and ICT tools with their pages.

Findings

The findings are analysed under four (4) categories in line with the research problems. Table 2 presents the learning outcomes in the 5th Grade Secondary School Mathematics Curriculum (2024) in terms of ICT use emphasis:

Table 2*: Number of Learning Outcomes According to Themes in the 5th Grade Secondary School Mathematics Curriculum (2024) in Terms of ICT Use Emphasis*

Theme Name	Numbers and Quantities	Algebraic Thinking with Operations	Geometric Shapes	Geometric Quantities	Statistical Research Process	From Data to Possibility
Total Learning Outcome	4	4	7	4	2	1
Learning Outcome with Emphasis on ICT Count	3	1	5	0	2	0

An examination of Table 2 shows eleven learning outcomes (f=11) in the Turkey Century Education Model 5th Grade Secondary School Mathematics Curriculum (MoNE, 2024) emphasizing the use of ICT tools. In the 5th grade secondary school mathematics curriculum (2024), the rate of emphasis on the use of ICT tools in learning outcomes is 47.82%. The theme with the highest emphasis on ICT tools is the Statistical Research Process theme with a rate of 100%. In the themes of Geometric Quantities and From Data to Probability, there is no statement about the emphasis on the use of ICT tool types. The reason why there is no emphasis on ICT in the Geometric Quantities theme is that mathematics instruction in this theme (e.g., length, area, volume measurements) is generally carried out using concrete tools (ruler, compass, measuring instruments). Those who prepared the

curriculum/textbook believe that teaching these topics is more suitable with traditional measuring tools rather than ICT tools.

The learning outcomes in the 5th Grade Secondary School Mathematics Curriculum (2024) were in detail examined. Table 3 presents the findings related to the learning outcomes that encourage and emphasize the use of ICT.

***Table 3**: Ranking of the Learning Outcomes in the 5th Grade Secondary School Mathematics Curriculum (2024) in Terms of Emphasis on ICT Use*

THEMES	LEARNING OUTCOMES	Emphasis
Numbers and Quantities	MAT.5.1.1. Generalise reading and writing six-digit numbers to multi-digit numbers MAT.5.1.2. Solve real life problems involving natural numbers and operations MAT.5.1.4. To be able to make inferences about the comparison of fractions expressed in different representations	*Learning-Teaching :* In their applications For learning outcome MAT.5.1.1. *''...they can be provided to access digital information'',* For MAT.5.1.2. learning outcome *''...digital tools for problem solving using...'',* For learning outcome MAT.5.1.4., emphasis is made with the expressions *''...use of artificial intelligence...''.*
Algebraic Thinking with Operations	MAT.5.2.1. To be able to make inferences about conservation of equality and operation properties	*Learning-Teaching :* For the learning outcome MAT.5.2.1. in their practices, it is emphasised with the expressions *''...various tools and technologies are utilised.''*
Geometric Shapes	MAT.5.3.1. To be able to use mathematical tools and technology for basic geometric drawings MAT.5.3.3. To be able to use mathematical tools and technology to measure angles MAT.5.3.4. To be able to make inferences about the angles that may occur depending on the	*Process Components* : For MAT.5.3.1. and MAT.5.3.3.3. learning outcomes, emphasis was made with the process component contained in the expression *''...tools and technologies...''.* *Learning-Teaching :* For the learning outcome MAT.5.3.4. in their

	position of two or three lines in the plane relative to each other MAT.5.3.5. To be able to interpret polygons as closed figures formed by consecutive intersecting lines in the plane MAT.5.3.7. To be able to reason about the centres of a pair of circles intersecting at two points in the plane with the help of mathematical tools and technology and the side properties of triangles constructed with one of the intersection points.	applications, for the learning outcome *''...angle measurement tool in the mathematics software...''* For learning outcome MAT.5.3.5. *''...the correct tool in the mathematics software...''* For MAT.5.3.7. learning outcome *''...maths 'Utilising line and circle tools in the software...'* is emphasised with the statements.
Statistical Research Process	MAT.5.5.1. To be able to work with categorical data and make decisions based on data MAT.5.5.2. Discuss statistical results or interpretations based on categorical data generated by others	*Learning-Teaching :* For learning outcome MAT.5.5.1. *''...some visuals prepared according to the data available online...''* , *''...they are enabled to make use of digital tools.'', ''...online applications and statistical software are introduced.'', ''...online applications, statistical software or electronic tables can help to prepare the circle graph.''* For MAT.5.5.5.2. learning outcome *''...critical thinking about the use of digital information 'thinking is encouraged.' is emphasised with the statements.*

This document analysis outlines learning outcomes and emphasizes the integration of technology in various maths themes. There is a relatively strong emphasis on digital tools for accessing information, problem-solving, and utilizing Artificial Intelligence which suggests a move towards interactive and ICT-driven learning for number and quantities. However, its current ICT emphasis often lacks the depth, specificity, and pedagogical justification needed to ensure effective and

equitable ICT use and maths learning. It needs to clarify *how* technology enhances understanding, address potential pitfalls like over-reliance, and outline concrete strategies for implementation and teacher support.

Afterwards, it was examined the activities, performance tasks and QR codes in the 5th grade secondary school mathematics textbook (MoNE, 2024) emphasizing ICT use. Table 4 presents the findings obtained:

***Table 4**: Examination of the Activities, Performance Tasks and QR Codes Emphasising ICT in the 5th Grade Secondary School Mathematics Textbook (MoNE, 2024) According to Themes*

Theme Name	Numbers and Quantities	Algebraic Thinking with Operations	Geometric Shapes	Geometric Quantities	Statistical Research Process	From Data to Possibility
Quantity of Activity and Performance Task Emphasising ICT	2	0	0	4	2	0
Quantity of QR Code Including ICT Related Applications	3	2	9	4	10	1
Total	5	2	9	8	12	1

When Table 4 is examined, the theme with the highest number of activities and performance tasks emphasizing ICT is Geometric Shapes, and the theme with the highest number of QR codes is Statistical Research Process. It is evident that the theme with the highest number of activities, performance tasks, and QR codes emphasizing ICT in the textbook is Statistical Research Process. Another noteworthy point in the table is that QR codes carry more ICT emphasis according to activity and performance tasks. This situation may cause students to exhibit passive attitudes in areas such as accessing information if they do not actively use technology in the

learning process. In addition, activities should be enriched in a way that actively involves students in problem-solving, discovery, and production processes. The text is arguing that while QR codes are a form of Information and Communication Technology (ICT), their use in education is often limited to simply providing access to information. This can lead to passive learning, where students are only consuming content rather than engaging with it. To counteract this, it is suggested that educational activities should be enriched to encourage students to use technology in more active and creative ways. This means shifting from simple information retrieval (like scanning a QR code to read a document) to more hands-on tasks

ICT tools are also analyzed according to their types. Table 5 presents the different types of ICT tools used in the activities and performance tasks in the textbook:

***Table 5**: Classification of ICT Tools According to Their Types*

Type of ICT Tools	Dynamic Maths Software	Software with Mathematics Content	Computer Software	Internet Applications
Number of Activity and Performance Tasks	2	0	1	4
Location of Activity and Performance Tasks	Performance Task: Designing (Book 1 p. 37) Activity : Creating a Dot Plot in Dynamic Maths Software (Book 2 p. 85)		Performance Task: Pixel Painting (Book 1 p.155)	Performance Task: Napiers Bones (Book 1 p.124) Performance Task: Artificial Intelligence (Book 2 p. 51) Performance Task: Investigating Environmental Pollution (Book 2 p. 78)

				Performance Task: I am researching measures to save money (Book 2 p. 82)

When Table 5 is analysed, it is the analysis revealed that the most frequently used type of ICT tool was "Internet Applications," while the least used was "software with mathematics content.". The ICT tool “internet” is used in the textbook to access the data available on the internet related to the subject.

The ICT tools used in the QR codes in the textbook are given in Table 6:

***Table 6**: Classification of ICT Tools Used in QR Codes According to Their Types*

Type of ICT Tools	Dynamic Mathematics Software	Software with Mathematics Content	Computer Software	Internet Applications
Number of QR Codes	7	19	3	1
Location of the QR Codes	Book 1 Geometrik Şekiller (ss. 20,24,27,30, 42,44,81)	Book 1 Geometric Shapes (pp. 85,90) Book 1 Numbers and Quantities (pp.134,136,144, 154,163,165) Book 2 Numbers and Quantities (s.54) Book 2 Statistical Research Process (ss.63,66,85,86,91,107, 112) Book 2 Algebraic Thinking with Operations (p.159, p.162)	Book 2 Statistical Research Process (ss.70,75,85)	Book 2 Statistical Research Process (s.61)

Book 2
From Data to Possibility
(s.181)

When Table 6 is examined, it is found out that the most used ICT tool type in the 5th grade secondary school mathematics textbook (MoNE, 2024) is *Mathematics Content Software* and the *Internet Application*. Mathematics Content Software is likely specialized programs or applications designed for learning math, such as geometry software, graphing calculators, or interactive tutorials. Internet Applications refers to web-based tools and resources. Examples could include educational math websites, online games, or digital manipulatives that are accessible through a web browser.

Investigation of ICT Usage Purposes in the 5th Grade Secondary School Mathematics Textbook

As a result of the analysis of the activities, performance tasks and QR codes in the MoNE 5th grade middle school mathematics textbook in line with their intended use, the categories were formed as follows in the light of the data obtained from the analyses: Practising, explaining information, concept construction. Table 7 presents the intended uses of ICT tools in activities and performance tasks, while Table 8 details their purposes within QR codes.

With the analysis of ICT-related activities, performance tasks, and QR codes, the intended uses of ICT tools within the 5th-grade secondary school mathematics textbook (MoNE, 2024) were categorized into practising, explaining information, and concept construction. *Practicing* use of ICT focuses on drills and repetition to help students solidify their understanding of maths. *Explaining information* use of ICT is used to introduce new mathematical concepts, explaining geometric principles or interactive diagrams demonstrating how a formula works, providing a richer learning experience. *Concept construction* use of ICT is the most sophisticated use of ICT, going beyond simple practice or explanation, building a deeper, more profound understanding of mathematical concepts by engaging with the material in

an active and meaningful way. Table 7 illustrates the purposes for integrating ICT tools into the textbooks activities and performance tasks, and Table 8 provides the purposes for their inclusion via QR codes.

Table 7: *Classification of ICT Tools According to Their Intended Use*

Purpose of Using ICT	Practising	Explaining Information	Concept Construction
Number of Activity and Performance Tasks	4	2	1
Activities and Performance Tasks Used	Performance Task: Designing (Book 1 p. 37) Performance Task: Napiers Bones (Book 1 p.124) Performance Task : Pixel Painting (Book 1 p. 155) Activity : Creating a Dot Plot in Dynamic Maths Software (Book 2 p. 85)	Performance Task: Artificial Intelligence (Book 2 p. 51) Performance Task: I am researching measures to save money (Book 2 p. 82)	Performance Task: Investigating Environmental Pollution (Book 2 p. 78)

When Table 8 is analysed, it is seen that in the activities and performance tasks in which ICT tools were used, the most common purpose of using ICT tools was to practice what they have learned and the least common purpose of using ICT tools was to construct concepts.

Table 8: *ICT Tools in QR Codes Can Be Classified According to Their Intended Use.*

Purpose of Using ICT	Practising	Explaining Information	Concept Construction
Number of QR Codes	16	2	12

QR codes Located in Location	Book 1 Geometric Shapes (pp. 85,90) Book 1 Numbers and Quantities (pp. 134,136,144) Book 1 Geometric Quantities (pp. 154,163,165) Book 2 Numbers and Quantities (s.54) Book 2 Statistical Research Process (pp. 86, 91, 107,112,) Book 2 Algebraic Thinking with Operations (pp.159,162) Book 2 From Data to Possibility (s.181)	Book 2 Statistical Research Process (ss.61,85)	Book 1 Geometric Shapes (ss. 20,24,27, 30,42,44,81) Book 2 Statistical Research Process (ss.63,66,70,75,85)

When Tables 7 and 8 are examined, it is seen that QR codes and ICT tools used in activity and performance tasks are most frequently used for the purpose of "practice." This situation may cause students to remain limited in higher-level cognitive processes such as concept construction. Technology needs to be used not

only as a practice tool but also to provide an environment for discovering, modeling, and discussing concepts.

Discussion

The findings of this study indicate the indispensable role of ICT in modern mathematics education. The integration of ICT tools is increasingly recognized as vital for enhancing student engagement, fostering conceptual understanding, and supporting individualized learning. This discussion explores the current state of ICT integration in the Turkish 5th grade mathematics curriculum and textbooks (MoNe, 2024). Despite the acknowledged importance of ICT in mathematics education within the literature, its explicit and consistent integration into the Turkish 5th grade maths curriculum remains a challenge. While the Turkish Century Education Model Secondary School 5th Grade Mathematics Curriculum doesnt offer explicit guidance on ICT orientation, it does acknowledge "e-content prepared by material preparers for each theme" and refers to "mathematical tools and technology" within theme content (MoNE, 2024, p.9). The document analysis clearly indicates a curriculum that seem to sufficiently integrate technology into mathematics education. The recurring phrases like "digital information," "digital tools," "mathematics software," "online applications," "statistical software," and "artificial intelligence" demonstrate a modern approach to teaching mathematics. While the curriculums embrace of technology is forward-thinking and aligns with modern educational trends, its current articulation often lacks the depth, specificity, and pedagogical justification needed to ensure effective and equitable ICT use and maths learning. It needs to clarify *how* technology enhances understanding, address potential pitfalls like over-reliance, and outline concrete strategies for implementation and teacher support.

However, a closer examination reveals that the use of ICT is not uniformly distributed across themes in the 5th-grade maths curriculum. Themes like "Geometric Shapes" and "Data to Probability" show relatively lower emphasis on ICT tools compared to "Statistical Research Process," which has the most. This

uneven distribution may limit the potential benefits of ICT across the entire mathematics spectrum of 5th grade curriculum. Textbook analysis illustrates inconsistencies in ICT emphasis. Beyond QR codes, the textbook features very few activities or performance tasks that specifically emphasize ICT use. It appears that the number of activities and performance tasks emphasizing ICT is eight and it can be concluded that this number is quite low when compared to the overall book. This finding comply with earlier research by Tural Sönmez (2024), who observed a similar low level of ICT tool integration in previously examined textbooks, despite differences in their structural approaches. This consistent lack of comprehensive ICT emphasis in maths textbook is a significant concern, as textbooks often serve as the primary resource for teachers and students, impacting the practical application of technology in classrooms.

5th grade maths textbooks activities, performance tasks, and QR codes (MoNE, 2024) include different ICT tool types such as dynamic mathematics software, mathematics content software, computer software, and the internet applications. Similar to the curriculum, the types of ICT tools are not homogeneously distributed across themes. Mathematics content software is the most frequently used, followed by dynamic mathematics software. This prioritization of dynamic mathematics software aligns with practices in other countries, such as Taiwan, where it is given considerable importance in their secondary school mathematics curriculum (Ataş, 2022). Looking at the learning outcomes in the 2024 Secondary School 5th Grade Mathematics Curriculum, while tools and technologies are directly mentioned in a number of learning outcomes, in others, there are expressions about digital and technology in the “Learning-Teaching Practices” sections (MoNE, 2024).This contrasts with the highly integrated approach seen in countries like Singapore, where technological tools are reportedly utilized across almost all learning areas in textbooks (Mersin & Karabörk, 2021). This study has certain limitations. First, the source of the study is limited to the curriculum and the 5th

grade mathematics textbook prepared in line with the Turkey Century Education Model in 2024. Therefore, the results obtained cannot be generalized to different grade levels or other subjects.

Second, document analysis was used as the research method. While this allows for the examination of the Information and Communication Technologies (ICT) integration envisaged in the curriculum and textbook, the study does not address how teachers and students experience this integration in practice.

Thirdly, the elements to which the review criteria were applied (learning outcomes, activities, performance tasks, and QR codes) are limited. Factors such as the visual design of the textbook, supplementary materials, or digital platform support were not included in the review.

Finally, this study focused on describing the existing situation. Therefore, no conclusions were drawn regarding the impact of ICT integration on student achievement, learning motivation, or the teaching process.

Purposes and Perceived Benefits of ICT in Maths Learning

The document analysis of this study indicate that the primary purposes for using ICT tools in QR codes, activities, and performance tasks include practising, explaining information, and concept construction. Notably, the use of ICT for "practising" is the most prevalent purpose. This contrasts with findings from Mersin and Karabörk (2021), who compared Turkish practices with those in Singapore. Their research concluded that while ICT tools in Singaporean textbooks were primarily used for calculation, verification, association, and visualization, Turkish textbooks predominantly utilized them for accessing, discovering, and presenting information. This difference highlights varying pedagogical approaches of countries for ICT integration to maths.

The literature consistently emphasizes the profound impact of ICT on student maths learning. For instance, using simulations to explore the relationship between experimental and theoretical probability can significantly enhance comprehension (Tural Sönmez & Aytekin, 2021). As Aspinwall and Tarr (2001)

pointed out, performing numerous experiments is crucial for teaching probability, a task greatly facilitated by ICT-based simulations that shorten the time students need to grasp complex concepts (Tural Sönmez & Aytekin, 2021). Dynamic visualizations, as highlighted by Roschelle et al. (2010), are crucial for bridging the gap between concrete experiences and abstract mathematical concepts. The effectiveness of technology integration, however, is contingent on several factors, including the technologys desi gn, the educational context, and the nature of the learning activities (Drijvers, 2015). This aligns with Niesss (2005) concept of Technological Pedagogical Content Knowledge (TPACK), which stresses the embedded understanding required for effective integration. Interactive e-books, for example, have been shown to positively affect students perceptions of mathematical objects and relationships, leading to more permanent learning and increased motivation (Radović et al., 2020). Studies by Ruzek et al. (2016), Sun et al. (2008), and Vukovic et al. (2013) further suggest a dual link between learning satisfaction and achievement with e-books. The use of links between mathematical objects and geometric interpretations, and the activation of student reasoning in e-books, can also lead to better knowledge retention (Hmelo-Silver, 2004).

Despite the clear benefits, integrating ICT into mathematics education faces several challenges. Teachers decisions to use ICT in the classroom are influenced by factors such as access to resources, incentive for change, ease of use, technical support, quality of software and hardware, professional learning commitment, and relevant policies (Mumtaz, 2000). It is stressed that teachers pedagogical beliefs about teaching and learning with ICT are central to successful integration, necessitating a three-stakeholder approach involving teachers, schools, and policymakers. Even with cutting-edge technology, teachers enthusiasm is crucial for effective classroom use, and they need evidence that ICT can make lessons more engaging and enjoyable for both themselves and their students. The research by Webb and Cox (2004) underscores that ICT-based learning environments demand

complex pedagogical judgments from teachers regarding the benefits of ICT, its specific possibilities, and how these align with subject-based objectives and student learning plans.

Studies also reveal disparities in ICT integration across different grades and maths curriculum. Arslan, Özpınar, and Kala (2010) found limited ICT activities in lower primary grades (1-5) in Turkish textbooks, with more prevalent use in higher grades (6-8), primarily involving dynamic geometry software, calculators, and the internet. In contrast, Erbilges (2019) c omparative study of mathematics curriculum in Turkey, Canada, and Hong Kong found explicit references to ICT tools in Canadas curriculum but none in Hong Kongs. Such curricular differences, as discussed by Ertmer and Ottenbreit-Leftwich (2010), significantly impact technology adoption, with specific curricular guidelines often acting as key enablers (Albro & Mucheru, 2018). Furthermore, assessments of ICT textbooks, such as those by Numanoğlu and Bayır (2009) on 6th and 7th-grade ICT textbooks in Turkish Republic of Northern Cyprus, reveal that visual design principles are often not fully considered, potentially hindering effectiveness.

Common barriers to ICT integration include lack of time, inadequate teacher training, insufficient technical support, and difficulties in integrating and using ICT effectively (Keong, Horani & Daniel, 2005). Given that countries with high mathematics achievement often use textbooks that successfully integrate ICT, and these are utilized by almost all teachers (Mullis, Martin, Foy & Drucker, 2012), there is a clear imperative for change. This analysis suggests that Turkey Century Education Model 5th Grade Mathematics Textbooks, with their limited ICT-emphasizing QR codes, performance tasks, and activities, may not fully support teachers in leveraging ICTs potential. Therefore, textbook authors should prioritize greater ICT integration to create more interactive and teacher-friendly resources, ensuring equal educational opportunities and maximizing the benefits of technology in mathematics learning.

Conclusion and Recommendations

As a result of the study, it appears that the ICT emphasis is not homogeneously distributed to the themes and the number of learning outcomes with ICT emphasis in the themes with ICT emphasis is the highest in the theme of 'Geometric Shapes', but there is no learning outcome emphasising ICT in the theme of 'Geometric Quantities'. Looking at the distribution of the number of activities, performance tasks and QR codes emphasising ICT in the analysis data to the themes, it is mostly found in the 'Statistical Research Process' theme. Based on the results of the research, it is evident that the Turkish 5th-grade mathematics curriculum is commendably progressive in its embrace of digital technology and tools. It reflects a clear intention to prepare students for a digitally-driven world by integrating various technologies, including AI, mathematics software. However, it is suggested that themes and learning outcomes should be taken into consideration in the curriculum and ICT use should be included in the themes in a more equal distribution, and more learning outcomes should be included in the curriculum in order to support ICT use. In addition, it can be recommended that ICT tools should be included in the textbooks in a way to ensure the development of students high - level skills. The findings of the study reveal in detail the current level of ICT integration in the curriculum and textbook, the themes on which it focuses, and the themes it does not cover at all. In this respect, it supports the issue of "imbalance in technology integration," which is frequently discussed in the literature, with concrete findings (İzmirli & Kırmacı, 2017; Dönmez, 2022). By examining the activities, performance tasks, and QR codes in the textbook, the study identifies potential shortcomings in practice, providing important feedback for education policymakers and textbook authors. Thus, the studys contributions extend beyond the theoretical dimension to highlight practical inadequacies, offering a unique contribution to the literature.

The frequent emphasis on what technology will be used, rather than how it will be leveraged to deepen conceptual understanding, raises concerns about potential superficial learning. Furthermore, the success of such an ICT-dependent curriculum depends on equitable access to resources, robust teacher training, and continuous technical support. Without addressing these critical implementation factors, the ambitious goals of this newly developed Turkey Century Education Model curriculum may fall short of achieving about technology-rich mathematics curriculum.

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