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Decoding mathematics values in a Turkish high-stakes exam: A qualitative content analysis

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Abstract: This study investigated the mathematical values conveyed in questions in a Turkish high-stakes exam, the High School Transition System, which marks the transition from middle school to high school. For this purpose, 100 mathematics questions from the High School Transition System exams over the past five years were obtained from open sources. Adopting a qualitative research design based on document analysis, the study employed content analysis methods focused on sentence-based meaning. The findings indicated that the questions were grouped into two mathematics value categories: transformational and structurational. Here, structurational values include structures and processes such as being disconnected, dehumanized, theoretical, abstract, objective, and controlling the environment. In contrast, transformational values are related to the applicability of mathematics in daily life, its connection to dynamic processes, humanization, and its openness to development. Some suggestions for education stakeholders and further research were also made, based on the study findings.

INTRODUCTION

Values are generally associated with an individual's moral, religious, and ethical beliefs, and there is a general tendency to exclude values from mathematics curricula and classrooms. However, it has been expressed that values can facilitate effective mathematics teaching/learning (Seah *et al.*, 2016), and it has been suggested that mathematics can play an essential role in the development and transfer of affective skills alongside cognitive skills (Swadener & Soedjadi, 1988). In this context, mathematics education emphasises both cognitive and emotional learning outcomes, and cognition and emotion are intertwined. (Chiu & Seah, 2024). The relevant literature supports this approach and emphasizes the need to consider both dimensions for effective mathematics teaching/learning (Aktaş & Argün, 2018; Aşıcı & Dede, 2019; Grootenboer & Marshman, 2016; Leder & Forgasz, 2002). Considering that values contain deeper structures than affective dimensions, such as beliefs and attitudes (Dede & Barkatsas, 2019), there has been an increase in articles examining values in mathematics education in recent years (Aktaş & Dede, 2024; Chung & Kim, 2022; Hill *et al*., 2021; Hill & Hunter, 2023; Lee-Poon & Simpkins, 2024), as well as books focusing exclusively on values in mathematics education (Clarkson *et al.*, 2019; Dede *et al.*, 2024).

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Values and Mathematics Education

The literature discusses values in different ways (Rokeach, 1973; Sagiv, 2002; Schaefer, 2012; Schwartz, 1994). However, values are generally expressed as general guidelines for behavior that emerge from one's experiences and relationships in life (Raths *et al*.,1987). Therefore, values can also play a significant role in educational settings and processes, having both positive and negative effects in various areas, ranging from students' professional careers to the construction of a democratic society (Aktaş & Dede, 2024; Rhodes & Roux, 2004). For this, values always require deliberate and conscious planning, and students can learn in any way and receive the message (Hill, 1991). In mathematics education, values significantly influence students' decisions to participate in or decline participation in a mathematical task, and they also play a role in shaping a sense of personal and social identity (Fitz Simons *et al*., 2001). Values are defined as personal, testable decisions and judgments that affect teachers' pedagogical identities and are considered important for their pedagogical identities (Chin & Lin, 2000). In this context, it is seen that some value classifications have been made in the related literature regarding the values that emerge and/or are reflected in mathematics classrooms. For example, Lim and Ernest (1997) grouped values related to mathematics education into three categories:

> (a) Epistemological values: These values refer to the theoretical aspects of mathematics learning and teaching, such as systematicity, certainty, rationality, and the appreciation and acquisition of mathematical knowledge, (b) Social and cultural values, including people's responsibilities for the society in which they live regarding mathematics education, such as justice, cooperation, and appreciation of the beauty of mathematics, and finally (c) Personal values: values that influence an individual such as curiosity, attitude, patience, confidence, and creativity (p.39).

Bishop (1988) proposed three value pairs: general educational values, mathematical values, and mathematics educational values. He classified mathematical values in Western culture into three complementary categories: rationalism-objectism, control-progress, and openness-mystery. Here, rationalism encompasses reason, hypothetical reasoning, logical thinking, explanation, abstraction, and theory, while objectism consists of atomism, materialism, determinism, analogical thinking, concretization, and symbolization. Control comprises prediction, knowing, security, mastery over the environment, rules, and power, while progress includes growth, cumulative knowledge development, generalization, questioning, and alternatives. Finally, openness consists of facts, articulation, demonstration, verification, universality, individual liberty, and sharing, while mystery includes abstractness, unclear origins, dehumanized knowledge, wonder, and mystique (Bishop, 1988*;* pp. 62-70). Also, Bishop (1998) explained the values in mathematics classrooms below:

> …when a teacher admonishes a child for cheating in a test, the values of *"honesty"* and *"good behavior"* derive from the general educational and socializing demands of society. Then, conveyed. However, other values are also being transmitted, which are specifically associated with the norms of the institutions within which mathematics education is formally conducted. For example, consider the following instructions from the teacher: "*Make sure you show all your working in your answers*", "*Don't just rely on your calculator when doing calculations, try estimating, and then checking your answers,*" the values implied are all about "*examination-wisdom*" and "*efficient mathematical behavior."* (p.34)

Considering these two value classifications proposed for mathematics classrooms, the epistemological values proposed by Lim and Ernest (1997) can be considered in the context of Bishop's (1988) mathematics values (mathematical values and mathematics educational values), and social and cultural values can be considered in the context of Bishop's (1988) general educational values (Dede, 2015). Seah *et al.* (2001) proposed a similar classification to

Bishop's (1988), stating that mathematics educational values can be influenced by factors such as country, school, environment, and content (e.g., curriculum, examinations), and thus can differ across cultures, societies, and educational systems. Here, these three value groups are not mutually exclusive (Seah & Bishop, 2000). Some values may be suitable for one, two, or three of these categories (for example, creativity). In this context, mathematical values can be considered an umbrella concept encompassing both mathematical values and mathematics educational values (Bishop, 1988). Here, mathematical values refer to the concepts and principles produced by mathematicians from diverse cultures, reflecting the nature of mathematical knowledge (Bishop *et al*., 1999). Mathematics educational values, on the other hand, are values that can be observed in textbooks, curricula, classroom practices, and other educational contexts, and influence these factors (Bishop, 1998). In this context, the current study utilized mathematical values to encompass both mathematical values and mathematics educational values.

High-Stakes Exams and Mathematics Values

Comparative examinations, as is well known, are conducted internationally to determine students' mathematical literacy and attitudes toward mathematics. For example, the Program for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) are among the most prominent. These examinations enable the identification of strengths and weaknesses in education systems, the monitoring of educational progress, and the determination of a framework for reforms, if necessary (OECD, 2013). For example, from a mathematics education perspective, PISA measures students' mathematical literacy skills through their mathematical reasoning and problem-solving skills. In addition to this cognitive dimension, PISA measures students' affective dispositions, including enjoyment, confidence, mathematics anxiety, self-concept, and self-efficacy.

It is stated that attitudes, feelings, and beliefs toward mathematics play a significant role in students' willingness or unwillingness to engage with mathematics. This situation is considered to have an impact on both students and teachers. Moreover, students who enjoy mathematical activities and are confident in performing them are more likely to apply mathematical thinking to situations they encounter in various aspects of their lives, both inside and outside of school (OECD, 2020). Students' positive perceptions of mathematics, within the context of mathematics values, have been shown to influence their academic achievement, meaningful mathematics learning, and the quality of classroom interactions (Guo *et al.*, 2015; Kalogeropoulos & Bishop, 2019). Furthermore, teachers' pedagogical decisions and teaching personalities also play a significant role in shaping mathematics instruction and learning activities (Chin *et al.*, 2021). At this point, when it is considered that values influence students' preferences for participating or not in any mathematical task (Fitz Simons *et al*., 2001), the importance of values in mathematics education becomes apparent.

A conceptual and functional framework has already been proposed for the OECD Learning Compass 2030. It defines the knowledge, skills, and values (and attitudes) students should have to fulfill their potential and contribute to the well-being of their societies and the world (OECD, 2019). However, besides international comparative exams like PISA and TIMSS, some can directly affect students' future careers and professional choices. Exams such as the Gaokao Exam in China, the JEE Advanced Exam in India, and the Graduate Record Examination (GRE) can be considered in this context. In this context, middle school level mathematics examinations are considered high-risk because they directly affect pupils, teachers, and schools (Reback *et al.*, 2014). Such high-stakes exams can cause anxiety and stress, primarily as they affect students' future opportunities and career choices (Peleg-Popko, 2004). Moreover, high-stakes exams can gradually become a form of high cognitive-demand competition and can be evaluated in terms of students' cognitive competencies and their coping mechanisms for anxiety (Burke, 2010; Keng *et al*., 2011). In this context, the High School Transition Examination [in

Turkish: LGS], which is conducted in Türkiye for the transition from middle to high school education and impacts students' career goals, can be considered one such high-stakes exam.

Due to the impact of high-stakes examinations, students often prioritize exam success and view mathematics as a tool, leading to the neglect of mathematics' aesthetic, cultural, and social values (Zuo & Wang, 2023). In this context, it can be argued that high-stakes examinations influence mathematical values. Moreover, specific mathematics values are emphasized within the PISA Assessment and Analytical Framework (OECD, 2022). These values can be considered as mathematical literacy, mathematical reasoning, application in real-world contexts, and critical thinking. For example, the concept of "*mathematical reasoning*" addressed within the PISA Assessment and Analytical Framework (OECD, 2022) emphasizes that mathematics should be solved not only with calculation skills but also with logical and rational thinking. Similarly, Bishop (1988) suggests that the rationalism value indicates that mathematical contexts can be solved through reasoning and logic. The intersection of different classifications under the same values makes this study a viable research topic.

Turkish Mathematics Curricula, Mathematics Values, and High Stakes Exams

Efforts to create a world where mathematics is at the center are the driving force of educational reforms (Cai & Howson, 2013) and include competencies such as problem-solving, reasoning, and communication (Boesen *et al*., 2018). At the same time, there is an interaction between mathematical values, affective components, and attitudes (Pang & Seah, 2021). Values and attitudes are also emphasized alongside competencies and skills that students/individuals should possess (OECD, 2019). The literature often notes that values and value education should be at the center of educational environments and processes (Clement, 2010; Halstead, 1996). In this context, in Türkiye, especially since the early 2000s, mathematics curricula from primary school to high school have been developed and updated with a values-oriented approach in addition to knowledge, skills, and the integration of technology in the classroom, in this context, values in Turkish mathematics curricula were first included in the mathematics curricula, which were updated in 2018, and 10 core values that can be evaluated in the context of educational values were included. These are justice, friendship, honesty, self-control, patience, respect, love, responsibility, patriotism, and helpfulness (Ministry of National Education [in Turkish: MEB], 2018). However, the integration of these values into mathematics teaching and learning processes has not been fully clarified (Dede & Barkatsas, 2019). Interest in values has increased, and with the mathematics curriculum updated in 2024, values have become one of the focus concepts that should be taught and transferred to students (MEB, 2024a). In this context, the most recent curriculum implemented in Türkiye is the Türkiye Century Maarif Model (MEB, 2025). This curriculum is structured around the dimensions of virtues, values, actions, and competencies. Within the curriculum, the application of virtues (e.g., justice, respect, responsibility) is linked to competencies in daily life, including cognitive, social, and emotional skills. Furthermore, the model does not focus solely on affective skills but also emphasizes cognitive abilities such as reasoning, relational thinking, and problem-solving. In other words, this latest curriculum aims to convey not only general educational values but also mathematical values, including analytical thinking and reasoning, to students. In this context, the latest curriculum also conveys mathematical values such as analytical thinking and reasoning to students, in addition to general educational values. Within the Turkish education system, which spans 12 years of compulsory education (divided into three stages), these values are integrated into various stages of educational life.

The Turkish education system comprises three levels: the primary school level (Grades 1-4), the middle school level (Grades 5-8), and the high school level (Grades 9-12). Here, centralized high-stakes exams are used to transition students from middle to high school, although the content has been modified. Students in the top 10% of these exams have the opportunity to attend public schools that can offer them better educational and career prospects. In contrast, the remaining students are placed in other public high schools based on their residence address, school achievement score, attendance, and absenteeism criteria (MEB, 2024b).

Examining the historical development of these exams reveals that school-based exams were first introduced in Türkiye in 1955 (Güven, 2010), and subsequently, they evolved into centralized exams. In this context, centralized exams have been administered since 1997 with varying contents and purposes. For example, Level Determination Exams [in Turkish: SBS] in 2009-2013, the Transition System from Middle to High School Education [in Turkish: TEOG] in 2014-2017, and the High School Transition System [in Turkish: LGS] exam in June every year since 2017. For example, 1,038,192 Grade 8 students applied for the June 2024 LGS exam. The LGS is administered in two consecutive sessions on the same day (with a 45-minute break between the two sessions) and consists entirely of multiple-choice questions. The total exam duration is 155 minutes; 90 questions are asked, and three incorrect answers result in one correct answer. The first exam session consists of 50 verbal questions and lasts 75 minutes. The second session, consisting of 40 numerical questions, lasts 80 minutes. The first session includes questions from Grade 8 Turkish, Turkish Revolution History and Kemalism, Religious Culture and Ethics, and Foreign Language; the second session includes questions from Mathematics and Science. The questions are prepared in accordance with the Grade 8 curriculum. They align with the subjects, achievements, activities, and questions in the textbooks prepared in line with the curriculum of the relevant courses. These questions measure students' science process skills, such as reading comprehension, interpretation, inference, problem-solving, analysis, and critical thinking (MEB, 2024c), and the questions in this exam (especially mathematics questions) are also called skill-based questions. In this context, 20 mathematics questions are asked in LGS. The topics that students are responsible for in this mathematics test are as follows: factors and multiples, exponential expressions, expressions with square roots, data analysis, probability of simple events, algebraic expressions and identities, linear equations, inequalities, triangles, congruence and similarity, transformational geometry, and geometric objects (MEB, 2024d).

Purpose and Importance of the Study

This study proposes to reveal the mathematics values of the questions in the mathematics test of a high-stakes exam [LGS] in Türkiye. This is because mathematics is a value-laden discipline, producing mathematics values of different cultures (Clarkson *et al*., 2019). Therefore, even if the same mathematics curriculum and content (textbooks, exams, etc.) are applied in mathematics classrooms in different cultures, different values may be transmitted to students in these different cultures (Bishop *et al*., 2000). Radford (2018) also emphasizes the impact of culture on mathematics education and teaching, stating that mathematics encompasses the needs, interests, ideas, and values of the society from which it emerged, as well as its own cultural and historical context. In this context, determining the mathematics educational values of the questions in the mathematics test of a high-stakes exam in Türkiye, a country situated at the crossroads of Asia and Europe, may provide a different perspective on the related literature. On the other hand, it is stated that an education independent of values is impossible and that states consider value education a critical component to building their future, protecting, and advancing their generations (Powe, 1993). For example, the Turkish middle school mathematics curriculum (MEB, 2024e) prioritizes the development of virtuous individuals. For this purpose, values and actions, the sub-dimensions of virtues, are considered cross-curricular components (mathematics, physics, etc.). Thus, it emphasizes that values should be integrated with other elements of the curriculum (skills and content area). Since values education and transfer continue even when not consciously planned (Hill, 1991), value transfer in mathematics education is usually carried out implicitly (Bishop, 2016). Values are consciously or unconsciously included in mathematics classrooms and documents and transferred to students (Clarkson, 2007); it is essential to reveal the mathematics values transferred to students through a written text [LGS] with the current study.

This study is expected to make two significant contributions to the literature. Firstly, this research differs from existing studies in that it focuses on revealing the mathematical values in mathematics questions found in high-stakes examinations. When examining studies conducted on high-stakes examinations in the literature, they focus on mathematics/science literacy (Kang & Cogan, 2022; She *et al.*, 2018; Siregar *et al.*, 2021), cognitive domains (Lee & Stankov, 2018; Liou & Bulut, 2020; Teig *et al.*, 2022), and academic achievement (Jerrim, 2023; Monrad *et al.*, 2021; Zuo & Wang, 2023). In this context, it can be said that the literature contains more cognitive-focused studies on high-stakes examinations, and there is a need for research focusing on values. The second important aspect of this research is its methodological difference. The word- and sentence-based analysis of the mathematics questions in the LGS, a high-stakes examination, supports this situation. Document analysis studies conducted in this field in the literature include curriculum comparisons (Au, 2007; Berliner, 2011; Polesel *et al.*, 2014). In this context, this study is considered original and important.

In this context, the present study is considered original, as it examines the mathematical values embedded within a high-stakes examination (LGS). Finally, the results of this study can also be used to compare the mathematics values conveyed in international comparative exams, such as PISA and TIMSS, and high-stakes exams, such as the Gaokao Exam. In this context, the present study seeks to answer the following question:

What mathematics values are conveyed in the mathematics questions on the high-stakes exam [LGS]?

METHOD

Research Design

This research employed the document analysis method, a qualitative research design, as past or present documents are often a rich data source for researchers (Punch, 2016). Document review is a systematic process for analyzing or evaluating printed or electronic materials (Bowen, 2009). In this context, in the present study, a total of 100 mathematics questions from the last five years of a high-stakes exam [LGS] administered during the transition from middle to high school in Türkiye, accessed by the researchers through open access, were analyzed in terms of mathematics educational values. At the same time, values have become one of the key concepts that should be taught and conveyed to students in the latest updated mathematics curriculum (MEB, 2024a), which has been influential in this research process. Some sample mathematics questions (from various topics) by year are presented in Table 1.

Table 1. *Samples of mathematics questions by year at the LGS (with authors' translation).*

Year	Topic	Question
2020	Multipliers and Multiples	"*…On one side of a square piece of paper with a side length of 54 cm, 12 equal rectangles and 1 square are drawn as follows…*" "*… To fill all 150 liters of milk produced on this farm, an equal number of glass bottles and paper cans are purchased…*"
	Exponential Expressions	"*... The prices of four different brands of televisions in TL, written as the product of prime factors, are shown below…*" "*...The sides of 10 blue identical rectangles with side lengths of 2^5 cm and 2^6 cm are overlapped as follows to form rectangle ABCD...*"
Year	Topic	Question
2021	Square Root Expressions	"*...According to this, which of the following is the length in centimeters of the line segment KL?*" "*...According to this, how many centimeters is the perimeter of a rectangular piece of cardboard?*"

Year	Topic	Question
2021	Data Analysis	*“ ...The 60 g salt distribution according to food types is shown below with a circle graph…”* *“…The installments of the total amount to be paid to store A are shown in the column chart on a unit squared basis…”*
2022	Probability of Simple Events	*“...The probability that the date of birth of a student randomly selected from this list is in April is greater than the probability that it is in May...”* *“…In a random draw, what is the probability of drawing a card with 5 (dots) on it?”*
	Algebraic Expressions and Identities	*“...According to this, which of the following is the algebraic expression that gives the length of the perimeter of the blue rectangular region in centimeters?”* *“The area of each white region is $(4x^2 + 8x + 4)$ cm^2, which is a quadratic equation.”*
	Linear Equations	*“…By adding only wheat flour to the prepared flour, the linear relationship between the rye and wheat flour amounts will be suitable for the graph…”* *“...The vertical line given in the model divides this door with a width of 352 cm into two equal parts…”*
2023	Inequality	*“...When Efe and Kuzey exchange a bag of marbles, what is the minimum number of marbles North has?”* *“…Which of the following is the correct order of the measures of the angles of triangle ABC?”*
	Triangles	*“...6 yellow flags in the shape of an equilateral triangle, each with a circumference of $24\sqrt{2}$ cm, with overlapping corners and edges on a string ...”* *“…Since $\|AC\| > \|BC\| > \|AB\|$ in triangle ABC, at least how many degrees is the measure of angle A?”*
2024	Equivalence and Similarity	*“...the triangle formed by moving along a linear path from point B to a point on the side ML is similar to the triangle AKB...”* *"… the similarity ratio of equilateral triangles with one side on the same line segment is 1/2."*
	Transformation Geometry	*“...According to this, which of the following cannot be one of the images formed in white rectangular regions?”* *"…The shape on the right is shifted six units to the left, after which the reflections of both shapes are created concerning the line k..."*
	Geometric Objects	*“…Based on the given, what is the ratio of the top piece's base radius to the middle piece's base radius? (π=3)"* *“In the inner area of this field, a road will be constructed along three sides, parallel to the edges, as shown in Figure II...”*

Data Analysis

The data were analyzed using a content analysis approach. Content analysis involves identifying patterns in the data, coding, categorizing, and naming the data (Creswell, 2013). In this context, the mathematics values (mathematical values and mathematics educational values) conveyed in LGS mathematics questions are the values examined in the present study. In this sense, the unit of analysis can be a word, theme, character, person, sentence, paragraph, or content (Yıldırım & Şimsek, 2008). Considering the possibility of overlooking the meaning of the sentence in word and paragraph analysis (Yıldırım & Şimsek, 2008), LGS mathematics questions were analyzed by focusing on “*sentences and the meaning in these sentences*” (in the context of values). In this context, the data analysis process was schematized as in Figure 1.

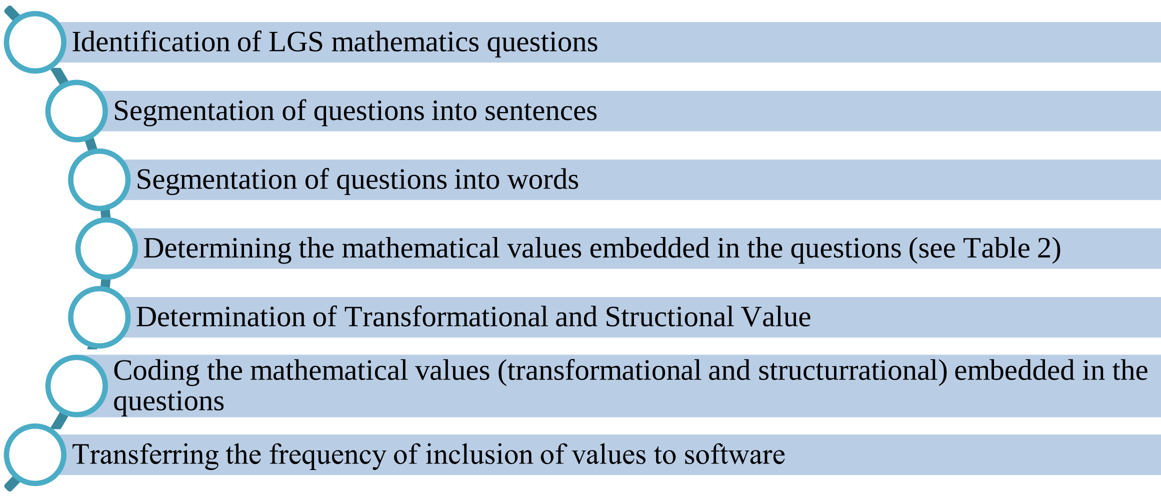


Figure 1. *Stages of data analysis.*

In the data analysis stage, the LGS mathematics questions were first identified. Subsequently, the questions were segmented at both the sentence and word levels. The implicit mathematics values (structurational and transformational) embedded in the questions were then classified according to the criteria presented in Table 2, including values, sub-values, and frequency of occurrence. In the final stage, the frequency of occurrence of structurational and transformational values was determined using a qualitative analysis software program.

For this purpose, LGS mathematics questions were first imported into a qualitative analysis software**.** It should be noted here that, due to the nature of values, a value can simultaneously be a mathematical value, a mathematics educational value, and a general educational value (e.g., flexibility, creativity) (Seah & Bishop, 2000). A sample analysis of an LGS mathematics question, focusing on values, is presented in Figure 2.

Question:

$A.10^n$ is scientific notation, where |a| is a real number greater than or equal to 1 and less than 10, and n is an integer. The monthly growth amounts of a plant are given in the table below.

Table: Growth amount of a plant according to months.

Month	Growth Amount (mm)
April	$0.081.10^4$
May	$0.19.10^3$
June	$0.0025.10^5$

Accordingly, which of the following is the scientific notation of this plant's total three-month growth amount in the table in millimeters?

A) $1.25.10^3$ B) $1.25.10^4$ C) $2.735.10^{12}$ D) $2.735.10^{11}$

Source: LGS 2022 mathematics exam, question no 2, p.2.

Figure 2. *A mathematical question and its sample analysis (with authors' translation).*

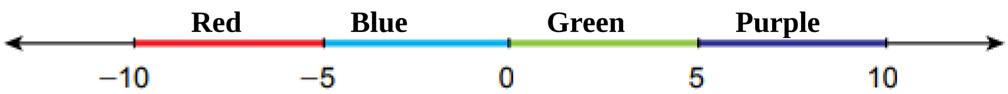
Analysis of the question in mathematics values

The sentence "*A.10n is 'scientific notation', where |a| is a real number greater than or equal to 1 and less than 10, and n is an integer*." defines the "*A.10n*" notation. Therefore, this sentence can be considered in the context of the "*definition, explanation*" sub-value under the "*structurational*" value. Here, a table presents the monthly growth amounts for a plant. Therefore, the "*tool*" sub-value of the "*transformational*" value can be mentioned here. "*Accordingly*" can be assessed within the context of the "*logical connector*" as the "*tool*" sub-value of the "*structurational*" value. Again, the sentence "*Accordingly, which of the following is the scientific notation of this plant's total three-month growth amount in the table in* *millimeters?*" can be considered in the context of the "*certainty*" value since it requires a clear answer. Moreover, this sentence and the entire question employ passive language; the expression of the plant's monthly growth amounts in millimeters and the requirement for the reader to determine the total growth can embody the "*mystery*" value. In addition, this question carries the "*relevance*" value, as it is based on a context related to daily life. Finally, the specification of the plant's monthly growth amounts in the table, the requirement to calculate the total growth, and the inclusion of multiple-choice options indicate the "*control*" value.

The Trustworthiness of the Study

The values that emerged in the present study were compared with the value categories proposed by Bishop (1988, 1998) and Lim and Ernest (1997) for mathematics classrooms, thereby employing "*theoretical triangulation*" (Cohen *et al*., 2000, *p. 113*). In addition, examples of mathematics questions from the LGS exam were included in the text to provide a thick description of the findings (Creswell, 2013). In this context, the questions were sent to two researchers with doctoral degrees in mathematics education. These two experts analyzed 15% of the data (MacNealy, 1999). The agreement correlation coefficients between the researchers and mathematics education experts were calculated as .82 and .84, respectively.

<u>*Question:*</u>



The exponential expressions 1^{-5}, $(-3)^2$, 2^{-3}, -3^2, and -3^2 will be placed on the number line at the points corresponding to their values.

Accordingly, on which colored line segment will the greatest number of exponential expressions be placed?

A) Red B) Blue C) Green D) Purple

Figure 3. *Analysis of a question that may elicit divergent perspectives (with* authors' translation*).*

Expert A says, "*The exponential expressions 1-5, $(-3)^2$, 2^{-3}, -3^2 will be placed on the number line at the points corresponding to their values.*" In this sentence, the phrase *"will be placed at the points"* indicates that each exponential number represents a colored segment on the number line, which may reflect the certainty value. The term "*Accordingly*" employs the logical connector value. The part containing the segment with the greatest number of exponential expressions may reflect the prediction value. Therefore, this question may encompass the certainty value from the structurational values. Regarding the transformational values, using the number line represents the tool value, and the fact that the problem can be solved by the reader using alternative methods represents the progress value. Associating the positions of the exponential numbers on the number line with colors signals the mystery value.

According to Expert B, this question incorporates both structurational and transformational values. The term "*accordingly*" in the question indicates a logical connector. The part of the question asking "*on which colored line segment*" may reflect the certainty value. At the same time, the phrase "*the greatest number of exponential expressions will be placed*" involves prediction, as it requires estimating the positions of the exponential numbers on the number line. The fact that the exponential expressions correspond to exact integers and the inclusion of multiple-choice options may reflect the control value. Furthermore, questioning the positions of the exponential expressions may embody the relevance value. The direct use of the number line as a model may also represent the tool value. Additionally, the phrase "*the greatest number*" indicates that some exponential expressions fall within the same colored segment, which can be considered in the context of the "*mystery*" value.

When the opinions of Experts A and B are evaluated, the common values represented in this question are certainty, logical connector, prediction, tool, and mystery. The values for which no consensus was reached are relevance and control. Therefore, a third expert with a doctorate in mathematics education was consulted regarding the "*relevance and control*" values and whether they are represented in this question.

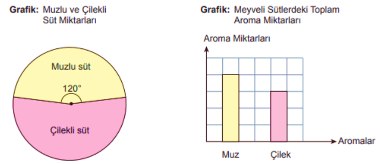
According to Expert C, the relevance value directly connects mathematical concepts to real-life situations, including awareness and inquiry in everyday contexts. Since this question does not involve a real-life situation, it does not reflect the relevance value. The control value involves comparing and questioning mathematical situations and verifying solutions. This value can be directly associated with techniques that allow control, such as multiple-choice tests, matching exercises, branching tree diagrams, and true/false questions. Therefore, since this question is a multiple-choice item that verifies the mathematical correspondences of exponential numbers via their positions on the number line, it can be considered within the control value. Considering the opinions of Experts A, B, and C on the question, and based on the above justifications, this question encompasses the following values: certainty, logical connector, prediction, tool, mystery, and control.

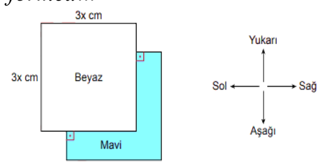
RESULTS

The results have indicated that the questions can be categorized into two groups: transformational values and structurational values. Structurational values are directly related to the structure of mathematics. Structurational values can be conceptualized as encompassing the values of rationalism, including reasoning, hypothetical reasoning, logical thinking, explanation, abstraction, theory, and control, as classified by Bishop (1988). They can also be regarded as a reflection of epistemological values outlined by Lim and Ernest (1997). On the other hand, transformational values are expressed in terms of the relevance of mathematics to daily life, its socio-cultural dimensions, and the nature of mathematical thinking (Bishop, 2008). It can be said that these two values, transformational and structurational, are generally distributed in balance in LGS mathematics tests (see Table 2). However, since passive language was used in all the questions examined here, mystery value (Seah & Bishop, 1999) can be considered an umbrella term encompassing both categories. Additionally, all questions in the mathematics test also carry a *"control"* sub-value within the structurational value because they include multiple-choice options. In this sense, the structurational values category covers the structures and processes of mathematics related to its nature, such as being disconnected, theoretical, abstract, objective, and controlling the environment.

When the sub-values presented in Table 2 are examined, it can be seen that the mathematical questions are grouped under five sub-value categories under structurational values: (i) certainty, (ii) definition, explanation, (iii) reasoning, (iv) logical connector, and finally, (v) prediction. When the sub-values presented in Table 2 are examined, it can be seen that the mathematics questions are grouped under five sub-value categories under structurational values: (i) certainty, (ii) definition, explanation, (iii) reasoning, (iv) logical connector, and finally, (v) prediction. A brief explanation of these values is as follows: Precision refers to clearly defined, unambiguous, and consistent boundaries in mathematical thinking. For instance, this includes situations such as determining a probability value between 0 and 1, or calculating the positions of edges and vertices of a polygon. Definition and explanation are applied in contexts that require precise scientific language and clarification. For example, "*One of two customers who visit a store consumes 3/4 of a pizza.*" Reasoning encompasses logical inferences, including conditional and hypothetical statements such as "*if that were the case*," "*if it were not the case,*" or "*let us assume.*" Logical connectors relate to situations involving structured logical reasoning, typically signaled by conjunctions such as "*therefore*," "*in this context*," or "*since.*" For example: "*If the dice rolled in a game shows an even number, the player wins. What is the probability of winning the game?"*

Table 2. *Samples of transformational and structurational values.*

<table>
<tr><th>Value</th><th>Sub-value</th><th>Value Indicator</th><th>Sample of Questions (with Authors' Translation)</th><th>Frequency (f)</th></tr>
<tr><td rowspan="5">Structurational</td><td>Certainty</td><td>Clear,
defined boundaries</td><td>"...What is the correct sequence of the angle measures in triangle ABC?"
"...According to this, how many liters is the amount of medicine in the tank at the beginning?"
"...What is the minimum number of marbles at the beginning?"</td><td>90</td></tr>
<tr><td>Definition, explanation</td><td>Scientific language, explanation, description</td><td>"The volume of a right circular cylinder of radius r and height h is pr^2h..."
"Probability of an event = (Number of possible desired states) / (Number of all possible states)..."
"...Writing a decimal notation as the sum of its place values is called decimal decomposition."</td><td>52</td></tr>
<tr><td>Reasoning</td><td>Logic, what if, what if not</td><td>"...The relationship between the volume of a television set and the volume indicator is given below. In this relationship, if the number indicating the volume level is a perfect square, the square root value; if it is not a perfect square, the natural number value to which the square root value is closest, is indicated by the number of lines next to the speaker symbol..."</td><td>80</td></tr>
<tr><td>Logical connector</td><td>Using logical conjunctions, abstract language</td><td>"...According to this, how many centimeters is the length of the red pencil?"
"...Since the total mass of the vehicles carried by two trucks is 214 kg, what is the number of vehicles carried by truck A?"</td><td>85</td></tr>
<tr><td>Prediction</td><td>Using estimation strategies, probability</td><td>"...Which of the following is the distance in meters from the starting line to the point where the ball Mehmet rolled stops?"
"...According to this, which of the following could be the length of the line segment KL in centimeters?"</td><td>45</td></tr>
<tr><td rowspan="3">Transformational</td><td>Relevance</td><td>Connection with daily life, questioning, and usefulness</td><td>"...The Akkuyu Nuclear Power Plant, which will meet a significant portion of Türkiye's electricity needs when fully operational, will prevent $21x10^8$ tons of carbon emissions over 60 years..."
"...The stations on the railway lines of a city are indicated with dots in the figure below..."
"...A customer who ate a portion of three different dishes at this restaurant consumed 5 g of salt..."</td><td>219</td></tr>
<tr><td>Progress</td><td>Flexibility, alternatives, growth, development, open-minded</td><td>"...The obsolete parts on the model, identified by the four white rectangular regions, will be completed according to the line of symmetry."
"...One of the beads in this abacus is removed from the rod and attached to another rod..."
"...Without moving the boxes in the blocks, these three blocks are stacked on each other to form a tower..."</td><td>35</td></tr>
<tr><td>Tool</td><td>Using model, sample, material, table, graphic, shape, etc.</td><td>"...The amount of banana and strawberry milk produced in a day is shown in the circle graph, and the total number of flavors used in these fruit milks is shown below in the bar graph on the squared ground."


"...After overlapping the white and blue cardboard in the shape of a square whose sides have a length of 3x cm, the white cardboard is shifted 1 cm up and 1 cm to the left, provided that the blue cardboard remains fixed, and the following figure is formed..."


"...If the balls in the boxes are combined in the empty bags A, B, and C, as shown in the table, the probabilities of one ball drawn randomly from these bags being blue are shown in the table."
<table><tr><th>Torbalar</th><th>Birleştirilen Kutular</th><th>Mavi Top Çekilme Olasılığı</th></tr><tr><td>A</td><td>I ve II</td><td>%100</td></tr><tr><td>B</td><td>I ve III</td><td>%75</td></tr><tr><td>C</td><td>I ve IV</td><td>%50</td></tr></table></td><td>208</td></tr>
</table>

Estimation involves making predictions and assumptions. For example: *"How tall will the plant be in the fifth month?"* The frequency of these sub-values in the questions, from most to least, is certainty (90), logical connector (85), reasoning (80), definition/explanation (52), and prediction (45) (Here, the numbers in parentheses show the frequency of occurrence of the sub-value).

When the sub-values presented in Table 2 are examined, it can be seen that the mathematics questions are grouped under three sub-value categories under the transformational values: (i) relevance, (ii) progress, and (iii) tool. When the sub-values presented in Table 2 are examined, it can be seen that the mathematics questions are grouped under three sub-value categories under the transformational values: (i) relevance, (ii) progress, and finally, (iii) tool. The following explanations can be made regarding these values: The relevance value expresses the relationship between everyday life situations and the discipline of mathematics. For example, a greengrocer sells five tomatoes for 20 TL and 10 apples for 40 TL. According to this, how much TL does a customer who buys 20 tomatoes and 20 apples pay the greengrocer? The progress value possesses characteristics that include producing alternative and new solutions, embodying open-mindedness, not requiring a single correct answer, and flexibility. Non-routine problem situations can be given as examples. The tools value can be expressed by concretizing abstract mathematical situations (using tables, shapes, graphs, models, samples, etc.). The frequency of these sub-values in the questions, from most to least, is relevance (219), progress (35), and tool (208). The frequency of these sub-values in the questions, from most to least, is relevance (219), progress (35), and tool (208).

DISCUSSION and CONCLUSION

This study obtained two categories of values: structurational values and transformational values. The structurational values may reflect Bishop's (1988) value of rationalism, which encompasses reason, hypothetical reasoning, logical thinking, explanation, abstraction, theories, and the control value. They may also be considered the epistemological values of Lim and Ernest (1997). Additionally, students often emphasize these values, such as the reasoning and logical connectors, in the related literature (Aktaş & Dede, 2022; 2025). The MEB (2024e) also suggested that students develop skills such as analysis, interpretation, inference, mathematical justification, and evidence, along with their process components. It also recommended that these skills be used to develop mathematical skills such as pattern searching, generalization, prediction, and multiple representations. Turkish and German mathematics teachers have also emphasized this aspect of mathematics (Dede, 2012), and mathematics textbooks from different cultures (Dede, 2006; Seah & Bishop, 2000) also contain these structurational values because these values include the protection of the essence and nature of mathematics (Wang *et al*., 2006). Similarly, Dede (2012) also considers it as "*isolated knowledge*" (*p. 1171*). Additionally, it can be assessed within the formalism and tool or schematic orientation aspects of Törner (1997) and Grigutsch *et al*. (1998). Among the values that emerge here, sub-values such as scientific reasoning and certainty related to the nature and discipline of mathematics always find a place as prominent values in studies conducted in different cultures (Bishop *et al*., 2001; Dede, 2012, 2019). These sub-values are evaluated within the scope of Bishop's (1988) rationalism and Lim and Ernest's (1997) epistemological values and can be seen as evidence of the universal language of mathematics. Moreover, this approach is also compatible with the Platonic philosophy of mathematics, as absolutist philosophers hold that the structure and objects of mathematics exist independently of humans. Thus, mathematical knowledge unifies these structures and objects (Ernest, 1998).

The findings of this study indicate that certain values frequently employed in mathematics questions, such as relevance, reasoning, logical connectors, prediction, and tools, are also implicitly embedded in the classroom practices of mathematics teachers. In line with this, the Values in Mathematics Teaching (VIMT) project conducted in Taiwan has shown that mathematics teachers in Central Asia embrace the values of rationalism–objectism, control–progress, and openness–mystery (Bishop *et al*., 2003). This may suggest that cultural influences play a significant role in shaping values. Accordingly, the textbooks and curricula implemented within similar geographical contexts may provide a basis for establishing connections between the mathematics values of teachers who share comparable cultural backgrounds.

Within the scope of this study, the structurational values most prominently emphasized were certainty, logical connectors, and reasoning. In contrast, definition/explanation and prediction values appeared at relatively lower levels. Certainty may correspond to Bishop's (1988) clarity value among these frequently observed values. As Corrigan *et al.* (2003) note, clarity emphasizes that when starting from the same conditions, one should always arrive at the same findings/results, thereby representing the transparency and reliability of mathematics. This feature is consistent with the high-stakes nature of the LGS examination, in which each question is designed to have only one correct answer. The value of logical connectors highlights the concept of "*logical connector*" in relation to Bishop's (1988) rationalism value, which encompasses logical, hypothetical, and inferential modes of thought (Bishop, 2004). Similarly, the mathematical literacy items in PISA, a high-stakes comparative assessment, emphasize the use of logical connectors (PISA, 2018). Additionally, the TIMSS exam emphasizes "*logical deductions*" in problem situations, based on specific assumptions and rules, and justifying results (TIMSS, 2023). Therefore, it is seen that the logical connector value is included in high-stakes exams. The reasoning value refers to the assumptions, methods, and rules employed within the question content to arrive at the correct answer. In contrast, prediction can be understood as a form of conjectural thinking. The relatively limited presence of definition/explanation and prediction can be attributed to the structurational characteristics of the LGS, which primarily aims to assess academic performance within a restricted time frame.

In this context, the transformational values most frequently identified were *relevance* and *tools*, whereas the progress value was observed at a relatively lower level. The predominance of *relevance* may be attributed to its association with real-life situations (Van de Walle, Karp, & Bay-Williams, 2014). The value of *tools* corresponds to Bishop's (1988) *objectism* value, which encompasses ideas such as symbolization and the concretization of abstract concepts (Bishop, 2004). This characterization supports the observation that LGS questions frequently employ symbolization and concretization, both of which lie at the core of objectism. Similarly, in international assessments such as PISA and TIMSS, the use of various forms of representation—including tables, figures, and graphs—in mathematics problems to examine relationships between variables, analyze and interpret data (Dossey *et al.*, 2006) and support research design reinforces this practice. This approach also strengthens the use of tools in mathematics education. Conversely, the limited presence of the progress value—which entails alternative and innovative solutions—appears to stem from the structurational features of the LGS as a high-stakes, multiple-choice examination administered under strict time constraints. Similarly, in international comparative assessments such as PISA and TIMSS, problem-solving skills are emphasized, and items that allow for alternative and multiple solution strategies are prevalent (Dossey *et al.*, 2016). This reflects the implicit presence of the value of progress. On the other hand, transformational values reflect usefulness, process, intuitiveness, communication, creativity, tools, induction, and relativity. It emphasizes the socio-cultural dimensions of mathematics and the mathematical thinking affected by these dimensions (Bishop, 2008). Turkish and German mathematics teachers have also emphasized the dynamic and daily life-related aspects of mathematics (Dede, 2012). Additionally, mathematics textbooks from different cultures (Dede, 2006; Seah & Bishop, 2000) convey these transformational values. In other words, it states that mathematics encompasses "*connected*" values (Ernest, 1998, *p. 45*) and "*connected thinking*" (Dede, 2012, *p. 1171*). Additionally, it can be considered in the context of the process and the application of Törner (1997) and

Grigutsch *et al*. (1998). Moreover, this approach is also compatible with the fallibilist philosophy of mathematics, as fallibilist philosophers argue that fallibility plays a crucial role in constructing and developing mathematical knowledge, and human work and history significantly contribute to the construction of knowledge. Mathematical knowledge is, therefore, an outcome of human work and social interaction (Ernest, 1998). In fact, the MEB (2024e) has similarly approached this issue, viewing mathematics as a discipline that enables individuals to acquire values through the intellectual tools it provides. Thus, individuals can make sense of objects, events, and phenomena surrounding them and their environment through mathematics and more easily adopt, protect, and develop values.

Further Research and Limitations

The study focused on revealing the mathematics values carried by one of the high-stakes national exams taken for the transition from Turkish middle school to high school, and it was limited to examining 100 mathematics questions. Another limitation of this research is that it is based on document analysis and relies on the relative potential subjectivity of coders during the analysis phase (word and sentence-based content analysis). In this context, it may significantly contribute to the relevant literature and serve as a valuable reference point for such studies. As mentioned, the Turkish mathematics curricula were updated to be skill-based and value-focused in 2024 (MEB, 2024a). Therefore, determining the values carried in the LGS mathematics exams to be held according to this new curriculum is a subject for further research. Furthermore, in light of the findings of the present study, future research could be proposed to compare the mathematics questions of other national (e.g., China’s Gaokao) and international (e.g., PISA and TIMSS) comparative examinations, particularly from a socio-cultural perspective and in terms of values. Additionally, it may be worthwhile to consider conducting qualitative studies to determine whether the current values obtained from a written document, such as LGS, have counterparts in middle school mathematics classrooms, mathematics curricula, and textbooks, and to identify the reasons for any possible differences. In addition, it is evaluated that the results of the current study may provide a good understanding for educational stakeholders (policymakers, curriculum developers, mathematics textbooks and test developers, and teachers) who prioritize improving student mathematics achievement by taking values into account. In this context, it is recommended that future research examine high-stakes examinations from the perspectives of both teachers and students. It is thought that this research may contribute to providing education stakeholders, curriculum developers, and teachers with a perspective on mathematical questions from the standpoint of mathematical values (structurational and transformational). It is thought that this research could contribute to the development of a perspective on the mathematical values (structural and transformational) of mathematical problems among education stakeholders, programme developers and teachers. In this context, teachers can design the characteristics of a problem containing mathematical value based on sentence-based content analysis. Programme developers can plan to integrate problem situations involving mathematical values into lesson content and textbooks. Education stakeholders can also develop a sense of awareness of the value of mathematical problems in mathematics lessons. Based on the findings of these studies, curriculum developers and teachers can approach mathematical questions with a focus on the value of mathematics (structurational and transformational).

Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest. This research study complies with research publishing ethics. The scientific and legal responsibility for manuscripts published in IJATE belongs to the authors.

Data Availability Statement

The datasets analyzed during the current study consist of publicly available LGS examination items. These materials are accessible through the official sources but are not publicly shareable by the authors due to copyright restrictions.

Contribution of Authors

Seda Türkmen Dural: Literature review, Conceptualization, Visualization, Formal analysis, Writing-original draft. **Yüksel Dede**: Methodology, Supervision, and Critical review.

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REFERENCES

Aktaş, F.N., & Argün Z. (2018). Examination of mathematical values in classroom practices: A case study of secondary mathematics teachers. *Education and Science*, *43*(193), 121-141. https://doi.org/10.15390/EB.2018.7177

Aktaş, F.N., & Dede, Y. (2022). Gifted students' mathematics educational and socio-cultural values in the decision-making process through STEM tasks. In T. Barkatsas (Eds.), *Educating gifted, talented, creative and dissimilar learners* (pp. 36-63). Brill. https://doi.org/10.1163/9789004532571_003

Aktaş, F.N., & Dede, Y. (2024). Re-imagining mathematics teacher education for 21st century skills: Harmful mathematics educational values. In T. Barkatsas, T. McLaughlin, & W. Goff (Eds.), *Global education in the 21st century series*. Brill Sense Publications.

Aktaş, F.N., & Dede, Y. (2025). Evidence from mathematical language for mathematics educational values through the lens of cultural neuroscience. In T. Barkatsas, & W. Goff (Eds.), *Advances in mathematics and stem education: Incorporating developments in neuroscience, brain, science and neurodiversity* (pp. 116-136). Brill Sense Publications.

Aşıcı, F., & Dede, Y. (2019). The transmission of educational values through mathematical problems: A theoretical study. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education*, *13*(1), 260-283. https://doi.org/10.17522/balikesirnef.518832

Au, W. (2007). High-stakes testing and curricular control: A qualitative metasynthesis. *Educational Researcher*, *36*(5), 258-267. https://doi.org/10.3102/0013189X07306523

Berliner, D. (2011). Rational responses to high stakes testing: The case of curriculum narrowing and the harm that follows. *Cambridge Journal of Education*, *41*(3), 287-302. https://doi.org/10.1080/0305764X.2011.607151

Bishop, A.J. (1988). *Mathematical enculturation: A cultural perspective on mathematics education.* Kluwer Press.

Bishop, A.J. (1998, January 1). *Culture, values, and assessment in mathematics* [Paper presentation]. 1st Int. Comm Mathematics Instruction EAsia Conf Mathematics Education, Cheongju, Korea.

Bishop, A.J., Clarkson, P., Fitzsimons, G., & Seah, W.T. (2000). Why study values in mathematics teaching: Contextualising the VAMP project? In W.S. Horng & F.-L. Lin (Eds.), *Proceedings of the HPM 2000 conference on history in mathematics education* (Vol. 2. pp. 147-154). National Taiwan Normal University.

Bishop, A.J., Clarkson, P., FitzSimons, G., & Seah, W.T. (2001). Studying values in mathematics education: Aspects of the VAMP Project. In J. Novotná (Ed.), *Proceedings of the second conference of the European society for research in mathematics education.* (pp. 368-376). HAL open science.

Bishop, A.J., Seah, W.T., & Chin, C. (2003). Values in mathematics teaching-the hidden persuaders? In A.J. Bishop,F. Leung, J.Kilpatrick, K.Clements (Eds.), *Second international handbook of mathematics education* (2nd ed., pp. 717-766). Kluwer Academic Publications.

Bishop, A.J. (2004, July 4-11). *Critical issues in researching cultural aspects of mathematics education* [Paper presentation]. International Congress on Mathematical Education Copenhagen, Denmark.

Bishop, A.J. (2008). Teachers' mathematical values for developing mathematical thinking in classrooms: Theory, research, and policy. *The Mathematics Educator*, *11*(1/2), 79-88.

Bishop, A.J. (2016). Can values awareness help teachers and parents transition preschool learners into mathematics learning? In T. Meaney, T. Lange, A. Wernberg, O. Helenius, & M.L. Johansson (Eds.), *Mathematics education in the early years* (pp. 43-56). Springer International Publications.

Boesen, J., Lithner, J., & Palm, T. (2018). Assessing mathematical competencies: An analysis of Swedish national mathematics tests. *Scandinavian Journal of Educational Research*, *62*(1), 109-124. https://doi.org/10.1080/00313831.2016.1212256

Bowen, G.A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*(2), 27-40. https://doi.org/10.3316/QRJ0902027

Burke, C.A. (2010). Mindfulness-based approaches with children and adolescents: a preliminary review of current research in an emergent field. *Journal of Child and Family Studies*, 19, 133-144. https://doi.org/10.1007/s10826-009-9282-x

Cai, J., & Howson, A.G. (2013). Toward an international mathematics curriculum. In M.A. Clements, A. Bishop, C. Keitel, J. Kilpatrick & K.S.F. Leung (Eds.), Third international handbook of mathematics education research (pp. 949–978). Springer Publications.

Chin, C., Leu, Y.C., & Lin, F.L. (2001). Pedagogical values, mathematics teaching, and teacher education: Case studies of two experienced teachers. In F.-L. Lin & T.J. Cooney (Eds.), *Making sense of mathematics teacher education* (pp. 247-269). Kluwer Academic Publications.

Chin, C., & Lin, F.L. (2000). A case study of a mathematics teacher's pedagogical values: Use of a methodological framework of interpretation and reflection. *Proceedings of the National Science Council*, *10*(2), 90-101.

Chiu, M.S., & Seah, W.T. (2024). Values and valuing pedagogies in affect-focused mathematics teaching. *Social Sciences & Humanities Open*, *10*, Article 101050. https://doi.org/10.1016/j.ssaho.2024.101050

Chung, Y., & Kim, S. (2022). Expectancies, task values, and perceived costs: Reciprocal effects on math-related career intention and achievement among middle school girls. *Learning and Individual Differences*, *96*, Article 102145. https://doi.org/10.1016/j.lindif.2022.102145

Clarkson, P.C. (2007). The development of research into values in mathematics education. In G. Leder & H. Forgasz (Eds.), *Stepping stones for the 21st century* (p. 223). Sense.

Clarkson, P., Seah, W.T., & Pang, J. (2019). Scanning and scoping of values and valuing in mathematics education. In P. Clarkson, W.T. Seah, & J. Pang (Eds.), *Values and valuing in mathematics education* (pp. 1–10). Springer.

Clement, N. (2010). Student wellbeing at school: The actualization of values in education. In T. Lovat, R. Toomey, N. Clement (Eds.), *International research handbook on values education and student wellbeing* (pp. 37-62). Springer.

Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education*. Routledge Publications.

Corrigan, D.J., Gunstone, R.F., Bishop, A.J., & Clarke, B. (2003, July 19-23). *Values in science and Mathematics education: Mapping the relationships between pedagogical practices and student outcomes* [Paper presentation]. European Science Educational Research Association, Noordwijkerhout, Netherlands.

Creswell, J.W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications.

Dede, Y. (2006). Values in Turkish middle school mathematics textbooks. *Quality & Quantity*, *40*(3), 331-359. https://doi.org/10.1007/s11135-005-6133-8

Dede, Y. (2012). Why is mathematics valuable? A comparison of Turkish and German mathematics teachers. *Bolema: Boletim De Educação Matemática*, *26*(44), 1171-1206.

Dede, Y. (2015). Comparing primary and secondary mathematics teachers'preferences regarding values about mathematics teachıng in Turkey and Germany. *International Journal of Science and Mathematics Education*, *13*, 227-255. https://doi.org/10.1007/s10763-013-9483-z

Dede, Y. (2019). Why mathematics is valuable for Turkish, Turkish immigrant and German students: A cross-cultural study. In P. Clarkson, W.T. Seah, & J. Pang (Eds.), *Values and valuing in mathematics education: Scanning and scoping the territory* (pp. 143-156). Springer Publications.

Dede, Y., & Barkatsas, T. (2019). Developing a questionnaire to evaluate Turkish students' mathematics values and preferences. *Journal of Theoretical Educational Science*, *12*(4), 1142-1163. http://dx.doi.org/10.30831/akukeg.529092

Dede, Y., Marschall, G., & Clarkson, P. (2024). An overview of values in mathematics education. In Y. Dede, G. Marschall, & P. Clarkson (Eds.), *Values and valuing in mathematics education: Moving forward into practice* (pp. 3-12). Springer Publications.

Dossey, J.A., McCrone, S.S., & O'Sullivan, C. (2006). *Problem solving in the PISA and TIMSS 2003 assessments*. (Report No. NCES-2007-049). National Center for Education Statistics, US Department of Education.

Fitz Simons, G., Seah, W.T., Bishop, A., & Clarkson, P.C. (2001). Beyond numeracy: Values in the mathematics classroom. In J. Bobis, B. Perry, & M. Mitchelmore (Eds.), *Numeracy and beyond.* (pp. 202-209). Merga Publications.

Grigutsch, S., Raatz, U. & Törner, G. (1998). Einstellungen gegenüber Mathematik bei Mathematiklehrern [Attitudes towards mathematics among mathematics teachers]. *Journal für Mathematik Didaktik, 19*(1), 3-45. https://doi.org/10.1007/BF03338859

Grootenboer, P., & Marshman, M. (2016). *The affective domain, mathematics, and mathematics education*. Springer Publishing.

Güven, İ. (2010). *Türk Eğitim Tarihi* [History of Turkish Education]. Naturel Yayıncılık.

Halstead, M. (1996). *Values in education and education in values: Values and values education in schools.* The Falmer Press.

Hill, B.V. (1991). *Values education in Australian schools*. Australian Council for Educational Research Publishing.

Hill, J.L., Kern, M.L., Seah, W.T., & Van Driel, J. (2021). Feeling good and functioning well in mathematics education: Exploring students' conceptions of mathematical well-being and values. *ECNU Review of Education*, *4*(2), 349-375.https://doi.org/10.1177/2096531120928

Hill, J.L., & Hunter, J. (2023). Examining the mathematics education values of diverse groups of students. *International Journal of Mathematical Education in Science and Technology*, *54*(8), 1614-1633. https://doi.org/10.1080/0020739X.2023.2184280

Jerrim, J. (2023). Test anxiety: Is it associated with performance in high-stakes examinations?. *Oxford Review of Education*, *49*(3), 321-341. https://doi.org/10.1080/03054985.2022.2079616

Kang, H., & Cogan, L. (2022). The differential role of socioeconomic status in the relationship between curriculum-based mathematics and mathematics literacy: The link between TIMSS and PISA. *International Journal of Science and Mathematics Education*, *20*(1), 133-148. https://doi.org/10.1007/s10763-020-10133-2

Keng, S.L., Smoski, M.J., & Robins, C.J. (2011). Effects of mindfulness on psychological health: A review of empirical studies. *Clinical Psychology Review*, 31, 1041-1056. https://doi.org/10.1016/j.cpr.2011.04.006

Leder, G.C., & Forgasz, H.J. (2002). *Measuring mathematical beliefs and their impact on the learning of mathematics: A new approach. In Beliefs: A hidden variable in mathematics education?* Springer Publications.

Lee, J., & Stankov, L. (2018). Non-cognitive predictors of academic achievement: Evidence from TIMSS and PISA. *Learning and Individual Differences*, *65*, 50-64. https://doi.org/10.1016/j.lindif.2018.05.009

Lee-Poon, G., & Simpkins, S.D. (2024). Trajectories of math expectancies for success and values in Latinx and Asian students. *Developmental Psychology*, *60*(4), 711. https://doi.org/10.1037/dev0001687

Lim, S.C., & Ernest, P. (1997, May 15). *Values in mathematics education: What is planned and what is espoused?* [Paper presentation]. Conference of British Society for Research into Learning Mathematics, Nottingham, United Kingdom.

Liou, P.Y., & Bulut, O. (2020). The effects of item format and cognitive domain on students' science performance in TIMSS 2011. *Research in Science Education*, *50*(1), 99-121. https://doi.org/10.1007/s11165-017-9682-7

MacNealy, M.S. (1999). *Strategies for empirical research in writing.* Addison Wesley Longman Publications.

MEB. (2018). *Matematik müfredatı ilkokul ve ortaokul 1., 2., 3., 4., 5., 6., 7. ve 8. sınıflar* [Mathematics curriculum primary and middle school 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, and 8th grades]. https://mufredat.meb.gov.tr/Dosyalar/201813017165445-MATEMAT%C4%B0K%20%C3%96%C4%9ERET%C4%B0M%20PROGRAMI%202018v.pdf

MEB. (2024a). *Matematik müfredatı ortaokul 5., 6., 7. ve 8. sınıflar* [Mathematics curriculum Middle school 5th, 6th, 7th, and 8th grades]. https://mufredat.meb.gov.tr/ProgramDetay.aspx?PID=1978

MEB. (2024b, February 10). *Lise Giriş Sınavı (LGS) için ebeveyn rehberi tercih süreci* [Parents' guide to the high school entrance exam (LGS) preference process]. https://www.meb.gov.tr/mebden-lgs-tercih-sureci-icin-ebeveynlere-yonelik-kilavuz/haber/34176/tr

MEB. (2024c, February 18). *Liseye Geçiş Sistemi (LGS)* [High School Transition System (LGS)]. https://meb.gov.tr/lgs-kapsamindaki-merkez-sinava-yonelik-ornek-sorular-yayimlandi/haber/32661/tr

MEB. (2024d, February 18). *LGS Yol Haritası* [LGS Roadmap]. https://ofram.meb.k12.tr/meb_iys_dosyalar/61/08/964488/dosyalar/2025_02/06140951_lgs2025bulten.pdf

MEB. (2024e, September 9). *Millî eğitim bakanlığı Türkiye Yüzyılı Maarif Modeli'ne genel bakış* [Ministry of national education overview of the Turkey century education model]. https://tymm.meb.gov.tr/genel-bakis

MEB.(2025, September 18). *Türkiye Yüzyılı Maarif Modeli erdem-değer-eylem çerçevesi* [Turkey Century Education Model virtue-value-action framework]. https://tymm.meb.gov.tr/beceriler/erdem-deger-eylem-cercevesi?utm_source=chatgpt.com

Monrad, S.U., Wolff, M., Kurtz, J., Deiorio, N.M., Sabo, R., Stringer, J.K., & Santen, S.A. (2021). What is the association between student well-being and high-stakes examination scores?. *Medical Education*, *55*(7), 872-877. https://doi.org/10.1111/medu.14460

OECD(2013, October 31). *Turkey Assessment Report 2013*. https://www.oecd.org/en/publications/turkey-assessment-report-2013_5jz2rql69rxs-en.html

OECD (2019). *Future of education and skills 2030: What is the learning compass?* https://www.oecd.org/en/about/projects/future-of-education-and-skills-2030.html

OECD (2020, July 7). *Education Policy*. https://www.oecd.org/en/about/projects/education-policy-outlook.html

Pang, J., & Seah, W.T. (2021). Affective factors, values and achievement in mathematics learning: Korean students' perspectives. *Educational Studies in Mathematics*, *106*(*3*), 395-414. https://doi.org/10.1007/s10649-020-10012-4

Peleg-Popko, O. (2004). Differentiation and test anxiety in adolescents. *Journal of Adolescence*, *27*, 645-662. https://doi.org/10.1016/j.adolescence.2004.06.002

OECD (2022). *Mathematics framework*. https://pisa2022-maths.oecd.org/index.html#Mathematical-Reasoning

Polesel, J., Rice, S., & Dulfer, N. (2014). The impact of high-stakes testing on curriculum and pedagogy: A teacher perspective from Australia. *Journal of Education Policy*, *29*(5), 640-657. https://doi.org/10.1080/02680939.2013.865082

Powe, K.W. (1993). Values education and the local school board. *Updating School Board Policies*, *24*(6), 1-4.

Punch, K.F. (2016). *Developing effective research proposals*. National Academic Digital Library of Ethiopia. https://www.torrossa.com/en/resources/an/5019379

Radford, L. (2018). A plea for a critical transformative philosophy of mathematics education. In Ernest, P. (Ed.), *The philosophy of mathematics education today.*(pp. 1-10). Springer Publications.

Raths, L.E., Harmin, M., & Simon, S.B. (1987). Selections from values and teaching. In J. Carbone (Ed.), *Value theory and education* (pp. 198-214). Robert E. Krieger.

Reback, R., Rockoff, J.E., and Schwartz, H.L. (2014). Under pressure: job security, resource allocation, and productivity in schools under no child left behind. *American Economic Journal: Economic Policy*, *6*(3), 207-241. https://doi.org/10.1257/pol.6.3.207

Rhodes, B., & Roux, C. (2004). Identifying values and beliefs in an outcomes-based curriculum. *South African Journal of Education*, *24(*1), 25-30.

Rokeach, M. (1973). *The nature of human values*. Free Press Publications.

Sagiv, L. (2002). Vocational interests and basic values. *Journal Of Career Assessment*, *10*(2), 233-257. https://doi.org/10.1177/1069072702010002 0

Schaefer, M.P. (2012). *Determining methods for teaching character education in elementary schools* [Unpublished doctoral dissertation]. University of Northcentral.

Schwartz, S.H. (1994). Are there üniversal aspects in the structure and content of human values? *Journal of Social Issues*, *50*(4), 19-45. https://doi.org/10.1111/j.1540-4560.1994.tb01196.x

Seah, W.T., & Bishop, A.J. (1999). Realizing a mathematics education for nation-building in Southeast Asia in the new millennium. *Malaysian Educational Research Association and Educational Research Association Singapore,3,* 1241-1249.

Seah, W.T. & Bishop, A.J. (2000, April 24-28). *Values in mathematics textbooks: A view throught the Australasian Regions* [Paper presentation]. The Annual Meeting of the American Educational Research Association, New Orleans, Los Angeles.

Seah, W.T., Bishop, A.J., FitzSimons, G.E., & Clarkson, P.C. (2001, December 2-6). *Exploring Issues of Control Over Values Teaching in the Mathematics Classroom* [Paper presentation]. The 2001 Annual Conference of the Australian Association for Research in Education, Fremantle, Australia.

Seah, W.T., Andersson, A., Bishop, A., & Clarkson, P. (2016). What would the mathematics curriculum look like if values were the focus. *For the Learning of Mathematics*, *36*(1), 14-20.

She, H.C., Stacey, K., & Schmidt, W.H. (2018). Science and mathematics literacy: PISA for better school education. *International Journal of Science and Mathematics Education*, *16*(1), 1-5. https://doi.org/10.1007/s10763-018-9911-1

Siregar, E., Sutiarso, S., & Yusuf, Z. (2021). Analysis of students' mathematical literacy ability in algebraic concepts based on trends in international mathematics and science study (TIMSS) problems. *Technium Social Sciences Journal*, *21*, 381-392.

Swadener, M. & Soedjadi, R. (1988). Values, mathematics education and the task of developing pupils' personalities: An indonesian perspective. *Educational Studies In Mathematics*, *19*(2), 193-208. https://doi.org/10.1007/BF00751232

Teig, N., Scherer, R., & Olsen, R.V. (2022). A systematic review of studies investigating science teaching and learning: over two decades of TIMSS and PISA. *International Journal of Science Education*, *44*(12), 2035-2058. https://doi.org/10.1080/09500693.2022.2109075

Törner, G. (1997, March 3-7). *Views of German mathematics teachers on mathematics* [Paper presentation]. The Annual Conference on Didactics of Mathematics, Regensburg, Germany.

Van de Walle, J.A., Karp, K.S., & Bay-Williams, J.W. (2014*). Elementary and middle school mathematics: teaching developmentally*. Nobel Publications.

Wang, C.Y., Lin, F.C., Chin, C., & Chang, G.Y. (2006, April 7-11). *Re-examining the category framework for describing mathematics teachers' values* [Paper presentation]. The Annual Conference of Educational Research, Hwa-Lien, Taiwan.

Yıldırım, A., & Şimsek, H. (2008). *Sosyal bilimlerde nitel araştırma yöntemleri* [Qualitative research methods in social sciences]. Seçkin.

Zuo, H., & Wang, L. (2023). The influences of mindfulness on high-stakes mathematics test achievement of middle school students. *Frontiers in Psychology*, *14*. https://doi.org/10.3389/fpsyg.2023.1061027