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According to the 8th Grade Mathematics Curriculum and the Revised Bloom's Taxonomy, Investigation of the Mathematics Questions of the High School Transition System (LGS) Exams

Mehmet BALTAT[1*] Danyal SOYBAŞ[2]

1. Ministry of Education, Duran Yangın Anatolian Imam Hatip High School, Kayseri, Turkey
2. Math Education Department, Faculty of Education, Erciyes University, Kayseri, Turkey

* E-mail of the corresponding author: mehmetbaltat@gmail.com

Abstract

The aim of this study is to evaluate the mathematics questions in the LGS exams administered between 2018 and 2023 according to the 8th grade Mathematics Curriculum (MC) and the Revised Bloom's Taxonomy (RBT). A qualitative research approach was adopted within the scope of the research. Case study was used as the research design and document analysis was used as the method. The data obtained were also subjected to content analysis. The data of the study consisted of LGS exam mathematics questions consisting of 120 questions in total and 8th grade MC. Expert opinion was utilized to ensure the reliability of this study. The data obtained were transferred and interpreted with tables and chart. When the LGS exam mathematics questions were evaluated according to the MC objectives, it was determined that an average of 23.34 different objectives were tested in the exams each year. Considering the number of objectives in 8th grade MC, it was seen that the number of objectives tested was not sufficient. When the questions were evaluated according to learning and sub-learning areas, it was seen that some learning and sub-learning areas were neglected in the exams. It was found that the questions showed heterogeneity in their distribution according to both objectives and learning and sub-learning areas. As a general evaluation of the LGS mathematics questions according to the LGS Mathematics Test, it was observed that there were no questions to measure factual and metacognitive knowledge according to the knowledge dimension of the LGS Mathematics Test, and no questions to measure recall and production (creation) steps according to the cognitive process dimension of the LGS Mathematics Test. According to the knowledge dimension of the RBT, 17.17 questions on average were asked about procedural knowledge; according to the cognitive process dimension, 7.84 questions on average were asked about application and 7.34 questions on average were asked about analyzing. It was determined that the exam questions showed heterogeneity in their distribution according to RBT. It is recommended that future exams should be prepared by taking into account both the entire 8th grade MC and all the steps of the RBT as much as possible, and that questions measuring high-level cognitive skills should constitute the majority.

Keywords: High school transition system, Mathematics course questions, Mathematics curriculum, Revised Bloom's taxonomy

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1. Introduction

Education, which has important tasks related to both our present and our future, is very important for countries. The main purpose of the Turkish education system is to raise individuals who have knowledge, skills and behaviors integrated with our values and competencies (MEB, 2018). Since mathematics is one of the most important courses in our education system, mathematics-related behaviors have gained a place in every level and field (Baykul, 2020; Çekici & Yıldırım, 2015). Mathematics is a science in which students are introduced to the abstract thinking system for the first time, systems are established in which meaningful relationships between different variables can be established and expressed, calculations can be made by using various symbols, and results can be obtained as a result (Çekici & Yıldırım, 2015). Basic education in our country has two important tasks. One of them is to provide basic skills that can be called basic learning needs, while the other is to prepare students for secondary education, which is a higher education institution (Baykul, 2020). Similarly, mathematics teaching has two general objectives. One of them is to provide people with mathematical knowledge and skills that they can use in daily life, while the other is to provide them with a way of thinking that they can use the problem-solving approach in solving the problems or events they encounter (Altun, 2008). The organization of

learning experiences with activities planned inside and outside the school with a system structured in line with a certain system is called an education program (Demirel, 2020). In the curriculum of each course in the school, it is stated in which units the critical behaviors or achievements that are foreseen to be taught to students will be taught (Özçelik, 2013). All of the activities in mathematics learning and teaching processes are for the acquisition of cognitive skills. Students need to be able to construct new mathematical concepts in their minds in order to gain positive attitudes and skills about mathematics (Hacısalihoğlu & Mirasyedioğlu, 2004).

In all LGS exams held since 2018, 8th grade students taking the LGS exam are responsible for the 8th grade Mathematics Curriculum (MC) published in 2018. In this study, studies were conducted within the scope of the 8th grade Mathematics Curriculum. There are 5 learning and 12 sub-learning areas in the 8th grade Mathematics Curriculum. There are a total of 52 learning outcomes in learning and sub-learning areas (MEB, 2018).

As in many countries, there are differences in the quality of education among educational institutions in our country. Since there are many people who want to complete their education in educational institutions with high education quality, the interest and demand for these educational institutions is constantly increasing. Depending on the advantages that the desired schools bring or will bring, there are accumulations in line with these increasing demands day by day. The increase in quality differences along with the types of schools has led to a failure to maintain the supply-demand balance over time. Various models have been developed in order to prevent these backlogs in the transition from primary to secondary education institutions and from secondary to higher education institutions in a fair way. Along with the changing education system in order to comply with the requirements of the age, the methods and exams used to select students for secondary education institutions that have existed throughout the history of the republic have also changed many times over time (Atılgan, 2018). In our country, LGS exams, which were put into practice in 2018 in order to objectively place students in institutions that take students with centralized exams, are still being implemented today (Demir & Yılmaz, 2019). The central exam, which consists of 90 multiple-choice questions, consists of two separate sessions, numerical and verbal sections, and is held on the same day. The numerical section, which lasts 80 minutes, consists of 20 questions of Mathematics and 20 questions of Science subtests and is held in the second session (MEB, 2022).

There are many classification systems developed to objectively determine the level of cognitive domain achievements targeted to be gained by students and to evaluate their achievements (Demir, 2011). When the literature is examined, this classification system appears as a taxonomy. Taxonomy, according to the Turkish Language Institution (TDK, 2023), is defined as "classification and the set of rules used in this classification". Another definition of taxonomy is "the gradual ordering of desired behaviors from simple to complex, from easy to difficult, from concrete to abstract, in such a way that they are prerequisites for each other" (Sönmez, 2020, p, 41). Bloom's Taxonomy can be used in ordering the achievements in the curricula of the institutions affiliated to the Ministry of National Education from simple to complex, from easy to difficult, in the development of educational objectives and achievements, in determining the achievements of students in the cognitive field and the level of questions in central exams (Köğce, 2005). It is seen that the taxonomy used in the classification of students' cognitive abilities is mostly the Original Bloom Taxonomy (OBT) developed by Benjamin Samuel Bloom (1913-1999) in 1956 (Güleryüz & Erdoğan, 2018; Tahaoğlu, 2014). Bloom's taxonomy is a classification system that is hierarchically ordered from low to high, with the lowest cognitive skills at the lowest level and the highest cognitive skills at the highest level (Demir, 2011). Designed as one-dimensional, the OBT consists of 6 main steps: knowledge, comprehension, application, analysis, synthesis and evaluation (Krathwohl, 2002).

In a world changing over time, with the influence of humanistic psychology, it has become a necessity to reorganize the achievements and update the programs; accordingly, the accepted approach has been the constructivist theory. In the constructivist approach, which is student-centered, it was seen that the high-level cognitive skills aimed to be in the individual could not be measured at the desired level with Bloom's taxonomy (Ayvacı & Türkdoğan, 2010). Therefore, the taxonomy prepared by Bloom in 1956 was revised by Anderson and his colleagues and introduced to the literature as the Revised Bloom's Taxonomy (RBT) in 2001 (Anderson et al., 2001). Although the changes made in the OBT seemed to be minor on the surface, they actually contained quite significant differences. According to Forehand (2005), who analyzes these changes in three different categories, the first change, which perhaps contains the most significant differences, is the terminological change. The terminological changes can be summarized as follows: the knowledge step was renamed as the recall step, the comprehension step was renamed as the comprehension step, the synthesis step was renamed as the reconstruction step, the fifth step, the synthesis step, and the evaluation step were switched, and all the main categories of the OBT were changed from nouns to verbs. With the second change made in the one-dimensional structure of the OBT, the transformation of the RBT into two dimensions, namely the knowledge dimension and

the cognitive process dimension, is a structural change. With the third and last change, the purposeful change is the organization of the RBT so that it can be used by a wider audience than the OBT (Forehand, 2005). The problems arising from the fact that the knowledge step in the OBT, which was one-dimensional, was in the form of both nouns and actions were eliminated in the RBT, which gained two dimensions with the knowledge dimension formed on the basis of the noun element and the cognitive process dimension formed on the basis of the action element (Arı, 2011; Bümen, 2010; Krathwohl, 2002). The knowledge dimension, which is similar to the sub-dimensions of the knowledge dimension of the OBT, consists of factual, conceptual, procedural and metacognitive knowledge steps. While the knowledge dimension shows the names, noun phrases and contents of the objectives and outcomes, the cognitive process dimension, which consists of the steps of remembering, understanding, applying, analyzing, evaluating and producing, shows how the objectives will be realized. Thus, the assessment of cognitive learning in terms of both knowledge and process is possible thanks to the two-dimensional structure of the RBT. Moreover, since these two dimensions are interrelated, students can use four different types of knowledge at any stage in the cognitive process dimension (Birgin, 2016; Tutkun & Okay, 2012).

The factual, conceptual, procedural and metacognitive knowledge steps that constitute the knowledge dimension of RBT can be summarized as follows. Factual knowledge: The basic knowledge that students need to learn in order to recognize any subject area and solve problems specific to this area constitutes factual knowledge (Anderson et al., 2018). Conceptual knowledge: Conceptual knowledge is a level at which information is categorized, classifications are made, relationships between concepts are established, and interpretations can be made through schemas, models and theories to understand how different situations related to any subject are related to each other (Ayvacı & Türkdoğan, 2009). Procedural knowledge: Procedural knowledge is the type of knowledge that deals with how to do things that can range from daily routine tasks to solving new and different problems. Procedural knowledge, which generally appears in the form of operations to be performed in a certain order and steps to be taken, includes knowledge of skills, algorithms, techniques and methods, also known as operations, and knowledge of the criteria used to determine under what conditions and when to use different operations (Anderson et al., 2018). Metacognitive knowledge: In the metacognitive knowledge stage, individuals are expected not only to know and have knowledge about the information related to cognition, but also to be aware of their own cognition, to reflect on their experiences, and to be able to organize their own knowledge, and it is thought that individuals' interest and awareness will increase as they learn information (Anderson et al., 2018; Ayvacı & Türkdoğan, 2009).

Retention of learning is when students remember what they have learned, even after time has passed since they first learned the material, in a way that is almost identical to what they first learned. When students use what they have learned in solving new problems, answering new questions and facilitating new learning processes, this is called transfer. The past is emphasized in the term retention and the future is emphasized in the term transfer. Two of the most important goals of education are to ensure that the information learned is permanent and to increase its transfer. At the same time, achieving these goals shows that meaningful learning has occurred (Anderson et al., 2018). It was stated that the first step, the recall step, is closely related to the permanence of the knowledge and skills learned; and that the other five steps both help to ensure the permanence of the learned knowledge and skills and are ordered in a way to increase the transfers as they move towards the next step. In addition, the RBT was prepared to assist educators in designing, realizing, and evaluating goals related to increasing the transfer of learned knowledge (Anderson et al., 2018). These steps, which are neither cumulative nor hierarchical, are ordered from simple to complex from the recall step to the production (creation) step (Birgin, 2016; Krathwohl, 2002).

The steps of remembering, understanding, applying, analyzing, analyzing, evaluating and producing, which constitute the cognitive process dimension of RBT, can be summarized as follows. Recalling one of the most important goals of education is the recall step of the cognitive process, which aims to increase the retention time, that is, the permanence, of the materials presented to the students in their memory almost as they have learned them. This step includes the processes of retrieving the learned materials from long-term memory as they were first learned without any change or with very little change (Anderson et al., 2018; Ayvacı & Türkdoğan, 2009). Comprehension: Just as attention is focused on the recall step when it comes to increasing the retention of what is learned, attention is focused on the other five steps when it comes to increasing the transfer of what is learned. In schools, the step that is created on the basis of increasing transfer and includes the most of the educational objectives is the comprehension step. In the teaching process, students can be said to have reached the level of comprehension when they are able to create meanings from the messages presented to them either verbally, in writing or graphically during the teaching of the lessons or in examples of various verbal, pictorial and symbolic images on paper, textbooks, demonstrations, excursions, simulations, musical works and digital platforms

(Anderson et al., 2018). Application: Students at this stage should apply the information, generalizations or principles they have learned both in situations they are familiar with and in situations they are not familiar with, different from the content in the teaching process, and use them in solving new problems. Problems at this stage should be new both in quantity and quality. The information, principles, generalizations, methods and techniques needed to solve these problems should be used effectively by students (Ayvacı & Türkdoğan, 2009; Turgut & Baykul, 2019). Analyzing: Ayvacı and Türkdoğan (2009) define this step as the separation and analysis of the elements that make up the knowledge wholes into their elements in the structure or the whole and seeing the relationships; Arı (2011) defines it as the separation of materials into their parts or components, distinguishing different parts from each other, and determining the relationships of the parts with each other and with the general structure or purpose of the material they form. In addition, students at this level are expected to demonstrate skills such as organizing, criticizing, explaining, contrasting, comparing and distinguishing, and seeing similarities and differences (Arı, 2011). Evaluation: Evaluation is the step in which judgments are made based on quantitative or qualitative standards or criteria related to quality, efficiency, effectiveness and consistency, which can be determined by students or others. The situation that differentiates the evaluation step, which includes the sub-steps of auditing and criticizing, where standards can also be applied to criteria, from any judgment or decision is that the evaluation makes use of performance standards based on clearly defined criteria (Anderson et al., 2018). Producing: Producing is the stage where meaningful and functional wholes, original works, ideas, new and original products are created by combining and using parts or elements together. Students at this level are expected to demonstrate skills such as planning and designing, assembling and combining, constructing, formulating, developing, creating and producing (Arı, 2011; Ayvacı & Türkdoğan, 2009). The two-dimensional structure of RBT is visualized with a table called Taxonomy Table (TT), and an unfilled TT is shown in Table 1 below.

Table 1: The Two-Dimensional Structure of the RBT

	Cognitive Process Dimension					
Knowledge Dimension	Remembering	Understanding	Application	Analyzing	Evaluation	Production
Factual Knowledge						
Conceptual Knowledge						
Operational Knowledge						
Metacognitive Knowledge						

When the literature is examined, there are studies in which central exams are evaluated according to various taxonomies and the curriculum of that course. In their study, Ekinci and Bal (2019) evaluated 20 mathematics questions in the LGS exam held in 2018 according to both the level of measuring the learning outcomes in the curriculum and RBT. In his study, Şimşek (2021) evaluated 20 mathematics questions in the LGS exam in 2018 and 952 questions asked by mathematics teachers in Suluova district of Amasya province according to both the level of measuring the learning outcomes in the curriculum and the assessment level of the RBT. In his study, Şahin (2022) evaluated 80 mathematics questions in the LGS exams held between 2018-2021 according to both the learning outcomes in the curriculum and the RBT. Demir (2023) evaluated 100 mathematics questions in the LGS exams between 2018 and 2022 and 207 assessment questions at the end of the units in the 8th grade mathematics textbooks according to the RBT. There are few studies in which the LGS mathematics questions, which have been implemented since the 2017-2018 academic year, are evaluated according to the RBT and MC. However, no study has yet been found in which the distribution of the LGS mathematics questions of the six years from 2018, the first year it was implemented, according to the 2018 MC objectives, learning and sub-learning areas, and their classification according to RBT. The aim of this study is to determine the distribution of the mathematics questions in the LGS exam between 2018 and 2023 by evaluating them according to both MC and RBT. In this way, it will be possible to determine how the LGS exam mathematics questions are distributed according to the 8th grade MC objectives, learning and sub-learning areas, which objectives, learning and sub-learning areas are asked more questions, and which ones are neglected. In addition, it will also be possible to determine how the LGS exam mathematics questions are distributed according to the steps in the knowledge and cognitive process dimensions of RBT, which steps are included in the questions, which steps are given more weight, and which steps are neglected. It is thought that the findings to be obtained from the relationship with the curriculum by evaluating the mathematics questions in the LGS exams held between 2018-2023 separately and in comparison with each other within the framework of the 8th grade MC and from the data revealing their

qualities within the framework of RBT will be useful for the studies to be conducted on the mathematics course, the researches of the Ministry of National Education (MEB) on the measurement and evaluation processes, and similar studies that can be conducted in different courses.

The problem of the study is "How is the distribution of mathematics questions in LGS exams according to MC and RBT?". For this study, seven sub-problems were identified based on the research problem. The sub-problems of the study are given below.

1) When the distribution of mathematics questions in the LGS exams administered for 6 years is compared according to the 8th grade MC objectives, learning and sub-learning areas, what kind of a result emerges?
2) In the 2018 LGS exam, what is the distribution of math questions according to RBT?
3) What is the result of the distribution of math questions in the 2019 LGS exam according to RBT?
4) What kind of a result emerges when the math questions in the LGS exam administered in 2020 are distributed according to RBT?
5) What is the result of the distribution of the math questions in the LGS exam administered in 2021 according to RBT?
6) What is the distribution of the math questions in the LGS exam administered in 2022 according to RBT?
7) What is the distribution of the math questions in the LGS exam administered in 2023 according to RBT?

2. Method

Documents, which are among the important sources of information for qualitative research, can also be used as a data collection method alone in many studies (Yıldırım & Şimşek, 2021). The closest documents to the phenomena in terms of both reflecting them in terms of their closeness to the phenomena and integrating with the phenomena are the physical records and remains (Karasar, 2020). With the document analysis method, data are collected by systematically examining and analyzing written materials consisting of existing records, documents and data sources that contain information about the phenomenon or phenomena to be researched (Karasar, 2020; Yıldırım & Şimşek, 2021). Document analysis method is especially preferred in qualitative research on education where curricula, exams, official documents related to education, etc. materials are examined (Yıldırım & Şimşek, 2021). Some of the strengths of this method are that it is economical and reliable. In the document analysis method, in which the data obtained from previous studies are also used, these data are mostly economical because they are used as raw data; and since there is generally no change in the documents used as a source, these documents are both consistent and reliable (Karasar, 2020). In the case study, which is one of the empirical research methods and can be used in cases where there are many evidence or data sources, the case study was preferred as the design in this study because it allows the current phenomenon to be studied in its natural environment by taking the how and why questions as the basis, even if the boundaries between the phenomenon and the context in which it is located are not clear. In this study, in which LGS mathematics questions were evaluated according to MC and RBT, document analysis method was preferred due to the aforementioned features; with the case study design, the problem of the research, sub-problems, data obtained and findings reached were tried to be presented by linking them to each other with a logical fiction (Yıldırım & Şimşek, 2021).

The study group of this research consists of the mathematics questions of the LGS exam applied between 2018 and 2023 and the 8th grade MC learning outcomes, learning and sub-learning areas. In line with the research, a total of 120 mathematics questions were analyzed according to both 8th grade MC and RBT. In this part of the study, a literature review was conducted to understand and analyze the documents to be analyzed by document analysis method and to use the data obtained. Expert opinion was sought to eliminate possible bias in classification and to increase the reliability of the study. LGS exam mathematics questions were evaluated by both the researcher and the expert and the data of the study were obtained. In order to eliminate the disagreements in the classification of the questions, ideas were exchanged and finally a consensus was reached and common decisions were reached. As a result of these decisions, the researcher finalized the classification by making the necessary arrangements on the initial classification.

Content analysis can be defined as analyzing the unrevealed meanings of texts or transcripts or the messages that are intended to be conveyed by dividing them into concepts and categories as a result of systematic studies, and analyzing these concepts and categories in both quantitative and qualitative ways. Almost everything related to

communication can constitute the data of content analysis (Güler, Halıcıoğlu, & Taşğın, 2015). Content analysis can be performed for the purposes of defining the data, revealing the facts in the data, and organizing and interpreting the similar data in a way that can be understood by everyone by bringing them together on the axis of certain concepts and themes. In this study, the data obtained through document analysis were subjected to content analysis in order to reveal themes or dimensions that were not evident at the beginning, to reach concepts and relationships that can be defined and explained, and to enrich the analysis of these data by diversifying them with numbers (Yıldırım & Şimşek, 2021).

For data analysis, the questions were first classified separately by the researcher and then by the expert, and codes were obtained from both. Miles and Huberman's (1994) reliability formula [Reliability = (Agreement) / (Agreement + Disagreement)] was used to determine the similarity, consistency and harmony between these classifications and the codes obtained and to ensure the reliability of the study. The reliability coefficient is calculated by dividing the number of questions on which the researcher and the expert agree by the total number of questions. The reliability rate, that is, the agreement between the researcher and the expert's evaluations, was found to be 0.88. In order for the research to be considered reliable, the reliability coefficient is expected to be above 70%. According to the reliability rate, the data of this research is considered reliable (Miles & Huberman, 1994). The inconsistent questions were discussed; finally, the disagreements were eliminated by exchanging ideas, the agreement was ensured to be 100% as a result of the consensus, and the researcher gave the final shape to the study. In the last stage, the percentage and frequency distributions of the questions according to the years they belonged to were obtained and interpreted and compared in the findings section.

3. Results

Findings of the First Sub-Problem

The distribution of LGS mathematics questions in relation to the number of objectives in the 8th grade MC learning domains is shown in Table 2 below. Since some of the mathematics questions in the LGS exam are related to more than one learning outcome, the number of questions related to the learning outcomes in the learning domains is expressed in Table 2.

Table 2: Distribution of LGS Exam Mathematics Questions According to 8th Grade MC Learning Areas

8th Grade Mathematics Teaching Program Learning Areas	Total Number of Learning Outcomes in the Learning Area	Number of questions in 2018	Number of questions in 2019	Number of questions in 2020	Number of questions in 2021	Number of questions in 2022	Number of questions in 2023	Total Number of Questions
M.8.1. Numbers and Operations	16	11	16	16	17	15	22	97
M.8.2. Algebra	13	11	11	8	14	13	11	68
M.8.3. Geometry and Measurement	16	7	7	0	6	10	0	30
M.8.4. Data Processing	2	0	1	3	2	2	2	10
M.8.5. Probability	5	1	5	7	2	2	4	21
Total	52	30	40	34	41	42	39	226

The years with questions from all learning areas are 2019, 2020 and 2021. According to Table 2, the learning area with the most questions is "Numbers and Operations", while "Data Processing" is the learning area with the least number of questions. Due to the global pandemic Covid-19, students who took the LGS exam in 2020 were held responsible for only the first semester subjects in the exam. Therefore, there were no questions from the "Geometry and Measurement" learning area, all of which were in the second semester, while the learning area with the most questions in the exam was "Numbers and Operations". On February 6, 2023, one of the biggest earthquakes in the history of the Republic of Turkey, the students who took the LGS exam in 2023 were held responsible for only the first semester subjects in the exam.

The distribution of LGS mathematics questions regarding the number of objectives in the 8th grade MC sub-learning areas is shown in Table 3 below. Some of the mathematics questions in the LGS exam are related to more than one outcome. Table 3 shows the number of questions related to the objectives in the sub-learning areas.

Table 3: Distribution of LGS Exam Mathematics Questions According to 8th Grade MC Sub-Learning Areas

8th Grade Mathematics Teaching Program Sub Learning Areas	Total Number of Outcomes in Sub-Learning Areas	Number of questions in 2018	Number of questions in 2019	Number of questions in 2020	Number of questions in 2021	Number of questions in 2022	Number of questions in 2023	Total Number of Questions
M.8.1.1. Multipliers and Multiples	3	2	3	2	3	2	4	16
M.8.1.2. Exponential Expressions	5	3	4	6	6	4	6	29
M.8.1.3. Square Root Expressions	8	6	9	8	8	9	12	52
M.8.2.1. Algebraic Expressions and Identities	4	4	4	8	7	4	11	38
M.8.2.2. Linear Equations	6	5	5	0	4	5	0	19
M.8.2.3. Inequalities	3	2	2	0	3	4	0	11
M.8.3.1. Triangles	5	2	3	0	4	4	0	13
M.8.3.2. Transformation Geometry	3	1	1	0	0	1	0	3
M.8.3.3. Parity and Similarity	2	1	1	0	2	2	0	6
M.8.3.4. Geometric Objects	6	3	2	0	0	3	0	8
M.8.4.1. Data Analysis	2	0	1	3	2	2	2	10
M.8.5.1. Probability of Simple Events	5	1	5	7	2	2	4	21
Total	52	30	40	34	41	42	39	226

The years with questions from all sub-learning areas are 2019 and 2022. The 2023 LGS exam and the 2020 LGS exam are similar since both the first semester subjects that students are responsible for in the exam and the second semester subjects that they are not responsible for are the same. It is seen that the sub-learning areas with the most problems in all of the LGS exams are "Expressions with Square Root" and "Algebraic Expressions and Identities", and the sub-learning areas with the least problems are "Transformation Geometry" and "Congruence and Similarity"; in addition, it is seen that there were no neglected sub-learning areas in all of the last 6 exams. Students were held responsible for a total of 52 objectives in the LGS exam mathematics subtest. However, in the LGS exam mathematics subtest; questions were asked to measure 23 different outcomes in 2018, 28 in 2019, 15 in 2020, 26 in 2021, 29 in 2022 and 18 in 2023. "M.8.1.3.3. Measuring a square root expression with a$\sqrt{b}$ and writes a$\sqrt{b}$ takes the coefficient into the root in the expression in the form of a root." is the most frequently measured outcome.

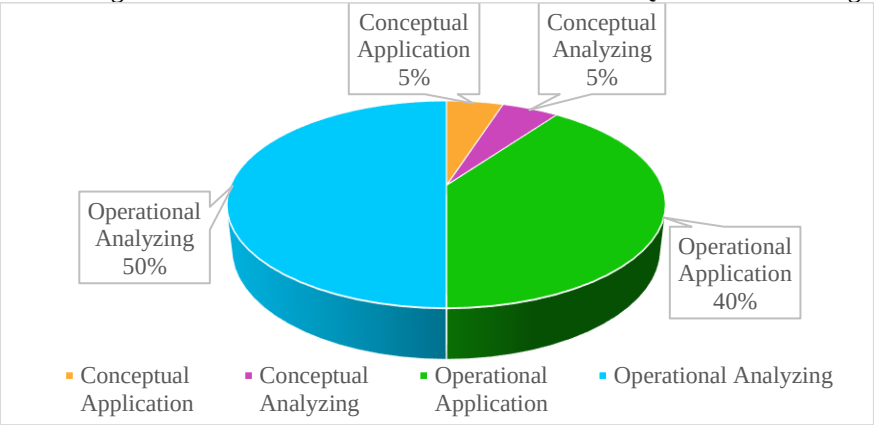
Findings of the Second Sub-Problem

In the 2018 LGS exam, there were a total of 20 mathematics questions. The mathematics questions of the 2018 LGS exam were analyzed and evaluated by the researcher and an expert in accordance with the RBT. The findings obtained from the distribution of the exam questions according to the steps of the RBT are shown in Table 4 and Chart 1.

Table 4: Findings from the Distribution of 2018 LGS Exam Mathematics Questions according to RBT

		Cognitive Process Dimension													
		Remembering		Understanding		Application		Analyzing		Evaluation		Production		Total	
		F	%	f	%	f	%	F	%	f	%	F	%	F	%
Knowledge Dimension	Factual Knowledge	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Conceptual Knowledge	–	–	–	–	1	5	1	5	–	–	–	–	2	10
	Operational Knowledge	–	–	–	–	8	40	10	50	–	–	–	–	18	90
	Metacognitive Knowledge	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Total	–	–	–	–	9	45	11	55	–	–	–	–	20	100

Chart 1: Percentage Distribution of 2018 LGS Exam Mathematics Questions According to RBT



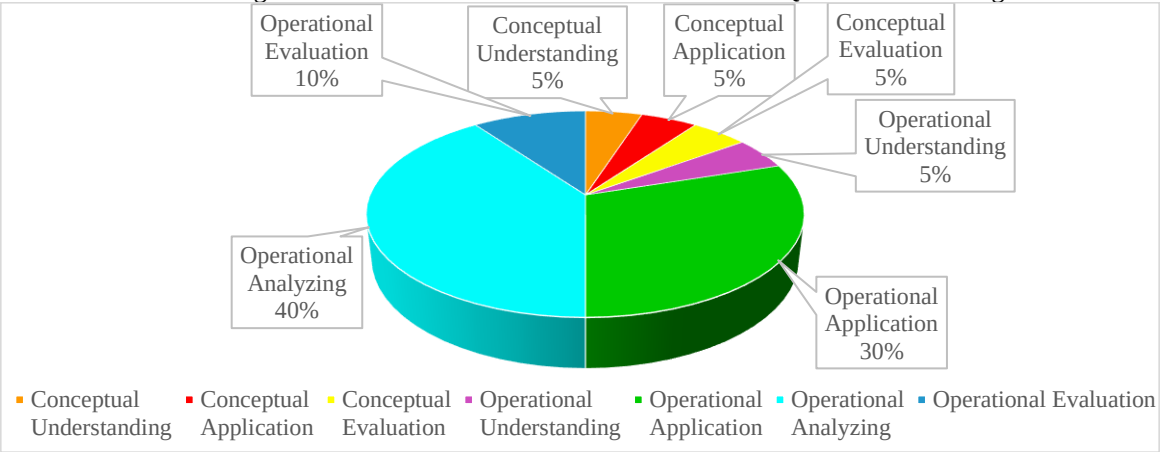
Findings of the Third Sub-Problem

In the 2019 LGS exam, there were a total of 20 mathematics questions. The mathematics questions of the 2019 LGS exam were analyzed and evaluated by the researcher and an expert in accordance with the RBT. The findings obtained from the distribution of the exam questions according to the steps of the RBT are shown in Table 5 and Chart 2.

Table 5: Findings from the Distribution of 2019 LGS Exam Mathematics Questions according to RBT

		Cognitive Process Dimension													
		Remembering		Understanding		Application		Analyzing		Evaluation		Production		Total	
		F	%	f	%	F	%	F	%	f	%	F	%	F	%
Knowledge Dimension	Factual Knowledge	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Conceptual Knowledge	–	–	1	5	1	5	–	–	1	5	–	–	3	15
	Operational Knowledge	–	–	1	5	6	30	8	40	2	10	–	–	17	85
	Metacognitive Knowledge	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Total	–	–	2	10	7	35	8	40	3	15	–	–	20	100

Chart 2: Percentage Distribution of 2019 LGS Exam Mathematics Questions According to RBT



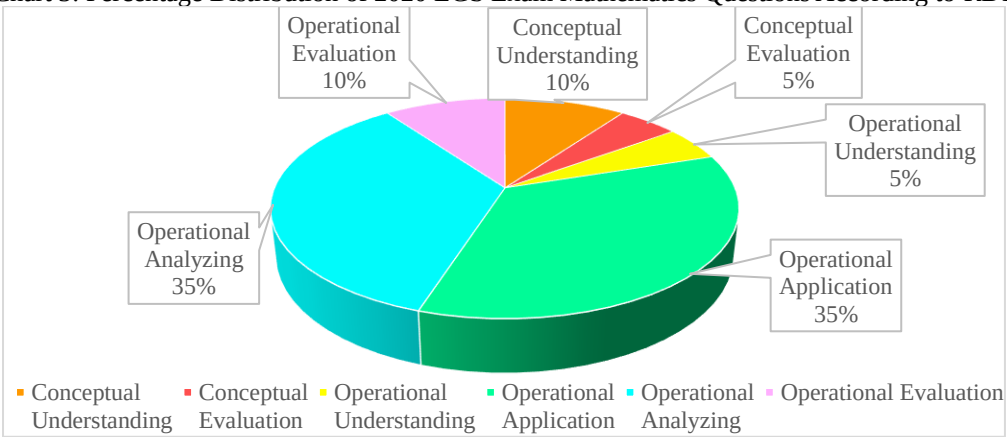
Findings of the Fourth Sub-Problem

There are a total of 20 mathematics questions in the 2020 LGS exam. The mathematics questions of the 2020 LGS exam were analyzed and evaluated by the researcher and an expert according to the RBT. The findings obtained from the distribution of the exam questions according to the steps of the RBT are shown in Table 6 and Chart 3.

Table 6: Findings from the Distribution of 2020 LGS Exam Mathematics Questions according to RBT

		Cognitive Process Dimension													
		Remembering		Understanding		Application		Analyzing		Evaluation		Production		Total	
		f	%	F	%	f	%	f	%	f	%	f	%	F	%
Knowledge Dimension	Factual Knowledge	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Conceptual Knowledge	–	–	2	10	–	–	–	–	1	5	–	–	3	15
	Operational Knowledge	–	–	1	5	7	35	7	35	2	10	–	–	17	85
	Metacognitive Knowledge	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Total	–	–	3	15	7	35	7	35	3	15	–	–	20	100

Chart 3: Percentage Distribution of 2020 LGS Exam Mathematics Questions According to RBT



Findings of the Fifth Sub-Problem

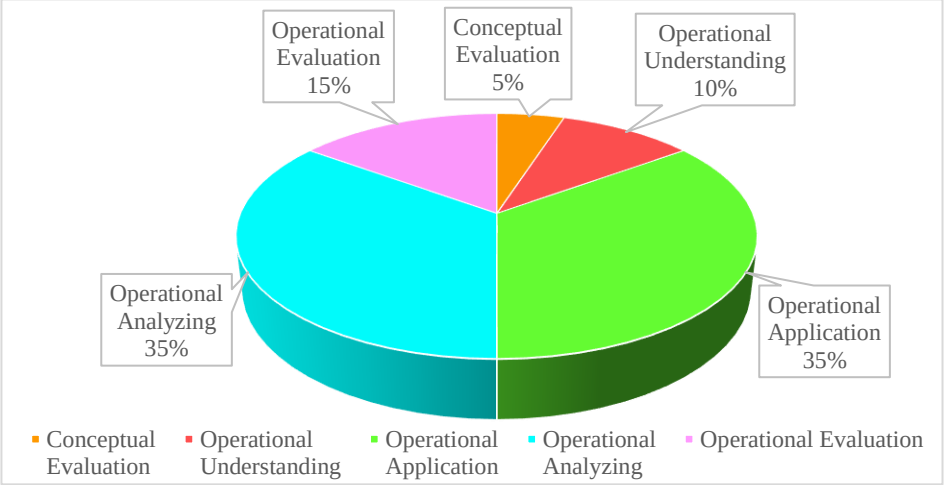
In the 2021 LGS exam, there are a total of 20 mathematics questions. The mathematics questions of the 2021 LGS exam were analyzed and evaluated by the researcher and an expert according to the RBT. The findings

obtained from the distribution of the exam questions according to the steps of the RBT are shown in Table 7 and Chart 4.

Table 7: Findings from the Distribution of 2021 LGS Exam Mathematics Questions according to RBT

		Cognitive Process Dimension													
		Remembering		Understanding		Application		Analyzing		Evaluation		Production		Total	
		f	%	f	%	f	%	f	%	f	%	F	%	F	%
Knowledge Dimension	Factual Knowledge	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Conceptual Knowledge	–	–	–	–	–	–	–	–	1	5	–	–	1	5
	Operational Knowledge	–	–	2	10	7	35	7	35	3	15	–	–	19	95
	Metacognitive Knowledge	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Total	–	–	2	10	7	35	7	35	4	20	–	–	20	100

Chart 4: Percentage Distribution of 2021 LGS Exam Mathematics Questions According to RBT



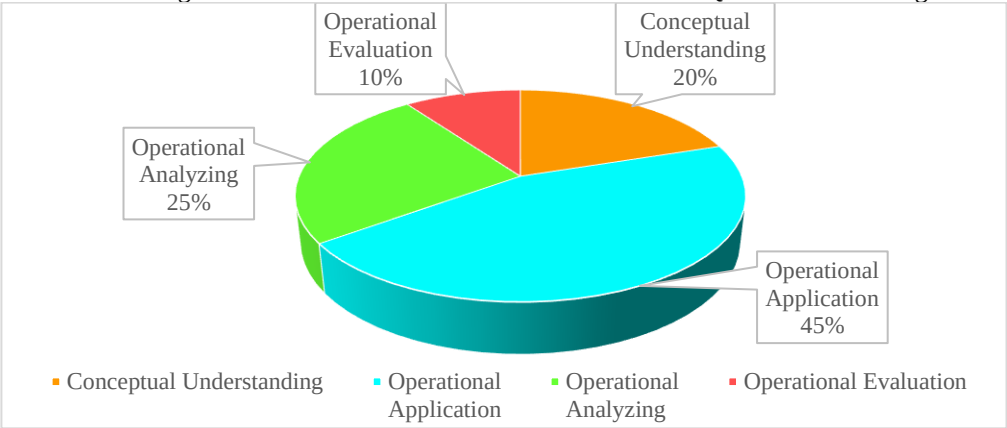
Findings of the Sixth Sub-Problem

There are a total of 20 mathematics questions in the 2022 LGS exam. The mathematics questions of the 2022 LGS exam were analyzed and evaluated by the researcher and an expert according to the RBT. The findings obtained from the distribution of the exam questions according to the steps of the RBT are shown in Table 8 and Chart 5.

Table 8: Findings from the Distribution of 2022 LGS Exam Mathematics Questions according to RBT

		Cognitive Process Dimension													
		Remembering		Understanding		Application		Analyzing		Evaluation		Production		Total	
		f	%	f	%	F	%	f	%	F	%	f	%	F	%
Knowledge Dimension	Factual Knowledge	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Conceptual Knowledge	–	–	4	20	–	–	–	–	–	–	–	–	4	20
	Operational Knowledge	–	–	–	–	9	45	5	25	2	10	–	–	16	80
	Metacognitive Knowledge	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Total	–	–	4	20	9	45	5	25	2	10	–	–	20	100

Chart 5: Percentage Distribution of 2022 LGS Exam Mathematics Questions According to RBT



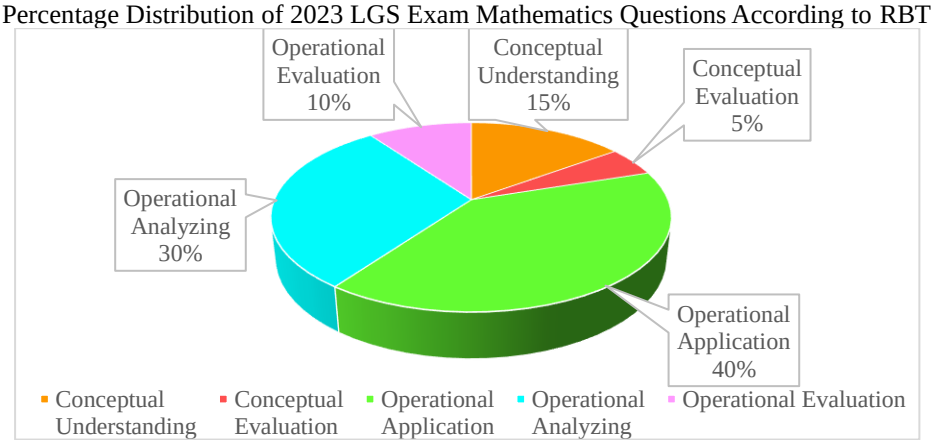
Findings of the Seventh Sub-Problem

In the 2023 LGS exam, there are a total of 20 mathematics questions. The mathematics questions of the 2023 LGS exam were analyzed and evaluated by the researcher and an expert in accordance with the RBT. The findings obtained from the distribution of the exam questions according to the steps of the RBT are shown in Table 9 and Chart 6.

Table 9: Findings from the Distribution of 2023 LGS Exam Mathematics Questions according to RBT

		Cognitive Process Dimension													
		Remembering		Understanding		Application		Analyzing		Evaluation		Production		Total	
		f	%	f	%	f	%	f	%	f	%	F	%	F	%
Knowledge Dimension	Factual Knowledge	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Conceptual Knowledge	–	–	3	15	–	–	–	–	1	5	–	–	4	20
	Operational Knowledge	–	–	–	–	8	40	6	30	2	10	–	–	16	80
	Metacognitive Knowledge	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Total	–	–	3	15	8	40	6	30	3	15	–	–	20	100

Chart 6: Percentage Distribution of 2023 LGS Exam Mathematics Questions According to RBT

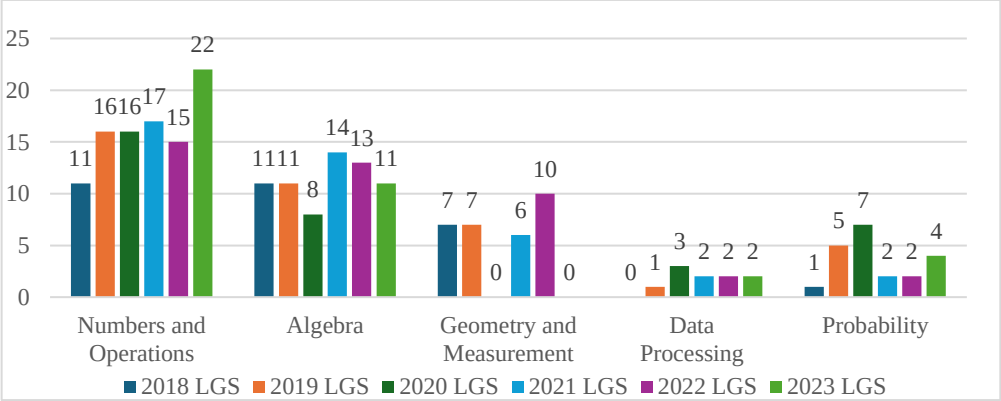


4. Discussion

Considering the number of objectives that students are responsible for in the LGS exam, it is thought that 23.34 different objectives, i.e. almost half of them, are tested in the exams, thus the validity of coverage is insufficient and the distribution of the questions is heterogeneous. Chart 7 below shows the numerical distribution of the

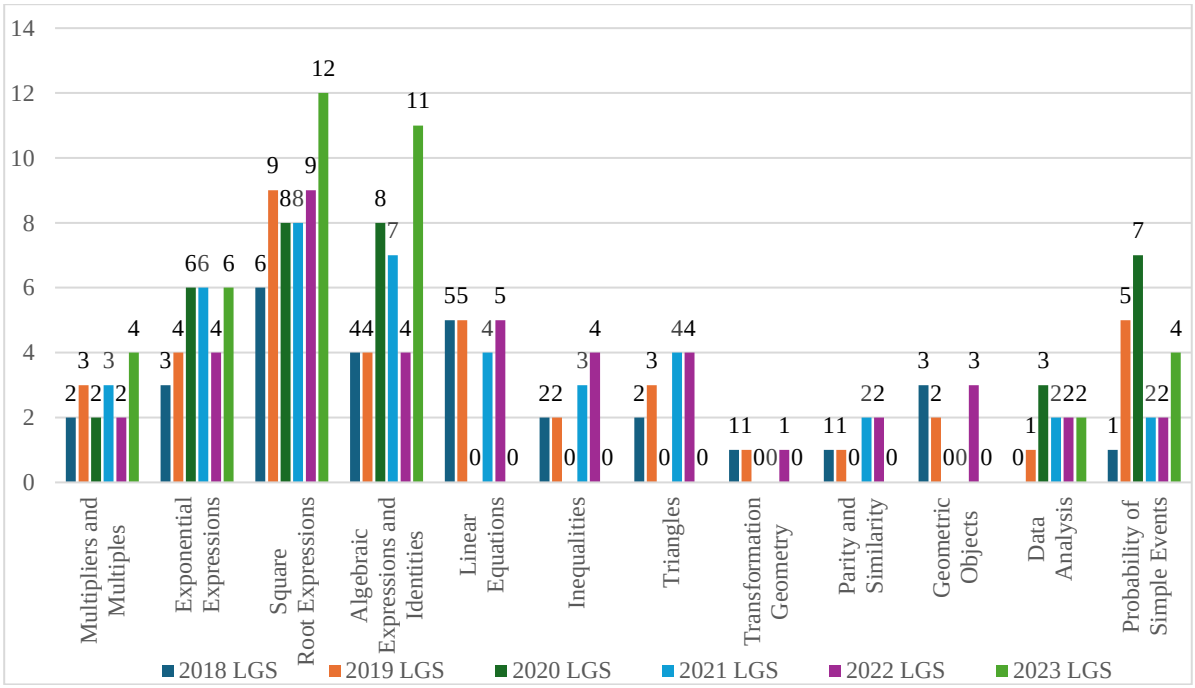
mathematics questions of the LGS exams administered between 2018 and 2023 according to the 8th grade MC learning areas.

Chart 7: Distribution of LGS Exam Mathematics Questions According to 8th Grade MC Learning Areas between 2018-2023



According to these results, it is also thought that the distribution of learning areas is heterogeneous. Chart 8 below shows the numerical distribution of the mathematics questions of the LGS exam administered between 2018 and 2023 according to the 8th grade MC sub-learning areas.

Chart 8: Distribution of LGS Exam Mathematics Questions According to 8th Grade MC Sub-Learning Areas between 2018-2023

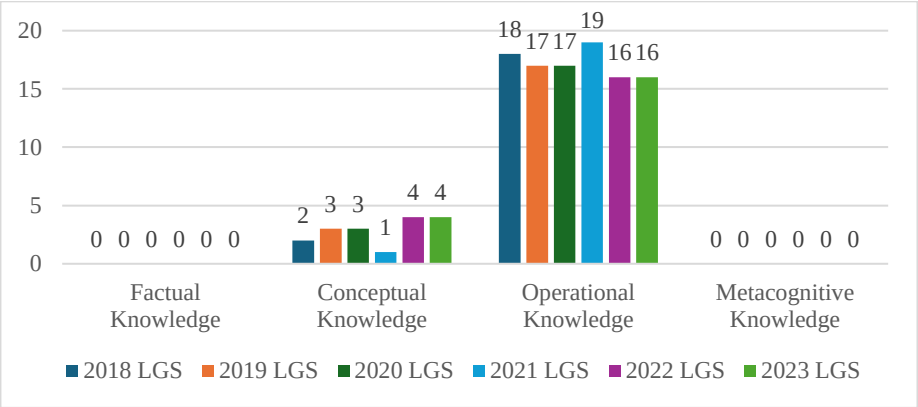


When the LGS exam mathematics questions are evaluated according to the percentages of learning outcomes, learning and sub-learning areas, it is thought that none of the distributions in the exams are homogeneous; all of them are heterogeneous because some of them are not measured at all in the exam and some of them are tested too much.

When the studies in which LGS exam mathematics questions were evaluated according to learning outcomes, learning and sub-learning areas were examined, the following results were obtained. Beyendi (2018) stated in his study that the 2018 LGS mathematics exam questions were not compatible with the questions in the textbook and achievement comprehension tests, some of the questions were very long and accordingly, there were problems in meeting the deadline, some of the questions measured more than one achievement although some achievements were never asked, and the number of achievements in the program was high. It can be said that the

results such as the high number of objectives in the program compared to the exam, the fact that some objectives have never been asked for years, and the measurement of more than one objective in some of the questions are similar to the findings of the study. In their study, Ekinci and Bal (2019) stated that the 2018 LGS mathematics exam questions did not cover all sub-learning areas and that there was not a complete harmony between gains and exam questions; it can be said that these results are similar to the findings of the study. Polat (2020), in his study in which he evaluated the 2018 LGS mathematics exam questions in terms of content validity according to MC and cognitive process dimension according to RBT, stated that the exam showed a homogeneous distribution according to learning domains, but it did not show a homogeneous distribution according to some sub-learning domains and was not at a sufficient level according to the content validity of the exam. It can be said that these results are similar to the findings of the study. In his study, Şimşek (2021) stated that the 2018 LGS mathematics exam questions could not represent both the sub-learning areas and the outcomes at the desired level, considering both the number of outcomes in the MC sub-learning areas and the time allocated for the sub-learning areas. It can be said that these results are similar to the findings of the study. Şahin (2022), in his study examining the distribution of LGS mathematics questions according to the MC, stated that when both the sub-learning areas and the number of objectives in the MC are taken into account, the LGS exams are not sufficient to measure the objectives because they do not contain a balanced and homogeneous structure according to the objectives, and the distribution according to the sub-learning areas is not homogeneous. It can be said that these results are similar to the findings of the study. In their study, Üzümcü and İpek (2022) stated that among the 2021 LGS mathematics exam questions, the "Numbers and Operations" learning domain constituted 45% of the whole exam, the "Algebra" learning domain constituted 75% of the whole exam with a rate of 30%, and the exam covered all sub-learning domains except the "Transformation Geometry" and "Geometric Objects" sub-learning domains. For the 2021 LGS mathematics exam questions, it can be said that this study is similar to the findings of the study in terms of the fact that the total of the learning areas mentioned in this study is 75.61% and that all but two of the sub-learning areas were measured. In their study, Yılmaz and Doğan (2022) analyzed the 2021 LGS mathematics exam questions according to the 8th Grade 8 MC, the exam was not homogeneous in learning and sublearning areas because some of the sublearning areas were not measured at all in the exam and some of them were tested too much, but when the exam questions were evaluated according to the number of learning and sublearning areas, they stated that the exam was relatively homogeneous because it covered all learning areas, but the exam had a heterogeneous distribution because some of the sublearning areas were not measured at all in the exam. It can be said that these results are similar to the findings of the research. Chart 9 below shows the numerical distribution of the mathematics questions of the LGS exam administered between 2018 and 2023 according to the knowledge dimension of RBT.

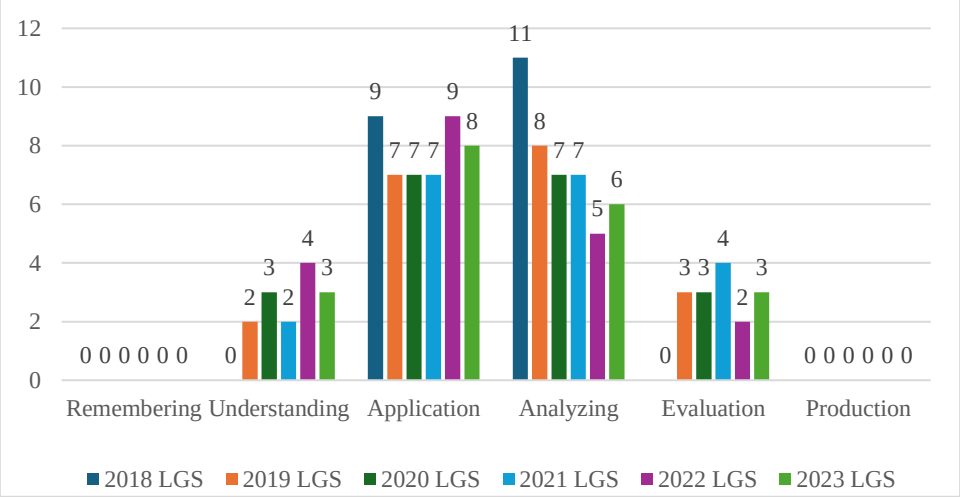
Chart 9: Numerical Distribution of LGS Exam Mathematics Questions According to the Knowledge Dimension of RBT between 2018-2023



Considering the steps that the students encountered in the LGS exam according to the knowledge dimension of the RBT shown in Chart 9, it was determined that on average, 2.83 different questions from the "Conceptual Knowledge" step and 17.17 different questions from the "Procedural Knowledge" step were tested in the exams. In addition, it was determined that there was no significant differentiation in the distribution of the questions according to the knowledge dimension of RBT by years and that the questions were predominantly in the "Procedural Knowledge" step. It is thought that the reason why more questions were asked at the procedural knowledge level is due to both the structure and content of the mathematics course and that it allows questions to be asked for this type of knowledge. According to Chart 9, when it is considered that the questions in the

mathematics subtests of the LGS exam administered for 6 years are concentrated in the "Procedural Knowledge" level and that there are no questions to measure the "Factual Knowledge" and "Metacognitive Knowledge" levels, it is thought that the LGS exam mathematics questions have a heterogeneous distribution according to the knowledge dimension of RBT. Chart 10 below shows the numerical distribution of the LGS exam mathematics questions according to the cognitive process dimension of the RBT between 2018 and 2023.

Chart 10: Numerical Distribution of LGS Exam Mathematics Questions According to the Cognitive Process Dimension of RBT between 2018-2023



Considering the steps that students encountered in the LGS exam according to the cognitive process dimension of RBT shown in Chart 10, it was determined that on average, 2.33 different questions from the "Understanding" step, 7.83 from the "Application" step, 7.33 from the "Analyzing" step, and 2.5 from the "Evaluating" step were tested in the exams. In addition, it was determined that there was no significant differentiation in the distribution of questions according to the cognitive process dimension of RBT according to years, the variety of steps increased after 2018, and the questions were predominantly in the "Application" and "Analyzing" steps. It is thought that the reason why there are more questions for the application step is due to both the structure and content of the mathematics course and that it allows questions to be asked for this step. When the mathematics questions of the LGS exam, which consisted of 120 questions in total, were evaluated according to the cognitive process dimension of RBT, it can be said that the number of questions measuring lower level cognitive skills was 61 and the number of questions measuring higher level cognitive skills was 59, so it can be said that the majority of the questions consisted of questions measuring lower level cognitive skills. Since there are more questions measuring lower level cognitive skills, it is thought that the mathematics questions of the LGS exam applied for 6 years are not sufficient to measure higher level cognitive processes. According to Chart 10, considering that the questions in the mathematics subtests of the LGS exam administered for 6 years were clustered in the "Applying" and "Analyzing" steps and there were no questions to measure the "Remembering" and "Producing" steps, it is thought that the mathematics questions of the LGS exam have a heterogeneous distribution according to the cognitive process dimension of RBT.

When the 6-year LGS exam mathematics questions were evaluated in general according to both MC outcomes and RBT, it was found that since almost half of the MC outcomes were measured in the exams, no question was found as a result of classification to measure both the factual and metacognitive knowledge steps in the knowledge dimension and the recall and production steps in the cognitive process dimension of RBT according to MC outcomes. For this reason, it is thought that the LGS exam has a heterogeneous distribution compared to RBT. As a result of the studies conducted by Bozkuş and Mersin (2020), Şimşek (2021), Şahin (2022), Üzümcü and İpek (2022), Yılmaz and Doğan (2022), and Demir (2023), the researchers stated that the LGS exam has an inhomogeneous distribution compared to RBT; the results of these studies coincide with the results of this study.

5. Conclusion

Results Regarding the First Sub-Problem

Considering the number of learning outcomes that students are responsible for in the exams, it was observed that an average of 23.34 different learning outcomes were tested in the exams each year, thus the number of learning

outcomes measured in the exams was insufficient; some learning outcomes were tested more than once and some learning outcomes were not tested at all. According to the MC, questions from all learning domains were asked in the LGS exams of 2019, 2021 and 2022; in 2018, questions were asked from the "Data Processing" learning domain; in 2020 and 2023, questions were asked from the "Geometry and Measurement" learning domain, all of which were in the second semester since students were only held responsible for the first semester subjects; Covid-19 in 2020 LGS and no questions were asked in the exam in 2023 LGS due to the earthquake. According to the MC, it was also determined that in the LGS exams of 2019 and 2022, questions were asked from all sub-learning areas, in the 2020 LGS exam due to Covid-19, which is a global epidemic, and in the 2023 LGS exam due to the earthquakes centered in Kahramanmaraş, students were only held responsible for the first semester subjects, so there were no questions from the 6 sub-learning areas in the second semester subjects, and in the other years, there were no questions in the exam from 1 sub-learning area in 2018 and 2 sub-learning areas in 2021. As a result, it was observed that some learning and sub-learning areas were neglected in the exams in a similar way as the learning outcomes. It has been determined that LGS exam mathematics questions show heterogeneity in their distribution according to both learning outcomes and learning and sub-learning areas.

Results Regarding the Second Sub-Problem

When the 2018 LGS exam mathematics questions were evaluated according to the knowledge dimension of RBT, it was determined that 2 of the 20 questions were at the conceptual knowledge and 18 questions were at the procedural knowledge stage; according to the cognitive process dimension, 9 questions were at the application and 11 questions were at the analysis stage. It was determined that there were no questions to measure the factual and metacognitive knowledge steps according to the knowledge dimension of the RBT and no questions to measure the recall, comprehension, evaluation and production steps according to the cognitive process dimension. When the test questions were evaluated according to the two-dimensional structure of RBT, it was seen that one question out of 20 questions was asked to measure the application and analysis stages of conceptual knowledge, 8 questions were asked to measure the application and 10 questions were asked to measure the analysis stages of procedural knowledge. As a result, it was seen that the majority of the mathematics questions in the 2018 LGS exam were at the analyzing step of procedural knowledge, and it was thought that the exam questions were sufficient to test high-level cognitive processes.

Results Regarding the Third Sub-Problem

When the 2019 LGS exam mathematics questions were evaluated according to the knowledge dimension of RBT, it was determined that 3 questions out of 20 questions were at the conceptual knowledge and 17 questions were at the procedural knowledge stage; according to the cognitive process dimension, 2 questions were at the comprehension, 7 questions were at the application, 8 questions were at the analysis and 3 questions were at the evaluation stage. It was determined that there were no questions to measure the factual and metacognitive knowledge steps according to the knowledge dimension of the RBT, and no questions to measure the recall and production steps according to the cognitive process dimension. When the exam questions were evaluated according to the two-dimensional structure of RBT, it was seen that one question out of 20 questions was asked to measure the comprehension, application and evaluation stages of conceptual knowledge, one question was asked to measure the comprehension of procedural knowledge, six questions were asked to apply, eight questions were asked to analyze and two questions were asked to evaluate. As a result, it was seen that the majority of the mathematics questions in the 2019 LGS exam were at the analyzing step of procedural knowledge; and it was thought that the exam questions were sufficient to test higher level cognitive processes.

Results Regarding the Fourth Sub-Problem

When the 2020 LGS exam mathematics questions were evaluated according to the knowledge dimension of RBT, it was determined that 3 questions out of 20 questions were at the conceptual knowledge and 17 questions were at the procedural knowledge stage; according to the cognitive process dimension, 3 questions were at the comprehension, 7 questions were at the application, 7 questions were at the analysis and 3 questions were at the evaluation stage. It was determined that there were no questions to measure the factual and metacognitive knowledge steps according to the knowledge dimension of the RBT, and no questions to measure the recall and production steps according to the cognitive process dimension. When the exam questions were evaluated according to the two-dimensional structure of the LGS, it was seen that 2 questions out of 20 questions were asked to measure the comprehension of conceptual knowledge, 1 question was asked to measure the evaluation

step, 1 question was asked to measure the comprehension of procedural knowledge, 7 questions were asked to measure application, 7 questions were asked to measure analyzing, and 2 questions were asked to measure evaluation. As a result, it was seen that the majority of the mathematics questions of the 2020 LGS exam were in the application and analysis stages of procedural knowledge; and it was thought that the exam questions were sufficient to test high-level cognitive processes.

Results Regarding the Fifth Sub-Problem

When the 2021 LGS exam mathematics questions were evaluated according to the knowledge dimension of RBT, it was determined that 1 question out of 20 questions was at the conceptual knowledge stage and 19 questions were at the procedural knowledge stage; according to the cognitive process dimension, 2 questions were at the comprehension stage, 7 questions were at the application stage, 7 questions were at the analysis stage and 4 questions were at the evaluation stage. It was determined that there were no questions to measure the factual and metacognitive knowledge steps according to the knowledge dimension of the RBT, and no questions to measure the recall and production steps according to the cognitive process dimension. When the exam questions were evaluated according to the two-dimensional structure of the RBT, it was seen that one question out of 20 questions was asked to measure the evaluation step of conceptual knowledge, two questions were asked to measure the comprehension step of procedural knowledge, seven questions each were asked to measure the application and analysis steps, and three questions were asked to measure the evaluation step. As a result, it was seen that the majority of the mathematics questions of the 2021 LGS exam were in the application and analysis stages of procedural knowledge; and it was thought that the exam questions were sufficient to test high-level cognitive processes.

Results Regarding the Sixth Sub-Problem

When the 2022 LGS exam mathematics questions were evaluated according to the knowledge dimension of RBT, it was determined that 4 questions out of 20 questions were at the conceptual knowledge and 16 questions were at the procedural knowledge stage; according to the cognitive process dimension, 4 questions were at the comprehension, 9 questions were at the application, 5 questions were at the analysis and 2 questions were at the evaluation stage. It was determined that there were no questions to measure the factual and metacognitive knowledge steps according to the knowledge dimension of the RBT, and no questions to measure the recall and production steps according to the cognitive process dimension. When the questions of the test were evaluated according to the two-dimensional structure of the RBT, it was seen that 4 questions out of 20 questions were asked to measure the comprehension step of conceptual knowledge, 9 questions were asked to measure the application step of procedural knowledge, 5 questions were asked to measure the analysis step and 2 questions were asked to measure the evaluation step. As a result, it was seen that the majority of the mathematics questions in the 2022 LGS exam were at the application stage of procedural knowledge, and it was thought that the exam questions were insufficient in testing high-level cognitive processes.

Results Regarding the Seventh Sub-Problem

When the 2023 LGS exam mathematics questions were evaluated according to the knowledge dimension of RBT, it was determined that 4 questions out of 20 questions were at the conceptual knowledge and 16 questions were at the procedural knowledge stage; according to the cognitive process dimension, 3 questions were at the comprehension, 8 questions were at the application, 6 questions were at the analysis and 3 questions were at the evaluation stage. It was determined that there were no questions to measure the factual and metacognitive knowledge steps according to the knowledge dimension of the RBT, and no questions to measure the recall and production steps according to the cognitive process dimension. When the exam questions were evaluated according to the two-dimensional structure of the RBT, it was seen that 3 questions out of 20 questions were asked to measure the comprehension step of conceptual knowledge, 1 question was asked to measure the evaluation step, 8 questions were asked to measure the application step of procedural knowledge, 6 questions were asked to analyze, and 2 questions were asked to measure the evaluation step. As a result, it was seen that the majority of the mathematics questions in the 2023 LGS exam were at the application stage of procedural knowledge, and it was thought that the exam questions were insufficient to test higher level cognitive processes.

When a general evaluation of the LGS mathematics questions was made, it was determined that there were no questions to measure the factual and metacognitive knowledge steps according to the knowledge dimension of

RBT and the recall and production steps according to the cognitive process dimension. It was thought that questions for these steps could not be asked in the exams due to the fact that the type of LGS exams was multiple-choice. It was observed that LGS mathematics questions were asked from the procedural knowledge step with an average of 17.17 questions in each year according to the knowledge dimension of RBT; and from the application step with an average of 7.84 questions and then from the analyzing step with the closest 7.34 questions according to the cognitive process dimension. It is thought that reasons such as the epistemology of the mathematics course, its content, its processing, its reasoning within itself and the multiple-choice type of the exam cause the LGS exam mathematics questions to pile up in the procedural knowledge according to the knowledge dimension of RBT, and in the application and analysis steps according to the cognitive process dimension.

6. Suggestions

When 6 years of LGS exam mathematics questions were evaluated according to the MC, it was concluded that in some years, some of the learning, sub-learning areas and outcomes in the MC were neglected in the exams. Since some of the learning, sub-learning areas and outcomes are neglected in the exams, students may have the perception that these topics will not appear in the exam and therefore there is no need to study. This situation may lead to the inability to form relationships at the desired level due to the gaps that may occur between concepts, and for the mathematics course, which has a spiral structure, it may cause a decrease in mathematics achievement in the future, and therefore prejudice and failure against mathematics. Preparing the exams by taking into account the entire 8th grade MC that students are responsible for in the LGS exams to be held is recommended with the idea that it will increase the success of the students who will take a relatively more homogeneous exam, as it may cause them to work on all mathematics subjects in the preparation process for the exam. In the LGS exam, although students take the exam responsible for the 8th grade MC, due to the spiral structure of mathematics, some acquisitions are closely related and related to the acquisitions of previous years. In order to increase LGS success, it is recommended that this process should be spread to all secondary school levels and cover a wide period of time; in summary, it is recommended that students should be tried to gain high-level cognitive skills with the acquisitions acquired in previous years.

When the 6-year LGS exam mathematics questions were evaluated in general according to RBT, it was determined that there were no questions to measure both the factual and metacognitive knowledge steps in the knowledge dimension and the recall and production steps in the cognitive process dimension of RBT. In the knowledge dimension, the questions were found to be in the conceptual and procedural knowledge stages and concentrated especially in the procedural knowledge stage; in the cognitive process dimension, the questions were found in the comprehension, application, analysis and evaluation stages and concentrated in the application stage. Although there was no significant difference in the distribution of the questions according to the years, it was determined that the questions were not equally distributed and some steps were neglected. It is thought that the exam will have a more homogeneous and balanced distribution by preparing the exam questions in a way to cover all knowledge and cognitive process steps of RBT as much as possible. Due to the contributions that a homogeneous and balanced distribution of the exam will provide to the knowledge and cognitive levels of the students and the thoughts that it will be more selective due to the fact that no step is neglected in the exam; it is recommended that the exam be prepared to cover all knowledge and cognitive process steps of the RBT as much as possible.

When the 6-year LGS exam mathematics questions were analyzed according to RBT, it was determined that 59 questions consisted of questions measuring higher-order cognitive skills and 61 questions consisted of questions measuring lower-order cognitive skills. Since it is thought that the majority of the exam questions consisted of questions measuring lower-level cognitive skills, albeit with a difference of 2 questions, and that there should be more questions measuring higher-level cognitive skills in order to make the exam more selective, it is recommended that questions measuring higher-level cognitive skills should constitute the majority in the future exams. It is also suggested that teachers and field experts should work together, in-service trainings should be organized for teachers, and university courses should include methods and techniques for preparing questions appropriate to the outcomes and Higher Level Cognitive Skills in order to help teachers prepare questions that will both cover the MC and measure Higher Level Cognitive Skills appropriate to the Higher Level Cognitive Skills in terms of secondary school mathematics exams. For future research; examining the university entrance exams according to RBT, examining the LGS exams and university entrance exams according to RBT, examining the similarities and differences between the LGS exams and the central exams applied before the LGS in terms of both MC and RBT, examining the relationship between the LGS exam and the sample questions

prepared for the LGS, examining the relationship between the LGS exam results and the students' written grades, It is also recommended to evaluate secondary school textbooks and high school textbooks in terms of RBT, to examine high school textbooks and university entrance exams in terms of both MC and RBT, to evaluate LGS exams in terms of different taxonomies, to evaluate university entrance exams in terms of different taxonomies, and to determine the opinions of students who were placed in secondary education institutions, their parents and teachers about LGS exams.

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