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Investigation of Unit Evaluation Questions in Elementary School 1st and 2nd Grade Mathematics Textbooks According to Revised Bloom Taxonomy

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Abstract

In this research, it is aimed to examine the assessment and the unit evaluation questions at the end of the units in the 1st and 2nd grade mathematics textbooks in line with the Revised Bloom Taxonomy (RBT), to make classifications and to evaluate the questions in terms of knowledge and cognitive skills. For this purpose, the unit evaluation questions in the mathematics textbooks prepared with the 2018 mathematics curriculum were classified in the light of RBT. Typical case sampling, which is one of the purposeful sampling methods, was used for sample selection. Thus, the sample of the research in 2019; 42 questions included in the measurement and evaluation questions in the 1st grade math textbook and 60 questions included in the unit evaluation questions in the 2nd grade math textbook; total of 102 questions. The researchers discussed the questions with an academician who is an expert in their field. They gathered and evaluated all the classifications of questions obtained from joint decisions made as a result of brainstorming under one roof. In general, the results show that the questions mostly contain procedural information in the knowledge dimension. Moreover, generally in cognitive process dimension were found 'understanding' step. In this sense, the deficiencies in the metacognitive knowledge and the creation steps of the unit evaluation questions in the textbooks prepared were observed and the aim was to shed light on those who prepared the textbooks.

Keywords

Elementary mathematics Teaching,
Textbooks,
Revised Bloom Taxonomy,
Unit evaluation questions

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Introduction

Mankind has always made efforts to put his life in order due to his nature.The mathematics and physics that were born to create and develop this order were discovered in their own place rather than being born.Therefore, it is possible to see the traces of mathematics in every part of life from shopping to business life.As a matter of fact, we know that mathematics first met children in the family, before school.Children need mathematics by their very nature and try to eliminate most of their curiosity with mathematics.The mathematics curriculum in schools aims to achieve many goals such as improving students' mathematical literacy skills and using them effectively, understand mathematical concepts and carry them into daily life, carry out problem-solving processes, make sense of the relationship between people and objects by using mathematics, improve their metacognitive knowledge and skills, and a positive attitude towards mathematics (Milli Eğitim Bakanlığı, 2018 p.9). With mathematics teaching, individuals learn to look at events from a different perspective and gain the ability to reason and interpret from these differences (Ocak & Dönmez, 2010).

Mathematics teaching in schools is a combination of 5 main things: students, teachers, curriculum, outcomes and textbooks. The importance of the textbooks, which indirectly affects the teaching learning process due to the problems in both their structure and usage methods, is greater in the first level of primary education (Çekirdekci & Toptaş, 2017). In fact, textbooks are the most easily procured materials that serve as a bridge between students and teachers in the classroom.Moreover, textbooks serve as mirrors that make the teaching programs prepared at the abstract level concrete (Demirel & Kıroğlu, 2006).The textbooks, which guide students on how to teach both at school and at home, especially during primary school, guide not only students but also teachers and parents.Therefore, it has always been as a matter of interest and time for education researchers to examine and develop the textbooks that support the teaching strongly for the improvement of the teaching.

One of the classification tables in which teaching materials such as textbooks and exam questions are examined is the Revised Bloom Taxonomy (RBT), which was developed by Bloom in 1956 and later revised by Anderson and Kratwohl (2001) to meet the needs of teaching. The taxonomy of educational goals was created in order to create question banks that measure each educational goal and to analyze the question exchange between faculties of various universities. Benjamin Bloom, when he was director of the University of Chicago Examinations Office, thought taxonomy would reduce the workload of preparing comprehensive annual exams.In other words, he argued that the preparation of the exams would now be easier.Thus, Bloom made the final arrangements with a group of experts he formed in 1949, and the book named Taxonomy of Educational Objectives Handbook I Cognitive Domain was prepared and published in 1956 (Bloom, 1956).After the book was published in 1956, they decided to update the book with a new group to be formed by David Krathwohl and Lorin Anderson and started their work.

As a result of the brainstorms created, some updates were made on the Original Bloom Taxonomy (OBT). The steps in Bloom's taxonomy include knowledge, comprehension, application, analysis, synthesis and evaluation. At the beginning of the changes made in RBT, it becomes two-dimensional as knowledge and cognitive process. The taxonomy, which classifies teaching and learning goals by customizing it in general, includes the knowledge dimension that processes what students know, including factual knowledge, conceptual knowledge, procedural knowledge and metacognitive knowledge.In addition, while classifying the information learned by students, the process that examines what and how they learned is called the cognitive process and it consists of the dimesions of remembering, understanding, applying, analyzing, evaluating and creating.Perhaps the most important innovation made in taxonomy may be the change in the 'synthesis' step in the Original Bloom Taxonomy to the 'creation' step in the Revised Taxonomy.The purpose of this change is to measure the students' realization of what they have learned and put out a new product based on what they have learned.In addition, the evaluation in the last step of the Original Taxonomy has been placed in the fifth step of RBT.The authors, who revised the taxonomy, aimed to measure the students' journey to reach the whole from what they learned.As information and cognitive dimensions, RBT has

become more comprehensive and applicable when classifying (Anderson & Krathworthl, 2001). The innovations made by Anderson and Krathwohl (2000) and their original form are shown in Figure 1.

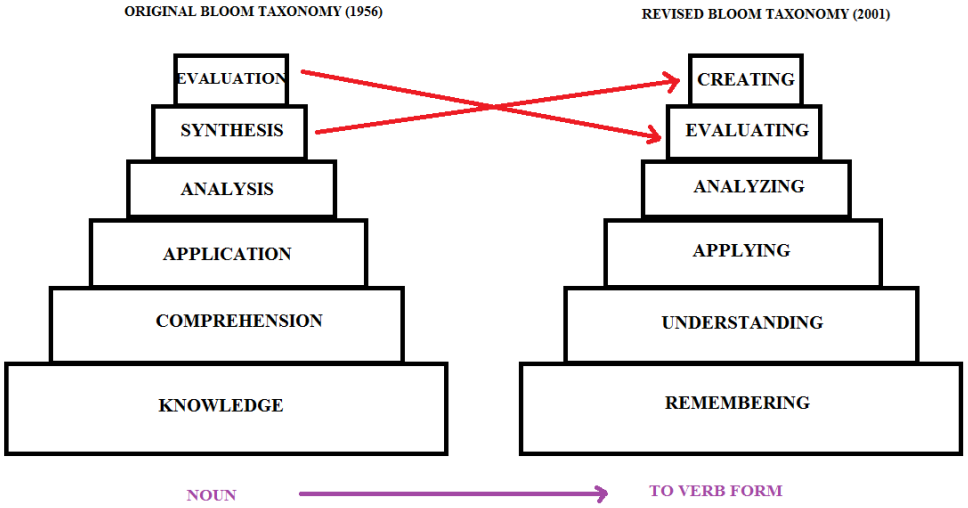


Figure 1. Changes in Bloom's Taxonomy

While the questions or gains are evaluated according to RBT, the step in the knowledge accumulation dimension and which step in the cognitive process dimension are decided separately. Then, the intersection of the information accumulation dimension in the row part and the cognitive process dimension in the column part determine the place of the problem in the Taxonomy (Karaman, 2016, p.32).The RBT classification table used on the basis of research is included in Appendix 1.

While the target of some RBT classifications made by researchers in many domestic and international studies are textbooks(Coşar, 2011; Kahramanoğlu, 2013; Sarar Kuzu, 2013; Rohani, Taheri & Poorzangeneh, 2014; Sivaraman & Krishna, 2015; Büyükalan Filiz & Delal Turan, 2018; Susan, Warsoo & Faridi, 2020); other classification goals include curricula, questions in country-wide exams, and teaching achievements(Ayvacı & Türkdoğan, 2010; Dalak, 2015; Karaman, 2016; Ardahanlı, 2018; Bangahei, Bagheri & Yanini, 2020).Yalçın (2020) classified activities and questions in 3rd grade mathematics textbooks according to RBT in his study. He determined that textbooks have a great effect on metacognitive thinking skills. He also stated that there were insufficient studies on textbooks in Turkey.One of the most important results obtained from these studies is the necessity of measuring whether the materials such as all kinds of questions, textbooks and acquisitions in the learning process of students are in line with the educational objectives in order to base the teaching on solid foundations.

This study includes the classification of the unit evaluation questions in textbooks in line with RBT, which is one of the leading roles in the changing learning-teaching process with a constructivist approach. The problem sentence of the research is "How do the unit evaluation questions in the 1st and 2nd Grade Mathematics Textbooks of 2019 distribute according to the level of knowledge accumulation and cognitive process dimension in the Revised Bloom Taxonomy?" sub-problems are expressed as follows:

1. What is the distribution of the unit evaluation questions in the 2019 Primary School 1st Grade Mathematics textbooks according to the knowledge and cognitive skill levels in RBT?
2. What is the distribution of the unit evaluation questions in the 2019 Primary School 2nd Grade Mathematics textbooks according to the knowledge and cognitive skill levels in RBT?

Methodology

Research Design

The qualitative research method was used in this research. The qualitative research is defined as a research in which a qualitative process is followed to reveal the perceptions and events in the natural environment in a realistic and holistic manner in which qualitative data collection methods such as observation, interview and document analysis are used (Yıldırım & Şimşek, 2016 p.41).Document analysis, one of the qualitative research models, was used in the study.Document analysis is defined as a qualitative research method used to analyze a number of written materials of painting, film etc. bearing the traces of past events, works, books, magazines etc. published on facts (Karasar, 2008, p.183). In addition, within the content of the study, the Revised Bloom Taxonomy was taken as basis and the case study was used as the research design.According to Bassey (1999), case study is a research approach that emphasizes understanding, defining, predicting, or controlling an individual, a situation or a cultural situation (Saban & Ersoy, 2017 p.144). The aim of this study was to examine the unit evaluation questions in mathematics textbooks in the light of the updated RBT.

Study Group

Typical case sampling, which is one of the purposeful sampling methods, was used in the study group of this research.In typical case sampling, if a researcher wants to introduce an innovation, he prefers the most typical case of an innovation (Yıldırım & Şimşek, 2016).In this respect, the sample of the study consists of the 1st and 2nd grade mathematics textbooks approved and taught by the MEB (Ministry of National Education) and Talim Terbiye Kurulu in 2019 with the 2018 curriculum and target content.The books that make up the sample are coded and defined as follows:

K.1. : MEB, 1st Grade Primary School Mathematics Textbook, published in 2019.

K.2. : MEB, 2nd Grade Primary School Mathematics Textbook published in 2019.

Question coding example: K.1.2.1

The meaning of the code:

K.1. : 1st Grade Math Textbook

2: Unit 2 Evaluation Questions in the Textbook

1: 1st Question in the 2nd Unit Evaluation

Data Collection and Analysis

The researchers examined 1st and 2nd grade Mathematics textbooks of the primary school that were taught in 2019, which formed the data of the study.For the research, 2019 mathematics textbooks were reached through the website of Talim Terbiye Kurulu.Descriptive analysis was used in the data analysis of the study. According to the descriptive analysis, the obtained data are summarized and interpreted on the basis of previously determined themes. The data can be arranged according to the themes revealed by the research questions, or they can be presented by considering the questions or dimensions used in the interview and observation processes.The purpose of this kind of analysis is to systematically organize and interpret the findings of the research and express cause-effect relationships clearly (Yıldırım & Şimşek, 2016, p.239).The questions at the end of the unit in the textbooks are classified according to the RBT Information and Cognitive Skills Table (Krathwohl, 2002 p.216), which was found as a result of literature reviews and was previously created.Before the research, the RBT tables and classification examples given in the book titled " Öğrenme Öğretim ve Değerlendirme ile İlgili Bir Sınıflama Bloom'un Eğitimin Hedefleri ile İlgili Sınıflamasının Güncelleştirilmiş Biçimi ", translated by Özçelik (2014), named Bloom's Classification Related to the Objectives of Education, were examined. Afterwards, a common RBT token table was created in order to place the questions in the RBT Indicator Table and used as a key table (Annex-1) in classification. In order to ensure external reliability in the analysis of the data, support was received from an expert lecturer who worked in the field of Classroom Education and Primary School Mathematics Education. The researchers discussed the classification process in detail with the expert, and the questions were

re-checked in the light of the brainstorming with the expert and the feedback received. It is believed that using a field education expert in the classification of the questions will increase the reliability of the study.The obtained data were tabulated and compared in order to find solutions to the created sub-problems in the research. In addition, in the analysis of the research, the questions and the themes prepared by the researchers and the expert together, and the classifications made in line with the RBT table were taken into consideration and the findings were formed.

Findings

Findings Regarding the First Sub-Problem

In this section, "What is the distribution of the unit evaluation questions in the 2019 Primary School 1st Grade Mathematics textbooks according to the knowledge and cognitive skill levels in RBT?" an answer to the sub-problem was sought and the results were tabulated.In the research, the textbook of this sub-problem was coded as K.1.Within the content of the research,the total of 6 unit and 42 unit evaluation questions were determined in the assessment and evaluation in the 1st grade Mathematics Textbook distributed and taught by the MEB in 2019. Table 1 shows the distribution and percentile of the findings obtained with the intersecting classification of the researchers in terms of knowledge and cognitive skills of RBT.In addition, in Graph 1 and Graph 2, there is the percentile of the classification of the target questions in the dimension of RBT knowledge and cognitive skills.

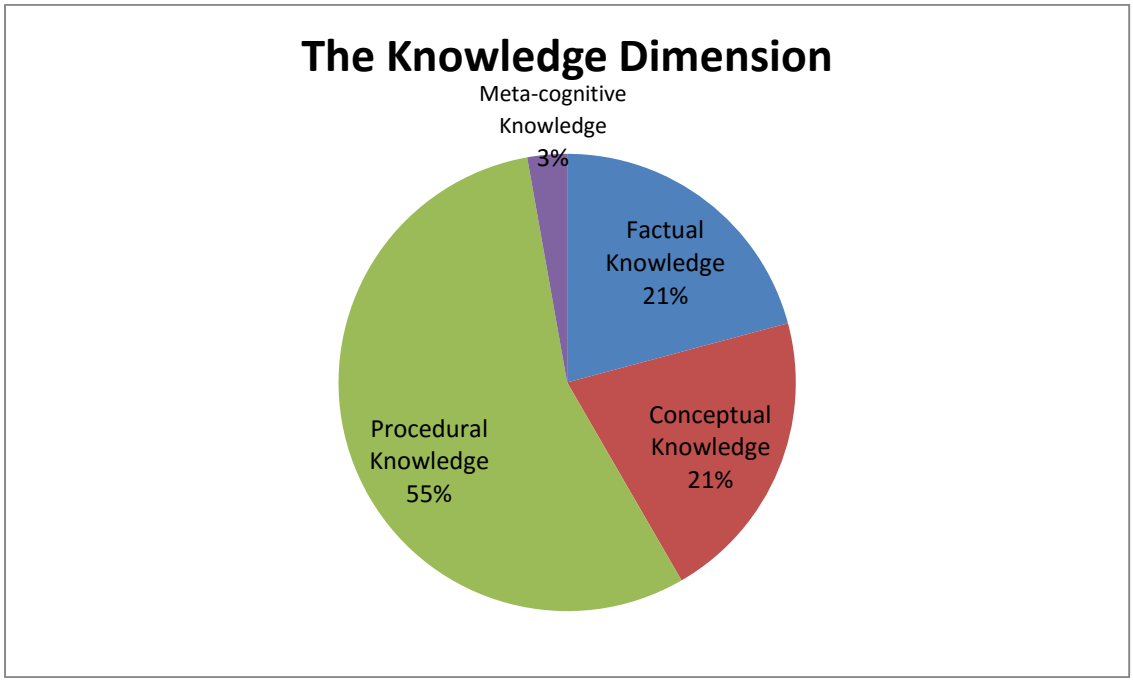
Table 1. Classification of Unit Evaluation Questions in the Textbook named K.1 Code according to the dimension of knowledge and cognitive skills in RBT

	Frequency				**Total**	
Information /Cognitive	Factual Knowledge	Conceptual Knowledge	Procedural Knowledge	Meta-cognitive Knowledge	Total	%
Remember	5	2	4		11	15.27
Understand	8	11	16		35	48.61
Apply	2		6		8	11.11
Analyze			11	2	13	18.05
Evaluate		1	2		3	4.16
Create		1	1		2	2.77
Total	15	15	40	2		
%	20.83	20.83	55.55	2.77		

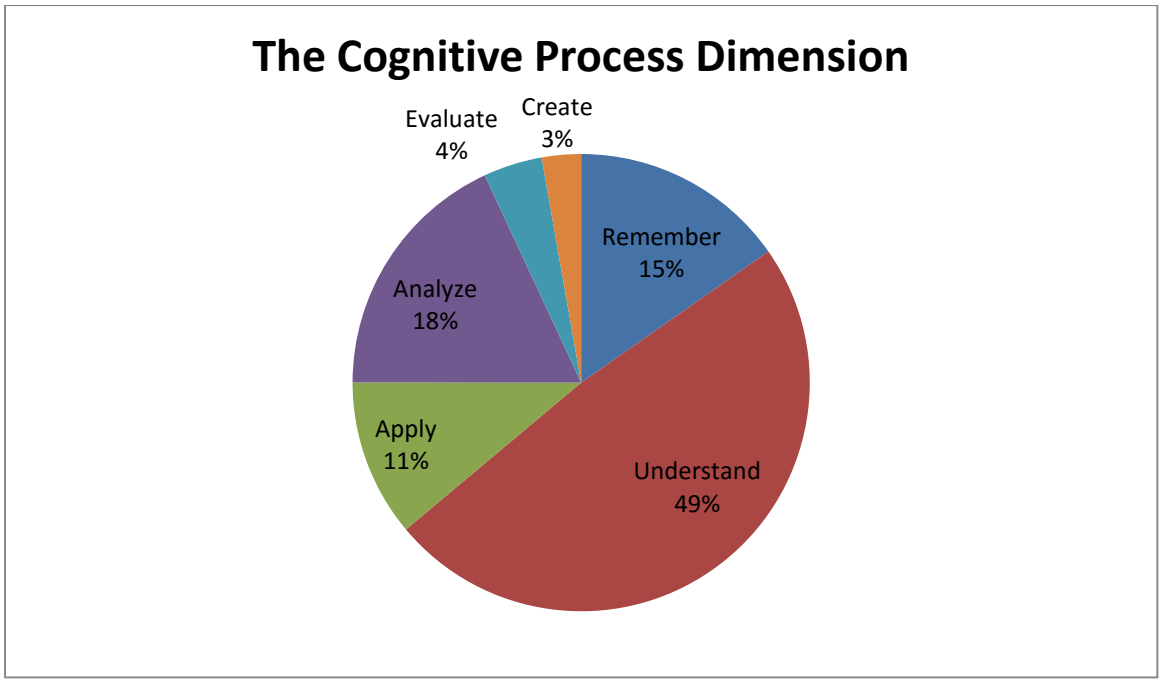
As it can be understood from Table 1, in the K.1 coded textbook in which the researchers were classified together, a total of 42 questions determined from the evaluation in a total of 6 units, common points in the knowledge and cognitive skills dimension of RBT intersected. There is a total of 72 (f = 72) information dimensions in 42 questions. When the questions were analyzed in terms of knowledge (f = 72); 15 of them are factual knowledge, 15 of them are conceptual knowledge, 40 of them are procedural knowledge and 2 of them are metacognitive knowledge.In the percentages of the information level dimension (f = 72), it was observed that the highest rate belongs to the procedural knowledge level with 55.55%. At the lowest rate, there is metacognitive information with 2.77%.

In addition, it was concluded that there is a total of 72 (f = 72) cognitive skill dimensions in 42 questions. When the questions are considered in the cognitive skill dimension, the total (f = 72), it is classified as 11 remember, 35 understand, 8 apply, 13 analyze, 3 evaluate and 2 create.While the highest rate in the percentages in the cognitive (understand) skill dimension (f = 72) is the comprehension level with 48.61%, the lowest rate is the create with 2.77%.

Graph 1 and Graph 2 show the percentages of the unit evaluation questions in the knowledge and the cognitive skill dimensions of the textbook named code K.1.



Graph 1. Percentage representation of the Unit Evaluation Questions in the Textbook named K.1 code according to the information dimension in RBT



Graph 2. Percentage representation of the classification of the Unit Evaluation Questions in the Textbook K.1 according to the cognitive skill dimension in RBT

Findings Regarding the Second Sub-Problem

In this section, "What is the distribution of the unit evaluation questions in the 2019 Primary School 2nd Grade Mathematics textbooks according to the knowledge and cognitive skill levels in RBT?" an answer to the sub-problem was sought and the results were tabulated.In the research, the textbook of this sub-problem was coded as K.2. Within the content of the research, the total of 6 unit and the 60 unit evaluation questions were determined in the assessment and evaluation in the 2nd grade Mathematics Textbook distributed and taught by the MEB in 2019. Table 2 shows the distribution and percentile of the findings obtained with the intersecting classification of the researchers in terms of knowledge and cognitive skills of RBT. In addition, in Graph 3 and Graph 4, there is the percentile of the classification of target questions in the dimension of RBT knowledge and cognitive skills.

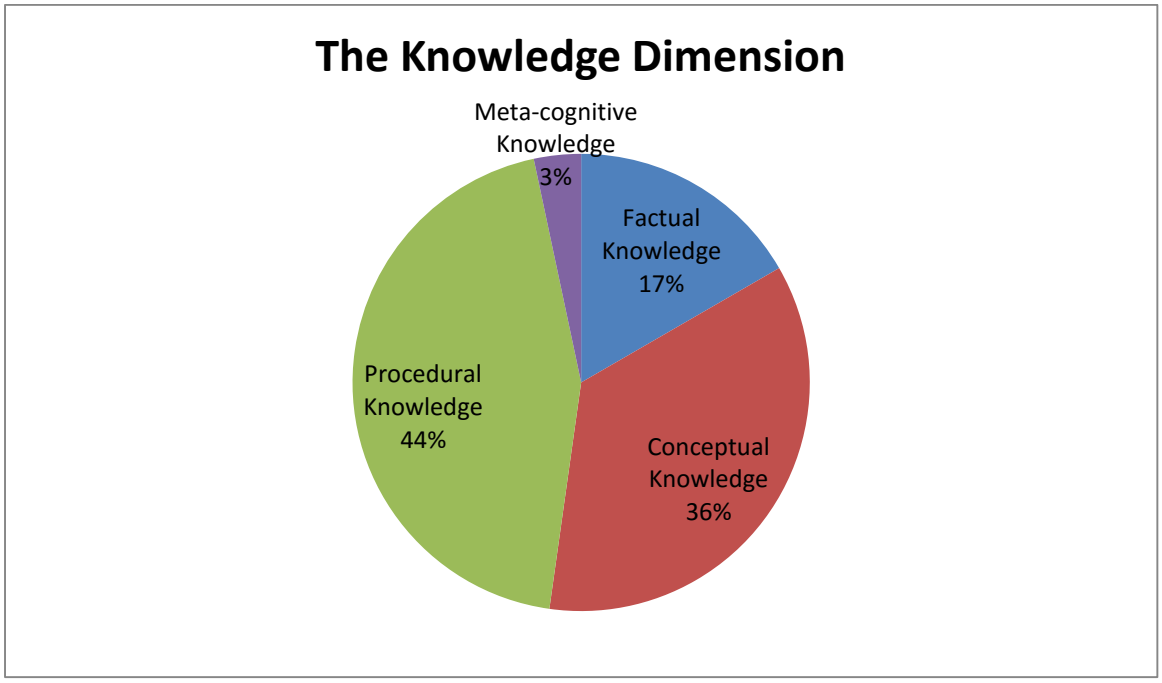
Table 2. Classification of Unit Evaluation Questions in the Textbook named K.2 Code according to the dimension of knowledge and cognitive skills in RBT

	Frequency				Total	
Information /Cognitive	Factual Knowledge	Conceptual Knowledge	Procedural Knowledge	Meta-cognitive Knowledge	Total	%
Remember	5	6	8	1	20	22.22
Understand	8	7	12		27	30
Apply		7	7	1	15	16.66
Analyze	2	6	8		16	17.77
Evaluate		6	3	1	10	11.11
Create			2		2	3.33
Total	15	32	40	3		
%	16.66	35.55	44.44	3.33		

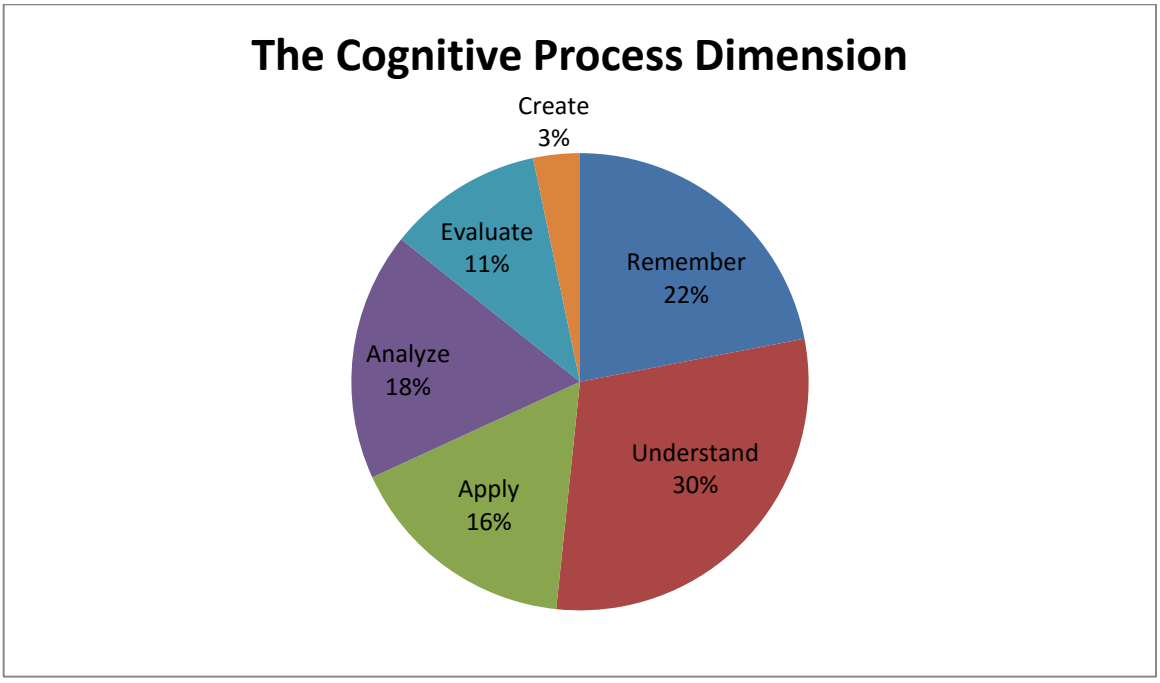
Table 2 shows the frequency and percentage distribution of the 60 questions in the evaluations at the end of 6 units of the 2019 2nd Grade Mathematics textbook, coded as K.2, where the researchers were classified together and the common points intersected in the dimension of knowledge and cognitive skills of RBT. A total of 90 (f = 90) information dimensions of these 60 unit evaluation questions in the textbook with code name K.2 were determined. The questions were classified in the knowledge dimension (f = 90); it was determined that there is 15 factual information, 32 conceptual information, 40 procedural information and 3 meta-cognitive knowledge dimensions.In the percentages in the knowledge level dimension of the target questions (f = 90), it was observed that the procedural knowledge level was the highest with 44.44% and the meta-cognitive knowledge was the lowest with 3.33%.

In addition, it was determined that 60 questions in the unit evaluations in the textbook named K.2. are 90 (f = 90) cognitive skill dimensions in total. When the target questions are classified in the cognitive skill dimension (f = 90); It was determined that 20 of them are at the stage of remembering, 27 of them are at the stage of understanding, 15 of them are at the stage of apply, 16 of them are at the analyze, 10 of them are at the stage of evaluate and 2 of them are at the create. In the percentages of the cognitive skill dimension (f = 90), the highest rate is understanding level with 22.22%. In addition, the lowest rate of classification is the create with 3.33%.

Graph 3. and Graph 4. have shown the percentile ratios of the unit evaluation questions in the knowledge and cognitive skill dimensions in the textbook named K.2.



Graph 3. Percentage representation of the classification of the Unit Evaluation Questions in the Textbook named K.2. according to the knowledge dimension in RBT



Graph 4. Percentage representation of the classification of the Unit Evaluation Questions in the Textbook named K.2. according to the cognitive skill dimension in RBT

Discussion, Conclusion and Suggestions

For the purpose of this study, a total of 102 questions that test the extent of learning at the end of the units in the 1st and 2nd grade mathematics textbooks taught in 2019 were examined and analyzed according to the knowledge and cognitive skill dimensions of RBT. One of the most important conclusions reached by the researchers is the uneven distribution of the tabulated findings in the classification.It has been observed that in some classifications, dimensions of knowledge or cognitive skills are rarely encountered.These dimensions of knowledge / cognitive skills, which are insufficient, left a question mark about the textbooks that should be prepared by adopting the

constructivist approach.Because textbooks are generally procedural knowledge in the dimension of knowledge; cognitive skills are classified in the comprehension dimension. The rarity of metacognitive knowledge or evaluation and creation makes it clear that textbooks do not give students enough opportunities to transfer the knowledge they have learned to a new environment or produce a new product with what they have learned.Sarar Kuzu (2013) stated in her study that when she classified the questions in the textbook she chose on the basis of samples, on the basis of RBT, high-level thinking skill levels were rarely encountered and stated that this situation weakened the constructivist approach. Krathwohl (2002) defined metacognitive knowledge as being aware of one's own cognition. Based on this, unless the correct questions are asked to direct the students to metacognitive knowledge, the possibility of students getting to know themselves and learning in the light of what they know may make us think. The mathematics lesson outcomes prepared by teachers, written exams and math questions asked in the central exams were classified with RBT (Ayvacı & Türkdoğan, 2010; Gökler, Aypay & Arı, 2012; Dalak, 2015; Demir, 2015; Kala, 2015; Zorluoğlu, Kızılaslan & Sözbilir, 2016; Karaman, 2016; Uymaz, 2016; Yakalı, 2016; Çiftçi, 2017; Ulum, 2017; Yunita, 2017; Arı, 2018; Büyükalan Filiz & Delal Turan, 2018; Çelik, Kul & Uzun, 2018; Gökdeniz, 2018; Aslan & Atik, 2018; Ardahanlı, 2018; Kozikoğlu,2018; Altıparmak & Palabıyık, 2019; Yolcu, 2019), and it was observed in previous studies that metacognitive knowledge was low compared to other knowledge dimensions.It was observed that the questions that directed to the students about metacognitive knowledge were inadequate, and while this is the case, the situation in which we educate thestudents who do not know themselves and their own cognition creates a question mark in the teaching.In the unit evaluation questions examined, and it was determined that one of the inadequate classifications belonged to the evaluation and creation step of the cognitive skill dimensions of RBT.Krathwohl and Anderson (2014, p.108) made the definition of evaluation as making judgments based on criteria or standards.In addition, the same authors defined creation as bringing together elements to form an integrated and functional unity. Moreover, they stated that the most important thing to consider in "creating" is that students realize what they learn in accordance with their age and teaching rather than originality.However, in the unit evaluation questions examined in the study, and it was determined that the students were not given sufficient opportunity to accurately convey what they learned.

One of the results obtained from the findings is that the procedural information was determined in general of the questions selected on the basis of samples. This uneven distribution with other dimensions of knowledge is actually not a negative situation as it is supposed. Krathwohl and Anderson (2014) generally interpreted procedural knowledge as the ability to conduct research on more fields and to know what kind of algorithm, method or strategy to apply with these researches.Therefore, the classification of the unit evaluation questions in the textbooks mostly in procedural knowledge indicates that the target questions are effective in the field of mathematics and that they try to teach in the field.

In the light of the information that each classroom teacher has taught in education faculties and gained through school experiences, it can be said that students who have just started school are in the age of play, and they agree to attract their attention with games and applications. Ballı (2006) stated that children in primary education need various social and physical stimuli considering their cognitive and affective development in this critical period and the easiest way is through play(Karamustafaoğlu &Aksoy, 2020). The more applications and activities students find themselves in, the easier and funnier learning becomes. In this case, teachers are aware that they need to activate the teaching with the pre-lesson preparations and textbooks. It is undoubtedly very important that the questions and activities in the textbooks that are prepared or needed to be prepared with a constructivist approach in which students are active when it is taken this situation into consideration.Thus, when the unit evaluation questions examined in the study are classified with RBT, it can be said that the application level in the cognitive skill dimension is at a sufficient level compared to the other steps, creating a positive effect for the research. With the introduction of the constructivist approach, many researchers such as Piaget (1953) always emphasized that children in the age of play make permanence and knowledge transfer easier with practical activities. Mayer and Wittrock (1996) stated that two of the most important goals of education are increasing the permanence and transfer of what has been learned, and these two constitute meaningful learning (Anderson & Krathwohl, 2014).

Therefore, it is one of the best functions of the primary school age children for concrete learning period and meaningful learning, that the student spends effectively and practically in mathematics lesson.

Perhaps one of the most important findings of the study is that 102 questions on sample basis are generally collected in 'understanding' of RBT. Anderson and Krathwohl (2014) explained understanding, which is one of the cognitive skill dimensions, in 7 items (interpretation, exemplification, classification, summarization, inference, comparison and explanation). Unit evaluation questions are generally classified in terms of 'understanding' and it is an indication that the questions prepared are actually questions that contain the most of these seven items.Especially considering the age characteristics of the students, it will be very helpful for children to do cognition studies that include understanding such as sampling, classification and comparison in order to understand a subject. Çelik, Kul, and Uzun (2018) found that the outcomes in the Mathematics Lesson Curriculum, which they examined on the basis of RBT, were gathered in the 'understanding' step in the cognitive skill process in general.

If the conclusion part of the research is summarized in general; Unit assessment questions in the 1st and 2nd grade mathematics textbooks of the year 2019 selected within the content of the study were classified with RBT tables and the obtained data were expressed in the form of frequency and percentiles. When these percentages are examined, it is seen that a total of 102 questions are generally classified with 'understanding' in the dimension of knowledge and in the dimension of 'procedural knowledge' in the cognitive skills.In this sense, it was concluded that more activities that improve metacognitive skills should be included in unit evaluation questions.

Based on the research results, some suggestions can be made for the application and the future research:

- As can be seen from the results of this study, taking into account the disproportionate distribution, the questions prepared on the basis of the analysis, the evaluation and the creation steps, which are the metacognitive skill dimensions, can be added to the textbooks.
- The importance of unit evaluation questions in the textbooks can be discussed by the conducting interviews with the classroom teachers.
- Similar researches can be conducted for different courses, years and grade levels.

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ANNEX-1: Classification Table of a Target (Anderson & Krathwohl, 2014, p.41)

The Knowledge Dimension	**The Cognitive Process Dimension**					
	1.REMEMBER	2.UNDERSTAND	3.APPLY	4.ANALYZE	5.EVALUATE	6.CREATE
A.FACTUAL KNOWLEDGE						
B.CONCEPTUAL KNOWLEDGE						
C.PROCEDURAL KNOWLEDGE						
D.META-COGNITIVE KNOWLEDGE						