Evaluation of the End-of-Unit Evaluation Questions in 6th Grade Science Lesson Book According to the Revised Bloom's Taxonomy[1]

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Abstract

Aim of this study was to examine the end-of-unit evaluation questions in the 6th Grade Science book of primary education according to the knowledge and cognitive process dimensions of the Revised Bloom Taxonomy. For that purpose, 130 end-of-unit evaluation questions of 6th grade Science textbooks which were approved by the Board of Education and Discipline in Ministry of National Education of Republic of Turkey. The evaluation was performed with document analysis with considering knowledge and cognitive process dimensions of the Revised Bloom Taxonomy. Data of this study were obtained with documet analysis which classified as qualitatively research method. Accessing documents, checking authenticity, understanding documents, analyzing and using data steps were performed. Analyzed questions were categorized according to previously published studies of experts, and according to the criteria of "Taxonomy for learning, teaching and Assesing" book written by Anderson et al which is published in 2001 and translated into Turkish by Ozcelik in 2010. Ratio and frequencies were used to reach results. When the unit evaluation questions of the 6th Grade Science Textbook are evaluated according to the cognitive level of the Revised Bloom Taxonomy, it is observed that 60 of the 130 questions are belong to remembering level. When these questions are evaluated according to the knowledge dimension it is observed that 60 of 130 questions are belong to factual knowledge. When the 6th grade units are evaluated as a whole, it's possible to observe that majority of the questions are belong to subcognitive knowledge level. These questions can be considered as factual knowledge level when evaluated according to Revised Bloom's Taxonomy. As a conclusion, it is suggested that the sub-cognitive and metacognitive questions according to the Revised Bloom's Taxonomy should be served equally at unit-end-up questions of the 6th grade of primary school Ministry of National Education approved book.

Keywords: Science, Curriculum, Revised Bloom's Taxonomy, 6th grade

Introduction

It is believed that one of the most important requirements to improve the quality of education is possible if the teachers prepare appropriate and right questions (Karamustafaoğlu et al., 2003). Mankind is a social kind that interacts and communicates with each other. The first step of communication is asking question due to providing a way for learning and improve through lifespan. More question capability provides the children to be more active during education. It is believed that better science education begins with appropriately prepared questions (Koray & Yaman, 2002). Learning is possible with the synapses between two neurons in the brain. For that reasons, questions that lightning flash in the student's brain may increase the permanence of learning. The permanency of the knowledge increases when a person has intense emotion. It is believe that right and appropriate questions increase the interaction between the teacher and the student. These questions increase the motivation and they are one of the most important tools to measure wheter the student understand the knowledge (Topçu, 2017). The content of the questions and the preparation method of the question are important factors for determining the reliability of the questions.

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Revised Bloom's Taxonomy

Bloom's Taxonomy aims to provide three (cognitive, affective, and psychomotor) learning domains to a person through education and training. One of these, the cognitive domain is related with knowledge that contains recognition, understanding and use of the knowledge (Doğanay and Sarı, 2017). The most important feature of the Revised Bloom's Taxonomy is transforming one-dimensional structure of the cognitive domain of this taxonomy into a two-dimensional structure (Krathwohl, 2002). A research group with the leadership of Anderson and Kratwohl which consist of cognitive psychologists, curriculum development experts, teaching-assessment and evaluation experts were generated a new taxonomic classification between 1995 and 1999 in order to Revise the Bloom's Taxonomy (Anderson et al., 2014).

This classification includes recognize, understand and use of knowledge of the individuals (Doğanay & Sarı, 2017). The most important feature in this revised taxonomy is transformation of one-dimensional cognitive domain into a two-dimensional structure (Krathwohl, 2002). In the knowledge level of the taxonomic structure, noun and verb were used to combine. It is believed that knowledge should be in student's mind and to be remembered in order for activation. Another difference in the Revised Bloom's Taxonomy is knowledge, comprehension and synthesis levels had been converted to remember, understand and create. In addition, in the revised taxonomy, the synthesis and evaluation levels have been replaced with the each other. In the revised taxonomy, prerequisite approach of the taxonomy had been removed to avoid negative critics (Arı, 2011).

Figure 1
Dimensions of the Revised Bloom Taxonomy (Translated from Zorluoğlu, 2017).

Knowledge dimension \ Cognitive domain	1. Remembering	2. Understanding	3. Applying	4. Analyzing	5. Evaluating	6. Creating
a. Factual Knowledge						
b. Conceptual Knowledge						
c. Procedural Knowledge						
d. Metacognitive Knowledge						

In the original Bloom's Taxonomy, the noun and verb forms of the knowledge level were used together. In order to turn into actual activities, students should keep the knowledge in their memory and remember it. Furthermore, it has been evaluated as two separated dimensions as knowledge and cognitive process dimensions in the revised taxonomy (Hamurcu ve Ekinci 2020). Similar as in the original, in the revised taxonomy, cognitive domain divided into six separated categories from basic to complicate. Furthermore, each category was divided into 19 subcategories to avoid knowledge confusion. Validity of Bloom's Taxonomy which is named in 1956 by Bloom's own discussed for a long time. As a result of these studies and discussions, Anderson et al. expressed Revised Bloom's Taxonomy as an alternative in 2001. There were two reasons suggested for the requirement of the revision. One of these is to increase attention of the educators to the taxonomy, the second one

Two of the most basic reasons for the renewal of the OBT have been put forward. First; to enable educators to focus on Taxonomy, Second; America's advancement in psychology, teaching methods and techniques with the development of developmental psychology and psychology of learning, measurement and evaluation is an effort to combine it with taxonomy by adapting it to the contemporary education system.

Purpose of the Research

The aim of this research is to adopt a constructivist attitude, the Science Curriculum, which was formed on the basis of the General Objectives and Basic Principles of Turkish National Education expressed in Article 2 of the National Education Basic Law No. it is to try to determine which level of the Management Knowledge Base they belong to, considering the unit evaluation questions included in the Science Course Curriculum, which was accepted with the board decision dated 18.04.2019 and numbered 8 (at 49th of the attached list) and written 10444088. For the purpose, it is aimed to examine the questions in the said curriculum.

Significance of the Research

The 4 basic elements of the training program are; the target, the content, the learning-teaching process and the assessment and evaluation process, and the evaluation process should be considered as a whole with other elements. Bloom's Taxonomy (1956), one of the most well-known taxonomies, was created to determine the knowledge and skill levels in order to make the evaluation process more systematic and regular (Zorluoğlu et al., 2017). Teachers need to know which cognitive process the questions correspond to for formative or summative assessments in order to better understand the lesson topics. A certain part of the questions in the curriculum can set an example for teachers.

Method

Model of the Research

This is a descriptive study using the scanning approach, with the goal of examining the end of unit evaluation questions in primary school 6th grade science textbooks according to the Cognitive Field Levels of the Revised Bloom Taxonomy. Survey models are research approaches that aim to describe a past or present situation (Karasar, 2007). Research data were obtained through document analysis, which is one of the qualitative research methods. The investigation of written documents containing information about the phenomenon or phenomena to be researched is known as document analysis (Yıldırım & Şimşek, 2013). Document analysis is the process of analyzing the data obtained in a systematic way by reviewing and evaluating electronic and printed materials (Bowen, 2009).

In the research, 130 evaluation questions at the end of the unit of the 6th grade science textbooks, which were accepted as an educational tool with the 2018-2019 dated 76198665 letter of the Board of Education (TTK) under the Ministry of National Education, were examined using the document review method. By digitizing a specific document and using a document analysis method to analyze its content, according to Karasar (2005), it makes it possible to analyze that document. The document review method used as an information method is stated by Foster;

      1-) Accessing documents,

      2-) Checking originality,

      3-) Understanding documents,

      4-) Analyzing data,

      5-) Using data

It was done in this manner.

Data Collection Tools and Analysis

In the research, the Ministry of National Education, which is included in te curriculum of science courses in the academic year 2020-2021, according to the decision of the Board of Education and Training Board dated 18.04.2019 and numbered 8 (at 49th of the attached list) and the article 10444088, 130 textbooks that have been accepted for 5 years and have been deemed appropriate to be read are included in the end of unit evaluation questions of science textbooks 6th classroom science question was classified according to the information and cognitive process dimensions by taking into account the abbreviations in the updated Bloom Taxonomy table and was corrected and

classified according to the feedback received by presenting it to two program development experts. The classification was finalized with considering expert opinions. The percentages and frequencies of the results were obtained and converted to various tables and visualizations.

Findings

Table 1
The rate of finding the unit evaluation questions in the 6th grade science curriculum units in the lower and higher cognitive domain levels.

Cognitive Process Dimension	Unit 1	Unit 1	Unit 1	Unit 1	Unit 1	Unit 1	Unit 1	Total	
Remembering	12	15	7	2	5	13	6	60	46,1%
Understanding	3	6	4	14	14	6	6	53	40,7%
Applying	0	0	6	1	0	0	1	8	6,1%
Total	**15**	**21**	**17**	**17**	**19**	**19**	**13**	**121**	**93,9%**
Analyzing	2	0	0	1	0	1	0	4	3,7%
Evaluating	1	0	0	0	3	0	0	4	3,7%
Creating	0	0	0	0	1	0	0	1	0,7%
Total	**3**	**0**	**0**	**1**	**4**	**1**	**0**	**9**	**9,2%**
General Total	**18**	**21**	**17**	**18**	**23**	**20**	**13**	**130**	**100,0%**

Table 1 show that there are 121 sub-cognitive domain stages among the 130 questions in the 6th grade science curriculum. Of these questions, 60 concern remembering, 53 concern understanding, and 8 concern applying. 9 questions from a total of 130 questions fall within the higher level cognitive domain steps. 4 of these questions belong to the analysis, 4 to the evaluation and 1 to the creation step. While there are too many questions for low-level cognitive domains in the 6th grade Science Curriculum, there are very few questions for high-level cognitive domains.

Figure 2
Distribution Chart of 6th Grade Science Curriculum End of Unit Evaluation Questions According to Revised Bloom's Taxonomy.
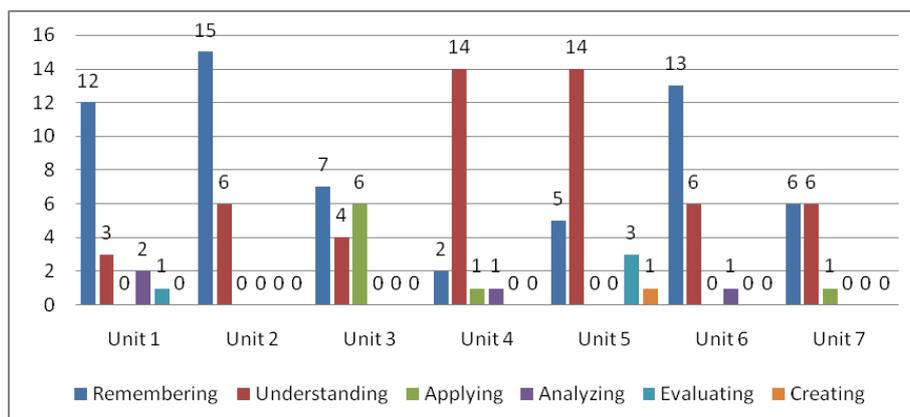
Examining Figure 2 and the science curriculum for 6th grade; it may be observed that the remembering and comprehension rates are high in the 6th grade science program's units. Therefore, it is seen that the questions of transferring knowledge increase in the units with the remembering level intensified at the sub-cognitive level, and in the units with a higher rate of comprehension level.

Table 2
The ratio of the questions at the end of the unit of the 6th grade science curriculum to the lower and higher cognitive domain levels.

6th Grade	Number of the Sub-congitive Domain Questions		Number of the Higher Level Congitive Domain Questions		Total Number of Questions	
Unit 1	15	84,0%	3	16,0%	18	100,0%
Unit 2	21	100,0%	0	0,0%	21	100,0%
Unit 3	17	100,0%	0	0,0%	17	100,0%
Unit 4	17	94,5%	1	5,5%	18	100,0%
Unit 5	19	83,0%	4	17,0%	23	100,0%
Unit 6	19	95,0%	1	5,0%	20	100,0%
Unit 7	13	100,0%	0	0,0%	13	100,0%

When table two examined; Unit 1: 18 questions are in total, covering the solar system and eclipses. These questions fall into two categories: sub cognitive domain steps (84%) and high-level domain steps (16%). Unit 2: There are a total of 21 questions on the systems in our body. There are no questions pertaining to the sub-cognitive domain steps, and all of these questions are related to the lower cognitive steps. Unit 3: force and movement has 26 questions in total, all of which are in the lower cognitive domain steps and none of which are in the higher level cognitive domain steps. Unit 4: matter and heat has 18 questions, of which 5.5 percent are in the higher-level cognitive domain steps and 94.5 percent are in the sub-cognitive domain steps. Unit 5: There are a total of 23 questions, all of which have features and sound. 83 percent of these questions are in the lower levels of the cognitive domain, and 17 percent are part of the sub-cognitive domain steps. Twenty questions concerning our body's processes and health are included in Unit 6. The sub-cognitive domain steps account for 95% of these queries, while the higher level cognitive domain steps account for 5% of them. Unit 7: The section on the transmission of electricity has a total of 13 questions. There are no questions pertaining to the sub-cognitive domain stages, and all of these questions fall within the higher level cognitive domain.

Table 3
An analysis of the questions in the 6th grade science textbook of secondary school (Solar System and Eclipses) according to the knowledge and cognitive process dimensions of the Revised Bloom Taxonomy.

Knowledge dimension	Cognitive process dimension												
	Remembering		Understanding		Applying		Analyzing		Evaluating		Creating		Total (%)	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Factual	12	67											12	67
Conceptual			3	17									3	17
Procedural														
Metacognitive							2	11	1	5			3	16
Total (%)	**12**	**67**	**3**	**17**			**2**	**11**	**1**	**5**			**18**	**100**

When analyzed according to the dimensions of knowledge and cognitive process, the 6th grade science course book 1st unit evaluation questions mostly consist of 12 (67%) remembering and 3 (17%) understanding steps. When we look at the knowledge dimension, it is seen that there are mostly questions in the Factual Knowledge 12 (67%) and Conceptual Knowledge 3 (17%) dimensions. When the 6th grade science lesson 1st unit evaluation questions are evaluated as a whole, 12 (67%) of the questions are in the dimension of remembering, 3 (17%) of these are in the understanding, 2 (11%) are in the analyzing and 1 (5%) is in the evaluating dimension.

Table 4
An analysis of the questions in the secondary school 6th grade science textbook unit 2 (Systems in Our Body) according to the knowledge and cognitive process dimension of the Revised Bloom Taxonomy.

Knowledge dimension	Remembering		Understanding		Applying		Analyzing		Evaluating		Creating		Total (%)	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Factual	15	71,5											15	71,5
Conseptual			6	28,5									6	28,5
Procedural														
Metacognitive														
Total (%)	**15**	**71,5**	**6**	**28,5**									**21**	**100**

When Table 4 is analyzed according to the dimension of knowledge and cognitive process, the most common evaluation questions of Unit 2 of the 6th Grade Science Textbook are 15 (71.5%) remembering steps and 6 (28.5%) understanding steps. When we look at the knowledge dimension, it is seen that there are mostly questions in the Factual Knowledge 15 (71.5%) and conceptual knowledge 6 (28.5%) dimensions.

Table 5
An analysis of the questions in the secondary school 6th grade science textbook unit 3 (Force and Motion) according to the knowledge and cognitive process dimension of the Revised Bloom Taxonomy.

Knowledge dimension	Remembering		Understanding		Applying		Analyzing		Evaluating		Creating		Total (%)	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Factual	7	41,1											7	41,1
Conseptual			4	23,5									4	23,5
Procedural					6	35,2							6	35,2
Metacognitive														

| Total (%) | 7 41,1 | 4 23,5 | 6 35,2 | | | | 17 100 |

When Table 5 is analyzed according to the dimensions of knowledge and cognitive processes, it is seen that the 6th Grade Science Textbook Unit 3 evaluation questions are mostly at remember 7 (41.1%), understanding 4 (23.5%) and applying level 6 (% 35,2). When we look at the knowledge dimension, it is seen that there are mostly questions in the Factual knowledge 7 (41.1%) and procedural knowledge 6 (35.2%) dimensions. When the 6th Grade Science lesson Unit 3 evaluation questions are evaluated as a whole, 7 (41.1%) of the questions are factual, 4 (23.5%) are cognitive-conceptual and 6 (35.2%) are procedural dimension.

Table 6

An analysis of the questions in the secondary school 6th grade science textbook unit 4 (Matter and Heat) according to the knowledge and cognitive process dimension of the Revised Bloom Taxonomy.

Knowledge dimension	Cognitive Process Dimension						
	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating	Total (%)
	f %	f %	f %	f %	f %	f %	f %
Factual	2 11,1						2 11,1
Conseptual		14 77,8					14 77,8
Procedural			1 5,5				1 5,5
Metacognitive				1 5,5			1 5,5
Total (%)	**2 11,1**	**14 77,8**	**1 5,5**	**1 5,5**			**18 100**

When table 6 is analyzed according to the dimension of knowledge and cognitive process, the Understanding questions of unit 4 of the 6th grade Science Textbook are mostly composed of 14 (77.8%) comprehension levels and 2 (11.1%) of them are in Remembering steps. When it is looked at the knowledge dimension, it is seen that there are mostly questions in the Factual Knowledge 2 (11.1%) and conceptual knowledge 14 (77.8%) dimensions. When the 6th grade science lesson 4th unit evaluation questions are evaluated as a whole, 2 (11.1%) of the questions are factual, 14 (77.8) are conceptual, 1 (5.5%) procedural and 1 (5.5%) of them are in the metacognitive knowledge dimension.

Table 7

An analysis of the questions in the 5th unit (Sound and Characteristics) of the secondary school 6th grade science textbook according to the knowledge and cognitive process dimensions of the Revised Bloom Taxonomy.

Knowledge dimension	Cognitive Process Dimension						
	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating	Total (%)

	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Factual	5	21,7											5	21,7
Conseptual			14	60,9									14	60,9
Procedural														
Metacognitive									3	13,0	1	4,3	4	17,3
Total (%)	**5**	**21,7**	**14**	**60,9**					**3**	**13,0**	**1**	**4,3**	**23**	**100**

The evaluation questions for unit 5 of the sixth-grade science textbook are made up of 14 (60.9%) and 5 (21.7%) for understanding and remembering levels respectively when Table 7 is assessed in accordance with the aspects of knowledge and cognitive processes. The knowledge dimension reveals that Conceptual Knowledge 14 (60.9%) and Factual Knowledge 5 (21.7%) are the two areas where there are the most concerns. 5 (21.7%) of the questions in the 6th grade Science lesson's fifth unit evaluation are factual questions, 14 (60.9%) are conceptual questions, and 3 (13.0%) are metacognitive. 1 (4.3 percent) of these is belonging to metacognitive knowledge.

Table 8

An analysis of the questions in the 6th unit (The System in Our Body and Its Health) of the secondary school 6th grade science textbook according to the knowledge and cognitive process dimension of the Revised Bloom Taxonomy.

	Cognitive Process Dimension													
Knowledge dimension	Remembering		Understanding		Applying		Analyzing		Evaluating		Creating		Total (%)	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Factual	13	65,0											13	65,0
Conseptual			6	30,0									6	30,0
Procedural														
Metacognitive							1	5,0					1	5,0
Total (%)	**13**	**65,0**	**6**	**30,0**			**1**	**5,0**					**20**	**100**

When the 6th unit is evaluated, 13 (65.0%) and 6 (30.0%) of the questions are belonging to Remembering and understanding steps respectively. Factual dimension covers 13 (65.0%) questions and conceptual knowledge is correlated with 6 (%39) questions were the most common in the knowledge dimension.

Table 9

An analysis of the questions in the secondary school 6th grade science textbook unit 7 (Production of Electricity) according to the knowledge and cognitive process dimension of the Revised Bloom Taxonomy.

	Cognitive Process Dimension						
Knowledge dimension	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating	Total (%)

	f	%	f	%	f	%	f	%	f	%	f	%	f	**%**
Factual	6	46,2											6	46,2
Conseptual			6	46,2									6	46,2
Procedural					1	7,6							1	7,6
Metacognitive														
Total (%)	**6**	**46,2**	**6**	**46,2**	**1**	**7,6**							**13**	**100**

When the questions in 7th unit were considered, the frequently questions were observed in Remembering and Understanding steps with 6 questions (%46,2). If the questions were evaluated with knowledge dimension Factual and Conceptual questions were distributed similarly with 6 questions (%46,2). On the other hand only 1 of these questions with %7,6 ratio was observed in Applying steps and Procedural dimension.

Conclusion and Recommendations

As a conclusion, when the 1st unit of the 6th grade science textbook, Solar System and Eclipses, was evaluated according to the Revised Bloom Taxonomy, the most remembering-factual 12 (66,6%) and understanding-conceptual 3 (16,7%) steps were included. When the 2nd unit of the 6th grade science textbook, the System in Our Body and Its Health end-unit evaluation questions were evaluated according to the Revised Bloom Taxonomy, the remembering-factual 15 (71,5%) and understanding-conceptual 6 (28,5%) steps were included the most. The 3rd unit of the 6th grade science textbook is evaluated according to the Revised Bloom Taxonomy of the Force And Motion end of unit evaluation questions, reembering-factual 7 (41,1%) and applying-conceptual 6 (%35,2) steps are mostly included. When the 4th unit of the 6th grade science textbook is evaluated according to the Revised Bloom Taxonomy of the Matter and Heat end of unit evaluation questions, the remembering-factual 2 (11,1%) and understanding-conceptual 14 (78,8%) steps were included the most. When the 5th unit of the 6th grade science textbook is evaluated according to the Revised Bloom Taxonomy of the Sound and Properties end of unit evaluation questions, the remembering-factual 5 (21,7%) and understanding-conceptual 14 (60,9%) steps were included the most. When the 6th unit of the 6th grade science textbook is evaluated according to the Revised Bloom Taxonomy of the System in Our Body and Its Health end of unit evaluation questions, the remembering-factual 13 (65%) and understanding-conceptual 6 (30%) steps were included the most. Questions in the 7th unit of the 6th grade science textbook, Conduction of Electricity, is evaluated the most frequently used steps are the remembering-factual 6 (46,2%) and understanding-conceptual 6 (46,2%). As a result, the units with the majority of the physics topics are seeing an increase in application steps since the foundation of the Physics, Chemistry, and Biology courses in the Science Discipline is covered (3rd unit, Force and Motion). When the questions in the 6th grade science curriculum were classified according to the cognitive process dimension of the Revised Bloom Taxonomy, it was determined that the number of questions belonging to the sub-cognitive domain steps was higher than the number of questions belonging to the higher-level cognitive domain steps. While there are the most questions in the remembering step, which is one of the sub-cognitive domain steps, there are the fewest questions in the application step. While there are more questions for the analysis step from the higher cognitive domain steps, there are very few questions for the creation step. While there are more questions for the analysis step from the higher cognitive domain steps, there are very few questions for the creation step. When the transitions between the units in the 6th grade science curriculum are examined; the rates of categorized questions in the sub-cognitive domain and high-level cognitive domain levels differ. In the 2nd, 3rd and 7th units, there are questions belonging to the sub-cognitive domain steps at a high rate. Units 1, 4 and 6 have more questions pertaining to higher-level cognitive domains than units of 2, 3 and 7. However, when we look at the knowledge dimension, the most of the questions are belonging to factual and the least are in metacognitive dimensions.

It was analyzed that the questions in the secondary school science curriculum were collected in the sub-cognitive domain steps according to the cognitive domain steps of the Revised Bloom Taxonomy. In the studies carried out, it was determined that the questions asked by science teachers during the

lesson were higher in the lower-level cognitive domain levels compared to the Bloom Taxonomy, and that they were mostly in the knowledge and application steps. It is said that the questions asked in the course materials are mostly questions belonging to the sub-cognitive domain steps.

Balta (2006), in this studies examining the importance of using Bloom's Taxonomy in exams applied in primary schools, determined that no progress could be made in the steps such as analysis, synthesis and evaluation, which require analysis, by measuring the knowledge level of students only in the exam. It is the proof of the low success performances determined in the national exams that the additional unplanned exam applications do not provide much benefit in terms of mental development in primary.

Similarly, Demir and Dindar (2006) analyze the 5th grade science exam questions according to Bloom's Taxonomy, which shows homogeneity with the research. In both studies, it was determined that most of the questions were at the knowledge level. Similar to these studies, Ayvacı and Türkdoğan (2009) concluded that the questions in the exam papers examined by science teachers according to YBT belong to low-level cognitive domain steps. Gündüz (2009) analyzed the 6th, 7th and 8th grade science and technology exam questions according to the cognitive domain steps of Bloom's Taxonomy; he determined that 92,19% of the questions were asked to measure low-level thinking skills and 7.79% to measure high-level thinking skills. schools.

Suggestions

When the literature is examined, it is seen that only 20% of the teachers ask questions that lead the students to think. Teachers will contribute to their learning by exiting low-level questions and directing students to metacognitive questions by transferring knowledge. The acquisition of advanced thinking abilities is one of the goals of the modern educational model. However, it was found that low-level cognitive domain questions received more space than high-level cognitive domain questions in the Science Curriculum for the 5th, 6th, 7th, and 8th grades. It is advised that the questions be well-balanced and appropriately cover high-level cognitive domains. This might help children develop higher-order thinking abilities.

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