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An Analysis of Mathematics Questions of the TPESE Exam According to Cognitive Levels of TIMMS 2015*

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Abstract

The purpose of the study is to compare TEOG Exam Mathematics Questions and TIMSS-2015 8th-grade Mathematics Questions by classifying them based on TIMSS-2015 cognitive domains. For this purpose, document analysis method was used. The study is limited to 240 mathematics questions included in TEOG exam and TEOG make-up exam applied to 8th-grade students between 2013 - 2016 and 212 items included in TIMSS-2015 8th grade Math achievement test. The research data were obtained by the researchers and 3 experts based on the TIMSS-2015 cognitive domain coding scheme. The findings of experts are evaluated by taking codes' percentages and frequencies. At the result of the study process; it is illustrated that 42.5% of TEOG and TEOG make-up exam Math questions belongs to "Knowing", 45.5% of it belongs to "Practice" and 12% of it belongs to "Reasoning" cognitive domain steps. Findings shows that 31% of the items in TIMSS 2015 8th grade Mathematics achievement test are related to Knowing, 45% of it related to Practice and 24% of it related to "Reasoning" cognitive domain levels. In the TEOG exams, questions that measure high-level thinking skills are less than in the TIMSS exam. The majority of the TEOG questions (88%) measure low-level skills. Moreover, as a result of testing with chi-square distribution that the cognitive percentages of the TIMSS-2015 Mathematics questions and the TEOG exam Mathematics questions are significantly different. In other words, they do not match with each other cognitively. On the other hand, Mathematics questions in TEOG and TEOG make-up exam matches with each other cognitively.

Keywords: TEOG exam mathematics questions, TIMSS-2015 cognitive domains, Question analysis.

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Introduction

International benchmarking efforts based on student evaluations such as TIMMS, PISA, and PIRLS are studies that do not carry the characteristics of a race among countries. They enable the participating countries to evaluate their educational systems and follow the development of their students in the fields of science, mathematics and reading throughout years (MNE, 2005). In many countries, the academic performance of students is evaluated in terms of the comparison of international competence (İncikabı, 2012). One of these international exams is the Trends in International Mathematics and Science Study (TIMSS).

TIMMS is a study conducted by IEA — the International Association for the Evaluation of Educational Achievement — every four years. In this article, students' knowledge and skills in the fields of mathematics and science are evaluated at the 4th and 8th-grade levels. TIMSS is an exam that first started in 1995, followed by a four-year period — administered in 1999, 2003, 2007, 2011 and 2015 (Mullis et al., 2009). It was designed to measure mathematics and science achievement in the international arena of primary school students studying in different countries. Another aim of the TIMSS studies is to collect information about the educational systems of countries and to improve mathematics and science education. To this end, various data are collected from countries and interpreted (EARGED, 2011).

TIMSS consists of surveys that collect information about achievement tests in science and mathematics, and educational and social environments that have an impact on student achievement. In TIMSS applications, 14 different booklets are used at each class level. These booklets are issued on behalf of the students and delivered to the schools where the tests will be administered (EARGED, 2011). As it was stated before, the main aim of TIMMS is to improve Mathematics and Science Education in various countries.

Profits of the countries participating in the TIMSS studies include having the opportunity to compare their educational systems with other countries and to be able to observe how they have progressed in terms of education over the years (MNE, 2005). TIMSS also collects data on countries' educational systems, curricula, students, teachers, and school information. Thus, developments in the educational systems of different countries can be followed globally.

As for the assessment of students succes in Turkey, two different assessment and evaluation systems are observed in Turkish education system; the first of which is local, and the second one is central (Çepni, Özsevgenç & Gökdere, 2003). Local assessment and evaluations are carried out by teachers in order to determine the level of knowledge and skills of students in the classroom. The examinations with broader participation prepared by the Ministry of National Education and applied in all the provinces are within the scope of the central assessment and evaluation. The history of the central examinations in the transition from primary school to secondary school in Turkey is studied, it shows that the High School Placement Examination (HSPE) administered up to 2003 was replaced with the Secondary Education Institutions (SEI) examination in 2004. The SEI exams were administered between 2004 and 2008. From 2008 until the year 2013, the Placement Examination (PE) was conducted. With PE, the ability of students to use various mental processes is measured based on student objectives in Turkish language, social sciences, mathematics, science, and English courses (MNE, 2010).

The TIMSS survey of more than 60 countries around the world is an important project in determining the educational policies of the participating countries (Karamustafaoğlu & Sontay, 2012). The draft of the mathematical evaluation for the TIMSS study was formed around two dimensions. One of them is the content domain which is composed of algebra, geometry, number, and data and probability. The other is the cognitive domain consisting of knowledge, practice, and reasoning (MNE, 2016).

The National TPESE Examination (Transition from Primary Education to Secondary Education), which is also administered at the 8th grade, is a national central examination. The most prominent feature of the TPESE examination is that it assesses the student in a process rather than at an instance (MNE, 2013a).

Table 1.TIMMS 2015 Content Areas

Content Areas	Percentage Evaluations
Numbers	31
Algebra	28
Geometry	21
Data/Probability	21

Table 1 showed that 31% of the questions come from numbers, 28% from algebra, 21% from geometry and 21% from data/probability content areas. Based on the calculations of the percentages when the TIMSS 2015 math questions are categorized according to cognitive levels, 31% of the questions were at the level of "knowledge", 45% at the level of "application" and 24% at the level of "reasoning".

Theoretical Background

Tetik (2013) classified and compared 355 PE mathematics questions asked to 8th-grade students between 1998 and 2012 and 89 mathematics questions asked in TIMSS 2007 according to the TIMSS 2007 cognitive domain levels. As a result of the research, it was found that 29.30% of the mathematics questions asked to the 8th-grade students between 1998 and 2012 were at the knowledge level, 60% at the practice level, and 10.70% at the reasoning level. In the case of 89 mathematical questions asked in TIMSS 2007, 25.84% were at the knowledge level, 61.79% were at the application level and 12.36% were at the reasoning level. Similarly, Başol et al. (2016) classified the mathematics test items of the TPESE exam according to the TIMSS levels and the Revised Bloom's Taxonomy in their study. As a result of the study, it was found that 78.8% of the questions were grouped under Level 1 and Level 2, 21.2% under Level 3 and Level 4 in the classification according to the TIMSS levels.

Taştekinoğlu (2014) examined the questions of the 4th-grade mathematics exam applied in 3 primary schools in Istanbul according to the levels of the cognitive domain. In cognitive domain comparisons, 40% of questions asked in TIMSS were at the knowledge, 40% were at the practice and 20% were at the reasoning cognitive levels. It was determined that of the exam questions that were evaluated within the scope of the study, 67% were of the knowledge, 18% were of the practice, 15% were of the reasoning cognitive level, and there was no consistency between the exam questions and the TIMSS questions. According to the data from interview forms administered to teachers, it was determined that the majority of the teachers did not repeat a subject if the percentage of success in the class was low, did not use different teaching techniques, and their level of knowledge about the cognitive domain was inadequate.

Delil and Delil (2012) classified and compared the 345 mathematics questions asked in the 5^{th} grade Free Boarding and Scholarship Exams between 1999 and 2011 according to the TIMMS 2011 cognitive levels. When all the questions asked in the examination were classified according to the TIMSS 2011 framework, it was seen that 17.7% were at the knowledge level, 41.7% at the reasoning level, 40.6% at the application level.

The studies on the analysis of the questions according to Bloom's Taxonomy include Yakalı's (2016) study examining all 80 questions in the mathematics tests of the TPESE exam applied in fall and spring semesters between 2013 and 2015 and 52 objectives related to these questions within the framework of the Revised Bloom's Taxonomy. As a result of the study, it was seen that the TPESE exam mathematics questions were piled up on the lower cognitive levels, and there was no question at the levels of evaluation and creation. It turned out that the exam questions were in parallel with the objectives of the curriculum but did not measure critical and creative thinking skills. This suggests that the mathematics curriculum does not coincide with its general purpose.

Baki and Köğce (2009) compared 290 mathematics questions asked at the Student Selection Examination (SSE) and 959 mathematics questions asked by teachers working in different types of secondary schools, by taking into account the cognitive levels of Bloom's Taxonomy. As a result of the study, it was found that the questions asked in SSE did not overlap with the exam questions asked in the General High School, the Trade Vocational High School and the Multi-Program High School, but with the exam questions asked at the Anadolu High School and the Science High School in the cognitive domain.

Dalak (2015), in his thesis, tried to reveal the parallels between the questions asked in the TPESE examinations, which were being applied since 2013, and the objectives related to the questions in the 8th-grade curriculum according to the Revised Bloom's Taxonomy (RBT). As a result of the study that used the document examination method, the rate of the Mathematics Course exam questions and the objectives of the program that were in the same level according to RBT were determined to be 50% and over.

Comparisons related to Bloom's Taxonomy or the Revised Bloom's Taxonomy were also made in different courses besides the Mathematics course. In his study, Aydoğan (2008) classified the questions of geography in the social studies test according to the cognitive domain levels of Bloom's Taxonomy in the high school placement exams (HSPE and SEI) conducted between 2003 and 2007, and he examined the appropriateness of the questions to the social studies program. It was found that the most number of questions came from the level of comprehension, and there were no questions on knowledge — the lowest level — and evaluation — the highest level — among the geography questions of the SEI social sciences test. Gündüz (2009), on the other hand, analyzed the questions of middle school Science and Technology courses according to Bloom's Taxonomy. It was seen that 64.65% of the questions were related with knowledge, 9.68% with comprehension, 17.86% with application, 4.51% with analysis, 0.94% with synthesis and 2.34% with evaluation levels. In summary, 92.19% of the questions were revealed to be questions that measured lower-level thinking skills. Özcan and Açık (2011) examined the questions in PE Turkish test and middle school Turkish textbooks of 2007-2008 academic year according to Bloom's Taxonomy. It was seen that the questions in the PE Turkish test and the textbooks were prepared considering the cognitive levels of Bloom's Taxonomy.

Studies found noteworthy that the findings of both the questions asked in the central examinations and the questions asked by the teachers in the exams were examined according to Bloom's Taxonomy. This is important in terms of both student achievements in international exams and achieving high-level cognitive goals.

Aim of the Study

The aim of this study is to classify and compare the questions in the mathematics field of the TPESE and TPESE make-up exams administered to the 8th-grade students between 2013 and 2016 and the questions in the 8th-grade mathematics field in the 2015 TIMSS exam based on the TIMSS 2015 cognitive levels. Sub-problems of the study are:

1. How are the mathematics questions of the TPESE exams administered between 2013 and 2016 classified on the basis of the TIMSS 2015 cognitive levels?

2. How are the mathematics questions of the TPESE make-up exams administered between 2013 and 2016 classified on the basis of the TIMSS 2015 cognitive levels?

3. In terms of the TIMSS 2015 cognitive levels, what is the relationship between the mathematics questions of TPESE and TPESE make-up exams administered from 2013 to 2016 and the 8th-grade mathematics questions of TIMSS 2015?

4. How are the TPESE exam mathematics questions classified on the basis of the TIMSS 2015 content areas?

Method

Research Model

The document analysis method is used in this study. According to Yıldırım and Şimşek (2004), document analysis covers the analysis of written materials containing information about the cases or phenomena targeted to be investigated. Karasar (2012) emphasizes that document analysis covers the processes of finding resources, reading, taking notes and — differently from others — evaluating, for a certain purpose.

Data Collection Process

The coding scheme for the cognitive levels of TIMSS 2015 is given in the table below. In the study, the questions were divided into cognitive levels according to this scheme.

Table 2. The TIMMS 2015 cognitive level coding scheme (Mullis et al., 2013).

1. KNOWLEDGE	2. APPLICATION	3. REASONING
1.1 Recall: Recall the terminology, explanations, number and geometry attributes, and notations (for example, a × b = ab, a + a + a = 3a).	2.1 Select: Select an appropriate operation, method or strategy to solve the problem where there is a known way, algorithm or method of the solution.	3.1 Analyze: Explain or make decisions about the relationships between variables in mathematical situations and make valid inferences from this information.
1.2 Recognize: • Recognize Mathematical objects (for example, figures, expressions, numbers, and quantities). • Recognize mathematical concepts that are mathematical equations (for example, equational fractions, percentages, decimals, different orientations of simple geometric figures).	2.2 Represent: Represent Mathematical information or data in diagrams, tables or graphs, and produce equivalent presentations/representations of a given mathematical phenomenon or relationship.	3.2 Generalize/ customize: Broaden the areas where the result of mathematical thinking and problem-solving is correct by presenting results again in more general, broader and acceptable terms.

1.3 Calculate: Carry out algorithmic procedures for +, −, ×, ÷ or combinations of these with all numbers, integers, decimals, and percentages. Tell approximate numbers for estimated calculations and carry out routine algebraic methods.	2.3 Model: Develop a proper model such as an equation, geometric figure or diagram to solve a routine problem.	3.3 Synthesize: Link different knowledge and related mathematical ideas. Combine mathematical methods, concepts, and facts to reveal results and achieve the next result.
1.4 Draw Conclusions: Read simple scales from tables and charts.	2.4 Apply: Apply the whole of a mathematical instruction (for example, draw shapes and diagrams for given definitions)	3.4 Verify: Provide verification by reference to known mathematical results or qualifications
1.5 Measure: Use measurement tools, and select appropriate measurement units.	2.5 Solve routine problems: Solve standard problems similar to those encountered in classrooms. These problems may be in similar structures, or may only be mathematical.	3.5 Solve non-routine problems: Solve problems that have never been encountered in similar structures by establishing mathematical or real-life environments and apply mathematical facts, concepts, and procedures in unusual or complex situations.
1.6 Classify/Order: Classify/group objects, numbers, forms, and expressions according to common qualities; make the right decision about group members, and sort objects and numbers according to their properties.		

Reliability and Validity

Karasar (2012) defines validity as the measurability level of the quality to be measured and the ability that the quality to be measured can be measured without being confused with other things. He defines reliability as the consistency between the independent measurements of the quality that is measured.

According to Tan and Erdoğan (2001), "Validation in measurement literature is also used to mean relevance, significance, usefulness of some inferences." Accordingly, in order to examine the validity of the study, its relevance dimension was examined. The aim of this study is to analyze the mathematics test questions administered to 8th-grade students in the TIMSS study of 2015 and the mathematics questions asked in the TPESE examination according to the TIMSS 2015 cognitive levels. The questions are relevant because they were classified according to the cognitive levels in the 2015 TIMSS national evaluation report.

While consistency, sensitivity and stability are important in reliability according to Büyüköztürk, Çakmak, Akgün, Karadeniz and Demirel (2010), it is important to collect data on relevance, usefulness and significance in validity.

Consistency between independent measurements are examined for reliability. In the analysis of the TPESE examination mathematics questions, three experts — two males with 8 years of teaching experience and one female with 5 years of teaching experience — together with the researcher independently examined

the cognitive levels of the TIMSS 2015 Mathematics framework, and again classified 20 mathematical questions independently of each other according to the cognitive levels of TIMSS 2015. In the first classification, the agreement rate was found to be 80%. This ratio was found by using the $P = \frac{Na.100}{Na + Nd}$ formula, mentioned in Türnüklü (2000), where *P* is the percent of the agreement, *Na* is the amount of agreement, and *Nd* is the amount of disagreement. According to Li (1999), the rate of agreement between experts and the researcher should be at least 72%. The disagreements were corrected by rechecking to which cognitive level they fit according to the definitions specified in the coding scheme. Thus, a total of 240 mathematics questions of the TPESE and TPESE make-up exams administered between the years 2013-2016 were categorized according to the cognitive levels by the experts and the researcher as mentioned above.

In the first classification, the agreement rate was found to be 80%. This ratio was found by using the $P = \frac{Na.100}{Na + Nd}$ formula, mentioned in Türnüklü (2000), where *P* is the percent of the agreement, *Na* is the amount of agreement, and *Nd* is the amount of disagreement.

$$P = \frac{Na.100}{Na + Nd}$$

$$P = \frac{16.100}{16 + 4} = \frac{1600}{20} = \%80$$

Na = 16 questions
Nd = 4 questions (2,3,11,17)

Data Analysis

The TPESE Exam of November 2013

The researcher and 3 experts classified 20 mathematics questions of the November 2013 TPESE exam independently of each other according to the TIMSS 2015 cognitive levels.

In the first classification, the agreement rate was found to be 80%. This ratio was found by using the $P = \frac{Na.100}{Na + Nd}$ formula, mentioned in Türnüklü (2000), where P is the percent of agreement, Na is the amount of agreement, and Nd is the amount of disagreement.

$$P = \frac{Na.100}{Na + Nd}$$

$$P = \frac{16.100}{16 + 4} = \frac{1600}{20} = \%80$$

Na = 16 questions
Nd = 4 questions (2,3,11,17)

The TPESE Exam of April 2014

The researcher and 3 experts classified 20 mathematics questions of the April 2014 TPESE exam independently of each other according to the TIMSS 2015 cognitive levels.

In this classification, the agreement rate was found to be 85%. This ratio was found by using the $P = \frac{Na.100}{Na + Nd}$ formula, mentioned in Türnüklü (2000), where *P* is the percent of the agreement, *Na* is the amount of agreement, and *Nd* is the amount of disagreement.

$$P = \frac{Na.100}{Na + Nd}$$

$$P = \frac{17.100}{17+3} = \frac{1700}{20} = \%85$$

Na = 17 questions
Nd = 3 questions (2,13,15th questions)

The TPESE Exam of November 2014

The researcher and 3 experts classified 20 mathematics questions of the November 2014 TPESE exam independently of each other according to the TIMSS 2015 cognitive levels.

In this classification, the agreement rate was found to be 80%. This ratio was found by using the $P = \frac{Na.100}{Na + Nd}$ formula, mentioned in Türnüklü (2000), where *P* is the percent of the agreement, *Na* is the amount of agreement, and *Nd* is the amount of disagreement.

$$P = \frac{Na.100}{Na + Nd}$$

$$P = \frac{16.100}{16+4} = \frac{1600}{20} = \%80$$

Na = 16 questions
Nd = 4 questions (5,8,9,10th questions)

All TPESE and TPESE make-up exams administered between the years 2013 and 2016 were analyzed by the researcher and 3 experts as shown above. The questions with disagreements were resolved once again according to the TIMSS cognitive level coding scheme.

FINDINGS

In this section, findings related to the data collected based on the sub-problems of the study are given.

Classification of TPESE Exam Mathematics Questions between 2013 and 2016 according to TIMSS 2015 Cognitive Levels

Table 3. TPESE Math Questions based on TIMMS 2015 cognitive levels

	Knowledge		Application		Reasoning		Total	
	f	%	f	%	f	%	f	%
2013November	10	50	7	35	3	15	20	100
2014 April	7	35	9	45	4	20	20	100
2014November	8	40	10	50	2	10	20	100

2015 April	9	45	8	40	3	15	20	100
2015November	11	55	7	35	2	10	20	100
2016 April	6	30	11	55	3	15	20	100
Total	51	42,5	52	43,3	17	14,2	120	100

As Table 3 illustrates, among the 120 Mathematics questions asked in the TPESE exam administered to 8th-grade students between 2013 and 2016, 51 were at the knowledge, 52 at the application and 17 at the reasoning cognitive level.

When the questions asked in the TPESE exam are examined, it is seen that the most number of questions is in the application cognitive level, and the least number of questions is in the reasoning cognitive level. There are almost equal numbers of questions from the cognitive levels of application and knowledge.

Among the 120 Mathematics questions asked in the TPESE exam administered to 8th-grade students between 2013 and 2016, 42.5% were at the knowledge, 43.3% at the application and 14.2% at the reasoning cognitive level.

Classification of TPESE Make-up Exam Mathematics Questions between 2013 and 2016 according to TIMSS 2015 Cognitive Levels

Table 4. TPESE make up exam based on TIMMMS 2015 cognitive levels

	Knowledge		Application		Reasoning		Total	
	f	%	f	%	f	%	f	%
2013 November	10	50	7	35	3	15	20	100
2014 April	7	35	9	45	4	20	20	100
2014 November	8	40	10	50	2	10	20	100
2015 April	9	45	8	40	3	15	20	100
2015 November	11	55	7	35	2	10	20	100
2016 April	6	30	11	55	3	15	20	100
Total	51	42,5	52	43,3	17	14,2	120	100

As shown in the table, among the 120 mathematics questions asked in the TPESE make-up exam administered to 8th-grade students between 2013 and 2016, 51 were at the knowledge, 57 at the application and 12 at the reasoning cognitive level. When the questions asked in the TPESE make-up exam were examined, it was seen that the most number of questions were at the application cognitive level, and the least number of questions were at the reasoning cognitive level.

Among the 120 mathematics questions asked in the TPESE make-up exam administered to 8th-grade students between 2013 and 2016, 42.5% came from the knowledge, 47.5% from the application and 10% from the reasoning cognitive level.

Investigation of the Relationship Between the Mathematics Questions of TPESE and TPESE Make-up Exams Administered from 2013 to 2016 and the 8th Grade Mathematics Questions of TIMSS 2015 in Terms of TIMSS 2015 Cognitive Levels

Table 5. Classification of TIMMS, TPESE, and TPESE Make-up Exam based on the TIMSS 2015 Cognitive Levels

	Knowledge		Application		Reasoning		Total	
	f	%	f	%	f	%	f	%
TIMSS-2015	66	31	95	45	51	24	212	100
TEOG & TEOG make up	102	42,5	109	45,5	29	12	240	100

Table 6. Frequencies of the TIMSS 2015, TPESE and TPESE make-up exam Mathematics questions

	Knowledge		Application		Reasoning		Total	
	f	%	f	%	f	%	f	%
TIMSS-2015	66	31	95	45	51	24	212	100
TEOG and TEOG make up	102	42,5	109	45,5	29	12	240	100

Cross-classification is done for the purpose of examining the relationship between characters in any column and row. In cross-classification, the general procedure is to determine the expected frequencies (E_{ij}) of the characters in each row and column and to compare them with the observed frequencies (O_{ij}) (Çakıcı et al., 2015).

H_0: There is no difference between TPESE and TIMSS exams mathematics questions in terms of the TIMSS 2015 cognitive levels.

H_1: There is a difference between TPESE and TIMSS exams mathematics questions in terms of the TIMSS 2015 cognitive levels.

İ	j
Sum of sequence	Sum of column

$E_{ü}$ = (i sum of sequence).(i sum of column)

General Total

Knowledge Application Reasoning

$$E_{11} = \frac{212.168}{452} = 78,7 \qquad E_{12} = \frac{212.204}{452} = 95,6 \qquad E_{13} = \frac{212.80}{452} = 37,5$$

$$E_{21} = \frac{240.168}{452} = 89,2 \qquad E_{22} = \frac{240.204}{452} = 108,3 \qquad E_{23} = \frac{240.80}{452} = 42,4$$

$$\chi^2_{test} = \sum_{i=1}^{m} \sum_{j=1}^{n} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

$$= \frac{(66-78,7)^2}{78,7} + \frac{(95-95,6)^2}{95,6} + \frac{(51-37,5)^2}{37,5} + \frac{(102-89,2)^2}{89,2} + \frac{(109-108,3)^2}{108,3} + \frac{(29-42,4)^2}{42,4}$$

$$= 2,04 + 0,003 + 4,86 + 1,8 + 0,004 + 4,2$$

$$\chi^2_{test} = 12,9$$

x^2 table value is 5.99 when degree of freedom = (number of rows - 1).(number of columns - 1) = (2-1).(3-1) = 2 and the significance level of α = 0.05.

When x^2 calculated is greater than x^2 table, the H_0 hypothesis is rejected.

Because 12.9 > 5.99, there was a difference between the TPESE and TPESE make-up exam mathematics questions and the TIMSS 2015 mathematics questions in terms of the cognitive levels.

In terms of the cognitive level, it was found that there was a significant difference between all the TPESE mathematics questions asked from 2013 to 2016 and the TIMSS 2015 mathematics questions. In other words, the mathematics questions of the TPESE exams did not overlap with those of TIMSS in terms of the cognitive domain.

Classification of the TPESE Exam Mathematics Questions on the Basis of TIMSS 2015 Content Areas

Table 7. TPESE Maths Questions based on TIMMS 2015 Content areas

	Number	Algebra	Geometry	Data/Prob.	Total
Nov.2013	16	1	3	-	20
Apr.2014	2	7	9	2	20
Nov. 2014	16	-	3	1	20
April 2015	3	6	8	3	20
Nov. 2015	18	2	-	-	20
Apr. 2016	2	6	10	2	20

Table 7 shows that the most number of questions came from the number and geometry content areas in the classification of the mathematics questions asked in the TPESE exams between 2013 and 2016 according to the TIMSS-2015 content areas. No questions came from the data/probability content area in the TPESE exam in November 2013, from the algebra content area in the TPESE exam in November 2014, and from the geometry and data/probability content areas in the TPESE exam in November 2015. This is because the TPESE exams are applied gradually as the 1st Term (November) and 2nd Term (April). Because the numbers of objectives in the first TPESE exam held in November are few, no questions came from the content areas mentioned above. Therefore, in order to see the big picture, the following table was created based on the academic year.

Results and Discussion

It was seen that among a total of 240 mathematics questions asked in the TPESE make-up exam administered to 8th-grade students between 2013 and 2016, 42.5% were at the knowledge, 45.5% were at the application and 12% were at the reasoning cognitive level. It was seen that the most number of questions came from the application and knowledge cognitive levels with similar percentages, and the least number of questions came from the reasoning cognitive level. The cognitive levels of knowledge and application constituted 88% of the questions. Only 12% belonged to the reasoning cognitive level. Hence, we can draw the conclusion that the TPESE exams have little room for questions that measure high-level thinking skills. Questions that measure low-level skills constitute the vast majority of questions (88%). In the literature, this situation has been put forward in Dalak's (2015) thesis. Dalak (2015), in his thesis, tried to reveal the parallels between the mathematics questions asked in the Transition from Primary Education to Secondary Education (TPESE) examinations, which were being applied since 2013, and the objectives related to the questions in the 8th grade curriculum according to the Revised Bloom's Taxonomy (RBT). He stated that only 15% of the 2013-2014 academic year fall semester TPESE exam questions measure high-level cognitive skills.

Moreover, Yakalı (2016) examined all 80 questions in the mathematics tests of the TPESE administered in fall and spring semesters between 2013 and 2015, and 52 objectives related to these questions within the framework of the Revised Bloom's Taxonomy. It indicates the lower cognitive levels and there are not any questions at the evaluation or creation levels. This situation is in contradiction to mathematical process

skills (such as reasoning and association) which are expressed and emphasized to be improved in mathematics teaching programs (MNE, 2013d).

When the distribution of the TIMSS 2015 Mathematics questions is examined, it is seen that 31% of the questions belong to the knowledge, 45% to the application and 24% to the reasoning cognitive level in the 8th-grade mathematics achievement test. Thus, the following conclusion can be reached: Of the TPESE math questions, the cognitive percentage of "knowledge" was well above the percentage determined by the TIMSS, while the cognitive percentage of reasoning was well below the percentage determined by the TIMSS. The cognitive percentages of application were close to each other. In the TPESE exam, instead of the reasoning questions that developed the reasoning power, questions at the knowledge level (the first level of the cognitive domain) were asked. This situation is in conflict with the mathematics curriculum. In addition to learning mathematical concepts, the development of a number of important skills has also been targeted with the approach adopted in the mathematics curriculum. These skills are high-level skills such as problem-solving, reasoning and associating (MNE, 2009).

As a result of the study, it was seen that the level that was represented the least in the mathematics questions of the TPESE examinations administered between 2013 and 2016, and in the mathematics questions asked in TIMSS 2015 was the reasoning cognitive level, but this rate was higher in the questions in TIMSS 2015. It was determined that there was fewer (12%) number of questions that measured high-level thinking skills in the TPESE examinations. This shows the need to increase the number of questions requiring high-level cognitive skills during the central exams in our country, Turkey.

İncikabı, Mercimek, Ayanoğlu, Aliustaoğlu and Tekin (2016) evaluated the objectives of the secondary school mathematics curriculum published in 2013 according to the TIMSS cognitive domains. In their study, they stated that 30% of objectives of the 8th-grade level was in the knowledge, 35% in the application and 35% in the reasoning domain. Although the rate of objectives about the reasoning domain in the mathematics curriculum was high, it is seen in studies (Başol, 2016; İncikabı, 2016) in the literature that this rate is low in mathematics questions of the entrance exams to secondary education institutions (PE and TPESE).

Başol, Balgalmış, Karlı and Öz (2016) classified the TPESE exam math test items according to the TIMSS levels and the Revised Bloom's Taxonomy. In their study, they found that 78.8% of the questions were grouped under Level 1 and Level 2, 21.2% under Level 3 and Level 4. In the distribution according to the revised Bloom's Taxonomy, the majority of the questions were at the application level, and the number of questions regarding the analysis and evaluation levels was small. The authors suggested that questions of an exam like TPESE (by which students are directed to an upper institution based on their cognitive levels) should be prepared in a way that they also measure high-level cognitive skills.

Interpretation of Results Related to the Distribution of TPESE Exam and TPESE Make-up Exam Mathematics Questions According to the TIMSS 2015 Content Areas

47.5% of the TPESE exam math questions come from the number content area, 18.3% from the algebra content area, 27.5% from the geometry content area, and 6.7% from the data/probability content area. It is seen that the most number of questions comes from the number content area, and the least comes from the data/probability content area. When the content areas of TIMSS 2015 are considered, it is seen that 31% of the questions come from number, 28% from algebra, 21% from geometry and 21% from data/probability content areas. In this case, it is seen that the percentages of number and geometry content areas in the TPESE exams exceed the percentages specified in TIMSS 2015. The percentages of algebra and data/probability content areas are below the percentages specified in TIMSS 2015.

49.1% of the TPESE make-up exam math questions come from the number content area, 17.5% from the algebra content area, 26.7% from the geometry content area and 6.7% from the data/probability content area. It is seen that the most number of questions comes from the number content area, and the least comes from the data/probability content area. When the content areas of TIMSS 2015 are considered, it is seen that 31% of the questions come from the numbers, 28% from algebra, 21% from geometry and 21% from data/probability content areas. In this case, it is seen that the percentages of number and geometry content areas in the TPESE make-up exams exceed the percentages specified in TIMSS 2015. The percentages of algebra and data/probability content areas are below the percentages specified in TIMSS 2015.

İncikabı et al. (2016) analyzed the mathematics and science questions in the student placement exams to secondary education institutions (PE and TPESE) according to the PISA problem-solving framework. In their study, they pointed out that the distribution of mathematics questions concentrates on certain issues in general. They stated that the most number of questions in the distribution of the mathematics questions according to the content areas comes from the geometry area and the least from the probability and statistics area. In the TPESE exams that were administered between 2013 and 2016, the least number of questions came from the data and probability content area. The most number of questions came from the number subject, followed by the geometry subject.

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