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Turkish Eighth Graders' Mathematics Performance on TIMSS 2007 and 2011 through A Content Analysis of National High School Placement Tests

Research Article

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ABSTRACT

The purpose of this study is to interpret the gains in Turkish eighth graders' TIMSS mathematics performance between 2007 and 2011 in terms of the two national assessments conducted to place eighth graders into high schools in Turkey, namely OKS 2007 and SBS 2011. Content analysis technique was employed to conduct a document analysis and three experts analyzed mathematics items in these national assessments. Items in the national assessments were categorized into the content domains (numbers, algebra, data & chance, and geometry) and cognitive domains (knowing, applying, and reasoning), which were described in the TIMSS 2011 assessment framework. As a result, it was found that the percentage of number content items decreased from 24% in OKS 2007 to 15% in SBS 2011 while the geometry content items increased from 36% in OKS 2007 to 50% in SBS 2011. On the other hand, there was an increase in the percentage of items in the knowing domain (32% in OKS 2007 to 50% in SBS 2011) and a decrease in the percentage of items in the other two cognitive domains. In terms of students' mathematics performance, no significant differences were observed among the given years in numbers content scores of Turkish eighth graders while their scores in the other content domains improved, especially in geometry, as well as the improvement in their knowing cognitive scores between TIMSS 2007 and 2011. As a result, in terms of the content domains, this study determined that changes in the focus of the Turkish assessments in relation to TIMSS is likely a reason for the increase in geometry in comparison to number performance, with all respect to the other factors affecting student achievement. It also raises concerns regarding the distribution of the cognitive domains in the national assessments, considering the inconsistency of the distributions with students' performances in the specific domains.

Keywords:

TIMSS, mathematics, assessment, content analysis, placement test

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Introduction

Collecting data to assess the quality of education and predict future trends in order to guide educational policy and decision-making mechanisms is gaining importance (Kellaghan, & Greaney, 2001). In addition to the essential guiding role of assessments toward the educational policy, they are also used to place students into colleges or high schools, namely placement tests. The decisions that colleges desire to acquire through placement tests are whether students are ready for the college level courses or they need additional developmental support. If students pass these placement tests, colleges take this as an indicator showing that students are able to attend college level courses (Belfield, & Crosta, 2012). With the similar sense, countries with highly centralized education systems, such as Turkey, also use placement tests at the high school level. However, differently than the college placement tests, which aim to assess the preparedness of students into colleges, high school placement tests are used to place students into the different types of high schools in Turkey, called ranking based placement tests. Countries with highly centralized educational systems are more likely to use national assessments only to place the students into the level of the educational circle than to use the results to inform curricular development, but both ends can be served together (Kamens, & McNeely, 2010).

In Turkey, the ranking based placement system was changed twice between 2006 and 2014 (Ministry of National Education, 2011a; Ministry of National Education, 2011d). In 2007, about 800,000 eighth graders in Turkey took the Assessment of Secondary Educational Institutions (OKS assessment) to be placed into the different types of high schools (Ministry of National Education, 2007a). There were 25 multiple-choice questions in each of four subjects, mathematics, literacy, science, and social knowledge, for a total of 100 in OKS 2007 (Ministry of National Education, 2007c). Besides the OKS assessment, no other factors were used to evaluate students' qualifications for particular high schools (Ministry of National Education, 2007b). In 2008, the OKS assessment was repealed as only determiner of high school placements and replaced with the Secondary Education Placement Test (SBS) and was still being used in 2011 (Ministry of National Education, 2007b; Ministry of National Education, 2011d). In 2011, after the transition from the OKS to the SBS, approximately one million eighth graders took the SBS assessment (Ministry of National Education, 2011b), which comprised 20 mathematics, 23 literacy, 20 science, 20 social knowledge, and 17 foreign language multiple choice questions for a total of 100 (Ministry of National Education, 2011c). In contrast with the OKS as sole assessment, students' Grade Point Average (GPA) scores at the sixth, seventh, and eighth grade were also calculated in addition to their SBS overall scores in 2011 (Ministry of National Education, 2011a) to contribute 30% of their high school placement scores (Ministry of National Education, 2011c).

In addition to the changes in the placement tests for eighth-graders between 2006 and 2014, there was also changes in 2014 and 2018. While SBS assessment was replaced with TEOG in 2013-2014 school year, TEOG was also replaced with LGS in 2017-2018 school year (Biber, Tuna, Uysal, & Kabuklu, 2018). They also indicated that items in LGS assessment were more distinctive than the ones in TEOG assessment in terms of assessing students' mathematical skills, according to the views of teachers participated in their study. And, this distinctive change in the items was caused by the increase in the importance of international assessments, especially TIMSS, in Turkey (Erden, 2020).

This willingness to alter assessment patterns to enhance the accuracy of student placements shows a flexibility in responding to issues that may be uncommon for many countries. An important factor influencing the change in the assessment patterns in Turkey is the perceived negative psychological effects of assessments on eighth graders such as stress and anxiety problems (Karabacak, 2013; Ministry of National Education, 2007b). One may imagine the stress and anxiety that Turkish eighth graders experienced when just one assessment determined the course of their educational career, especially when, prior to 2008, there was no possibility of making up the assessment (Ministry of National Education, 2007b). As Sarıer (2010) observed, students, parents, educators, and educational institutions all focus on OKS and SBS assessments because of the role they play in shaping students' future opportunities. Therefore, educational priorities are set within the frame of the national assessments, and curriculum decisions are related to preparation for the assessments (Ministry of National Education, 2007b).

In addition to the placement tests used to place students into the higher educational circles, international assessments are also in use by many countries. In the late 1950s, the International Association for the Evaluation of Educational Achievement (IEA) began measuring participant countries' levels of achievement in different subjects (Postlethwaite, 2005). Since 1995, TIMSS assessment results have been generated by the IEA every four years as an international measure of mathematics and science achievement of fourth and eighth graders (Mullis, Martin, Foy, & Arora, 2012). In 2007, 50 countries and seven regional jurisdictions of countries were included in the fourth TIMSS study (Martin, Mullis, & Foy, 2008), and in 2011, 45 countries and 14 regional jurisdictions (Mullis et al., 2012) participated in the eighth-grade assessment of the fifth TIMSS study. In addition to providing comparative statistics, the IEA also gives feedback to authorities on the extent to which their country's learning level goals were met (Postlethwaite, 2005), raising the important question of how countries should read the results. While by interpreting its results in comparison with those of other participants a particular country's broad goal is to keep up with world trends, another notable concern at the local level is taking those results into consideration in order to direct the national educational system toward global competitiveness (Incikabi, 2012; Pektas, 2012).

From this point of view, examining the national assessments, especially those applied in the same years as the TIMSS 2007 and 2011 reports, is a sound strategy to elucidate the differences between the perspectives of both the TIMSS assessments and the national assessments as ways of making sense of students' performances on TIMSS (Incikabi, 2012). Especially when considering the determination power of the national assessments to place students into the different types of high schools, reading TIMSS results by the formation of the national placement tests would make more sense. In contrast with placement tests, which focus on placing students into high schools, the TIMSS assessment gives Turkey the opportunity to evaluate its fourth and eighth grade mathematics and science achievement in relation to that of the other participant countries (Incikabi, 2012). Therefore, while applying OKS and SBS assessments to determine students' high school placements, it is also important to know how students perform on the international assessments comparing with the students in the other participant countries (Incikabi, 2012). In regard to the difference in the aim of these national and international assessments, there may be a need to meaningfully collect the information to know more about the students in a particular country. Thus, in order to utilize the TIMSS assessment results in a particular country, it is important to address the similarities and differences between the TIMSS and the assessments used in that country (Neidorf, Binkley, Gattis, & Nohara, 2006).

In this regard, it is essential to refer to Uğurel, Morali ve Keskin's (2012) examination of the mathematics items in the OKS 2008, SBS 2010, and the released items in TIMSS 2007 using the frame of the MATH (Mathematical Assessment Task Hierarchy) taxonomy (Smith et al., 1996). They found that SBS 2010 assessments of Turkish sixth, seventh, and eighth graders were relatively congruent with TIMSS 2007 assessments, based on MATH taxonomy. The MATH taxonomy was an improved form of Bloom's taxonomy and was used to determine whether the knowledge, skills, and talents that were intended to be assessed were measured adequately by specifically concentrating on the assessment itself rather than the evaluation for which it was used (Uğurel et al., 2012). Thus, the items in OKS 2008, SBS 2010, and TIMSS 2007 were categorized according to the MATH taxonomy to compare the national assessments to the TIMSS in order to determine the congruency between them (Uğurel et al., 2012). The MATH taxonomy was based on three main groups: Group A comprised "factual knowledge, comprehension, and routine use of procedures," while group B comprised the cognitive skills of "information transfer, application in new situations," and group C the processes of "justifying and interpreting, implications, conjectures and comparisons, and evaluation" (Smith et al., 1996). It was an effective way to categorize the items of national assessments using a taxonomy outside the framework of both national and international assessments. However, in this study, the items in the national assessments were categorized according to the TIMSS 2011 framework so that the comparison of national assessments to the TIMSS assessment could be meaningful through the lens of the TIMSS perspective.

In an investigation of the uses of the TIMSS assessment in Turkey, Güner, Sezer and İspir (2013) asked 200 Turkish 8th grade mathematics teachers if they took the TIMSS assessment into consideration when teaching, giving them only three response options: yes, no, or rarely. These 200 teachers were selected among the ones who represent the teachers in Turkey participating the TIMSS 2011. They found that 31% of the participants claimed to give importance to the TIMSS assessment on a regular basis; however, 54.5% of the participants stated that they gave no consideration to the TIMSS assessment when framing their lessons, and 14% declared they did so only rarely. Thus, it is hoped that the focus of this study on the TIMSS results may increase awareness of this assessment among the teachers in Turkey and lead to their developing instructional strategies that elevate Turkey to a high status among participant countries.

Additionally, Güner et al. (2013) investigated participant teachers' expectations of their students' performance on the specific mathematics domains of the TIMSS assessment, with regard to the four content domains (numbers, algebra, geometry, and data & chance) and further classified into cognitive domains (knowing, applying, and reasoning) within each content domain. By simply averaging the cognitive domain-based expectations in each content domain, we can infer that approximately 47.5% of the participant teachers expected their students to be successful in the numbers content of the TIMSS assessment, 39% expected success in algebra, 36% in geometry, and 42% in data & chance (Güner et al., 2013), indicating that these teachers' expectations were highest for the numbers content domain in the TIMSS, and lowest for geometry. It is important for educators to know teachers' expectations of their students on the TIMSS assessment because the compatibility or incompatibility between students' performances and teachers' expectations provides important information concerning whether teaching is on the right track or needs realignment in accordance with assessment results.

International assessments can help countries to reveal the relative indicators of the performance of their educational systems to enhance the educational practices and make progress toward higher student achievement through the international benchmarking (OECD, 2006). Through the assessment frameworks, the content and the form of items can be consistent across assessments (Neidorf et al., 2006). Thus, while examining both international and local assessments to have a general idea about the students' performance and the strong and weak points of an educational system, assessments can be accurately compared within a common framework and the ways of assessing students can be understood according to the same logic. This way can be likened to the weighing of two objects of different weights with the same scale already used to weigh one of the objects, so that people can compare the goods quantitatively.

Given the availability of the detailed frameworks of TIMSS assessments, the OKS and SBS assessments are categorized according to these frameworks. Mullis, Martin, Ruddock, O'Sullivan and Preuschoff (2009) stated that "the TIMSS 2011 Mathematics Framework is very similar to that used in TIMSS 2007 with only minor updates to particular topics," so it was logical to use the updated TIMSS 2011 framework. This categorization of the OKS and SBS items according to the TIMSS 2011 framework reveals the amount of emphasis on each domain in the framework and the differences between the TIMSS and Turkish assessments in terms of the importance placed on particular subjects, so that Turkish students' performance on TIMSS can be interpreted in a meaningful way. Sarıer (2010) stated that students, parents, educators, and educational institutions focus on OKS and SBS assessments because of their vital importance in students' educational career. Therefore, even the distribution of the items could play an important role when students consider the subjects to focus on. Thus, in this study, the TIMSS 2011 framework is used for OKS 2007, and SBS 2011 assessments so that the distribution of the items in the national assessments could be compared to the ones in the TIMSS assessment.

Finally, from Turkish eighth graders' mathematics results in the specific content and cognitive domains in TIMSS 2007 and 2011, the main topics in which they have made progress and those in which they have not can be determined. With this information, meaningful supports can be provided to help them catch up in areas in which they are behind others. Also, the OKS 2007 and SBS 2011 assessments, which were administered to eighth graders in the same years as TIMSS 2007 and 2011, can be analyzed to gain deep understanding of these results as well. Since teachers and students in Turkey give priority to content that reflects the national assessments, examining the OKS 2007 and SBS 2011 results would shed light on the Turkish students' TIMSS mathematics results, in particular by identifying possible discrepancies between what is prioritized in the curriculum and the topics emphasized in the TIMSS. Such insights can lead educators to reorient instruction so that henceforth it is based not only on the national assessments, but also on the TIMSS. This study contributes to this analysis and subsequent action by examining the degree of conformity between Turkish assessments and TIMSS, not only to influence curriculum reform but also to seek greater alignment between future Turkish and international assessments. Therefore, the research questions of this study are:

1. What are the differences between OKS 2007 and SBS 2011 in terms of the loadings of the content and cognitive domains described in TIMSS assessment framework?
2. Is there any particular change in Turkish students' performance between TIMSS 2007 and 2011, with regard to the change in the loadings of the content and cognitive items in OKS 2007 and SBS 2011?

Method

Data Collection

The data for this study included the mathematics items from the OKS 2007 (Ministry of National Education, 2007c) and SBS 2011 (Ministry of National Education, 2011c) national assessments of Turkey, as well as the Turkish eighth graders' average mathematics scores in each content and cognitive domain from the TIMSS 2007 and TIMSS 2011 results (Martin et al., 2008; Mullis et al., 2012).

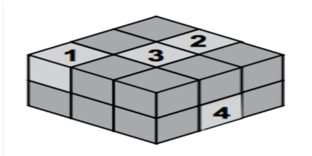
In the TIMSS 2011 mathematics assessment framework, the items were already categorized into either content or cognitive domains (Mullis et al., 2009). The content domain included four sub-domains: numbers, algebra, geometry, and data & chance; and the cognitive domain was divided into three sub-domains: knowing, applying, and reasoning (Mullis et al., 2009). Because the SBS and OKS assessments have no framework as detailed as that of TIMSS, the mathematics items in these assessments (25 items in OKS and 20 items in SBS) were categorized into the TIMSS sub-domains. Therefore, it is discussed how these items were analyzed by the experts in the following section.

Data Analysis: Content (Document) Analysis

A content analysis, in other words document analysis, was conducted to categorize the items in the OKS 2007 and SBS 2011 national assessments by the framework developed for TIMSS 2011 so that it is revealed the changes in the frequency of content and cognitive domain-based items between the OKS 2007 and SBS 2011 national assessments. Krippendorff's (2004) definition of content analysis as "…a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (p. 18) was followed. Krippendorff also indicated that one application of content analysis is the extrapolation of trends, which involves drawing inferences from changes between occurrences of observations. Thus, this study also employed content analysis technique to make inferences between the two national assessments by the help of TIMSS international assessment.

Three experts in the mathematics education field were involved in the coding process. Krippendorff (2004) stated that researchers employed in the content analysis should have strong cognitive abilities, but more importantly they need to have appropriate background in the area of inquiry and familiarity with the phenomena under the consideration. All three experts have had at least two years teaching experiences in Turkey in the mathematics education field and are familiar with the OKS and SBS assessments as well as TIMSS assessment. They all also have a doctoral degree in the mathematics education field, in which their expertise includes use of technology in the mathematics instruction, pre-service teachers' algebraic reasoning and teachers' beliefs on student learning. These experts coded the items independently with the indictive content analysis approach, which is consisted by organizing the data, coding, categorization, and the abstraction (Elo, & Kyngas, 2008). However, when conducting the content analysis, analysts benefited from TIMSS 2011 framework by using prescribed content and cognitive domains as a coding scheme. The process of using a framework to conduct the content analysis is called "Framework Analysis" (Ritchie, & Spencer, 1994). And, a discussion meeting took place to discuss the categorization made by the experts. During the coding process, the percent agreement among the analysts was 92% for the OKS, and 95% for the SBS items. Table 1 illustrates an example of the categorization of one item from each assessment according to the TIMSS 2011 framework all three experts agreed upon. The items on which experts did not agree were discussed and categorized at the final stage upon an agreement.

Table 1. The Sample from the Content Analysis of OKS 2007 and SBS 2011 Items by TIMSS Framework (Ministry of National Education, 2007c; Ministry of National Education, 2011c)

	OKS 2007	**SBS 2011**
Item Number	7	13
The Original Item in the Assessment	What is the result of the following operation? $\sqrt{\frac{1}{16}-\frac{1}{25}} : \sqrt{\frac{1}{36}+\frac{1}{64}}$	The figure is consisted of unit-cubes. What cube can be taken away without changing the lateral area of the whole cube? 
Content Domain	Numbers	Geometry
Cognitive Domain	Knowing	Reasoning

Results

In this part, it is discussed the changes in the mathematics performance of Turkish eighth graders in TIMSS 2007 and 2011 and the results of the content analysis of OKS 2007 and SBS 2011 mathematics items according to the TIMSS 2011 assessment framework in two aspects: content and cognitive domains.

Results for the Content Domains

As can be seen in Table 2, Turkish eighth graders' overall mathematics scores on the TIMSS increased from 432 in 2007 to 452 in 2011, representing significant gains in all content areas, especially geometry (Table 2), except numbers, in which there was no significant difference in scores. These results were opposite to teachers' expectations as reported by Güner et al. (2013), who found that the content domain in which the teachers in their study expected the greatest improvement on the TMSS was numbers, and the domain in which they expected the least was geometry. Thus, there was a major disparity between teachers' expectations and students' most recent performance on the TIMSS.

Table 2. Turkish Eighth Graders' Average Mathematics Scores on TIMSS 2007 and 2011 across Content Domains (Martin et al., 2008; Mullis et al., 2012; NCES, 2015)

	Overall	Numbers	Algebra	Geometry	Data & Chance
TIMSS 2007	432	427	439	406	431
TIMSS 2011	452**	435	455*	454**	467**

*p <.05, ** p <.01

In addition to the fact that there were significant increases in students' average performances on all content domains except numbers, Table 2 also shows that students' average scores were lower than their overall scores in three content domain results: 2007 and 2011 numbers content and 2007 geometry content scores (the one-point difference for Data & Chance being considered negligible). While there was a sizeable improvement in geometry scores on the second test, both numbers scores indicate that Turkish eighth graders may have problems with this particular content. Because the Ministry of National Education does not disclose the data for the average content-based scores on the OKS and SBS assessments, useful information about the issues underlying the scores could not be accessed. Therefore, the only way to interpret Turkish students' lower scores on the TIMSS than on the national assessments was to compare the distributions of the items belonging these specific content domains in the assessments. That is, the average and content-based numbers scores on the national assessments should be examined in terms of the frame of the TIMSS assessment to make sense of the scores of the latter. On the other hand, despite their low score in geometry in 2007, which was lower than their overall score, Turkish eighth graders scored 43 points gain in this area, which was the most significant gain in all average content scores (Table 2). Therefore, examining the reason why eighth graders' average geometry scores increased so dramatically is also useful to gain insight into the lack of improvement in the numbers content.

Table 3 shows the percentages of content-based items in OKS 2007 and SBS 2011 items as a result of the content analysis in regard to the TIMSS framework. Between these two assessments, there is a remarkable difference between the distribution of the items in numbers and geometry contents. On the one hand, while 24% of mathematics items in OKS 2007 assessment were based on numbers content, this ratio decreased by almost half in the SBS 2011 assessment, to 15%. Conversely, the percentage of the geometry items increased from 36% in 2007 to 50% in 2011. Additionally, there was a slight change in the proportion of algebra items, and data and chance items.

Table 3. Proportion of Items in OKS and SBS assessments according to the content domains of TIMSS

	OKS 2007		SBS 2011	
	f	%	*f*	%
Numbers	6	24	3	15
Algebra	8	32	6	30
Geometry	9	36	10	50
Data & Chance	2	8	2	10
Total	25	100	20	100

Table 4 provides the opportunity to compare the distribution of content domains among the national and the international assessments. In numbers content, while the percentage of the numbers items was closer in OKS 2007 with the TIMSS, it fell behind the TIMSS in SBS 2011. The importance of the numbers content in OKS 2007 declined to almost half in SBS 2011. And, there is no significant change in students' average scores in number content between TIMSS 2007 and 2011. On the other hand, geometry items in SBS 2011 constituted half of the total mathematics items, an increase from 36% in OKS 2007, while only 20% of the TIMSS items were geometry content based, both distribution of the items being significantly higher than the TIMSS distribution. Given that increases and decreases in the distribution of other content domains seem irrelevant to the changes in average scores. This increase in the importance of the geometry content in Turkish assessments may not be the only explanation for why students were successful in geometry content on the TIMSS, but it may help to understand this phenomenon.

Table 4. Percentage of Content Domains in Assessments (Mullis et al., 2009)

	Numbers	Algebra	Geometry	Data & Chance
TIMSS*	30%	30%	20%	20%
OKS 2007	24%	32%	36%	8%
SBS 2011	15%	30%	50%	10%

**TIMSS items were already classified by developers of the 2011 TIMSS framework.*

On the other hand, in algebra content, there is a very slight decrease (from 32% to 30%) in the percentage of the items between OKS 2007 and SBS 2011, while the percentage of algebra items in the TIMSS framework was 30% (Table 4). Despite the very close national percentages, students' TIMSS algebra scores significantly increased from 439 to 455 from 2007 to 2011 ($p < .05$) (Table 2). On the other hand, the increase from 431 to 467 in students' data & chance TIMSS scores between 2007 and 2011 ($p < .01$) may be related to the national increase of data & chance items from 8% to 10%, bringing it closer to the TIMSS's 20%. However, again, these could be related to the other factors as well. Further, only the ratio of geometry items in SBS 2011 is higher than the equivalent ratio in the TIMSS, which is also a likely explanation of the large gain in geometry average scores. However, there is still a possibility that students may simply be doing better in some categories than others regardless of the importance of the domain in the national assessment, indicating the need for average and domain-based scores in national assessments.

Results for the Cognitive Domains

Examining the content domains of each assessment provides at least a partial possible explanation of students' significant gain in geometry, and non-significance in numbers content domains. However, it is also essential to examine the changes in the distribution of the cognitive domains. Table 5 illustrates the changes in students' average scores in each cognitive domain between TIMSS 2007 and 2011, as well as their overall scores.

Table 5. Turkish Eighth Graders' Average Mathematics Scores on TIMSS 2007 and 2011 across Cognitive Domains (Martin et al., 2008; Mullis et al., 2012; NCES, 2015)

	Overall	Knowing	Applying	Reasoning
TIMSS 2007	432	434	423	436
TIMSS 2011	452*	441	459*	465*

*p <.01

Table 5 indicates that students' average scores in applying and reasoning cognitive domains increased significantly while there is no significant difference in their average scores in knowing cognitive domain. One question may arise: how are the distribution of these cognitive domains in the national assessments? Table 6 shows the categorization of the SBS and OKS items in terms of the cognitive domains of the TIMSS framework.

Table 6. Categorized Items in SBS and OKS assessments according to the cognitive domains of TIMSS 2011

	OKS 2007		SBS 2011	
	f	%	*f*	%
Knowing	8	32	10	50
Applying	9	36	5	25
Reasoning	8	32	5	25
Total	25	100	20	100

In addition to Table 6, Table 7 compares the distribution of the cognitive domains in Turkish assessments to those in the TIMSS. The only increase is in the knowing domain between the distributions in OKS 2007 and SBS 2011.

Table 7. Percentage of Cognitive Domains in Assessments Based on the TIMSS Framework (Mullis et al., 2009)

	Knowing	Applying	Reasoning
TIMSS*	35%	40%	25%
OKS 2007	32%	36%	32%
SBS 2011	50%	25%	25%

When considering the average scores in the cognitive domains (Table 5), Table 7 indicates that the average performance of Turkish eighth-graders increased in the applying and reasoning cognitive domains when the distribution of these domains decreased, and their performance did not significantly change in knowing cognitive domain while the distribution of the knowing cognitive domain items increased between 2007 and 2011 in the national assessments. It is necessary to indicate the fact that teachers and students give importance to the percentage of the items in the content areas of the previous placement tests while being prepared for their recent ones (Basturk, 2011). Since they focus only on the content areas of the items, while no attention paid to the cognitive base of the items, this disparate result may not be a surprise.

Discussion and Conclusion

To interpret Turkish eighth graders' TIMSS 2007 and 2011 mathematics results, this study compared the OKS 2007, SBS 2011 and TIMSS mathematics assessments in terms of the content and cognitive domains of the TIMSS 2011 framework. Although the overall average mathematics score of the Turkish eighth graders increased from 432 to 452 from 2007 to 2011 in TIMSS assessment, there was no significant increase in numbers content based score, while the other content domains (algebra, geometry, and data & chance) showed increases, especially a gain of 43 points in geometry (Table 2).

Uğurel et al. (2012) indicated similarities between TIMSS and Turkish assessments by examining them with the MATH taxonomy. However, experience with the examination through the TIMSS framework in this study indicates that the range of the content and cognitive domains in each assessment is not similar enough to the other to be counted as compatible. While the percentage of numbers content items decreased from 24% in OKS 2007 to 15% in SBS 2011, the percentage in TIMSS assessment is 30%; and the distribution of geometry items increased from 36% in 2007 to 50% in 2011 while only 20% of the TIMSS items were geometry content-based (Table 4). As a result, this study indicated that the national assessments were drastically changed between 2007 and 2011 in Turkey, in terms of the distribution of content and cognitive domains described in TIMSS 2011 framework. Of course, assessment developers did not have to consider TIMSS framework when creating a national assessment to place students into different types of high schools in Turkey; however, the drastic changes were still questionable. Based on the review of the national documents, it was not found any information for how national assessments were framed around the different content or cognitive domains. It is also possible that the information on the creation of these assessments may not be accessible. Nevertheless, it is suggested by the findings of this study that the items in the national assessments should base upon a framework, which may help to decrease the anxiety that students, teachers and parents have because of the placement tests.

Additionally, the changes in the distribution of the items belonging to content domains between OKS and SBS assessments may not fully explain why students performed differently because changes in patterns of the distribution appear irrelevant to the changes in average scores when considering overall. However, the change in the distribution of the numbers and geometry items in SBS looked relevant to the change in students' average scores in these two content domains. While the distribution of the numbers content domain decreased between OKS 2007 and SBS 2011, there is no significant difference between students' average scores in the number content domain between TIMSS 2007 and 2011, which is the only content domain having non-significant change. In addition, students' average scores increased drastically between TIMSS 2007 and 2011 in the geometry content domain when the distribution of the geometry items drastically increased from 36% to 50% between OKS 2007 and SBS 2011. Determining why geometry content is given such vital importance in Turkish assessments is a topic for further study.

Changes in the distribution of the numbers and geometry content-based items between the national assessments seem relevant to the changes in students' performances between the TIMSS international assessments in respective years. While OKS assessment was used in 2007 and SBS in 2011, placement tests were also replaced with TEOG in 2014 and LGS in 2018. These drastic changes in the placement tests were of course made to enhance the placement system of eighth-graders into the high schools; however, it should also be considered the negative psychological effects on students (Karabacak, 2013; Ministry of National Education, 2007b). Students, parents, educators and educational institutions heavily focus on these national assessments because of their pay vital importance in students' future education (Sarier, 2010). In addition, educational priorities are also developed by the highly consideration of the frame of the national assessments (Ministry of National Education, 2007b). Biber et al. (2018) indicated that the extent to which items distinguish students based on their mathematical skills was increased with the recent transition to LGS assessment in 2018. And, Erden (2020) stated that this distinctive enhancement in the national assessments may be caused by the increase in the given importance to TIMSS assessment, especially by teachers. Thus,

- national assessment developers should also give importance to the international assessments, especially TIMSS that is more curriculum-oriented, in addition to the teachers who highlight TIMSS assessment when preparing students to the national assessments,
- it is not only suggested to give importance to the international assessments when developing national assessments, but also to have a conceptual framework that strictly determines the content domains of the items in the national assessments, especially considering the fact that educational priorities are set within the frame of the national assessments (Ministry of National Education, 2007b) and students, parents, educators and institutions take these national assessments heavily into consideration (Sarier, 2010).

In terms of the cognitive domains, on the one hand, examining the percentages of cognitive domains in the assessment items, shows that there has been an increase only in the knowing domain, from OKS 2007 to SBS 2011. On the other hand, knowing domain was the only one that students' average score did not change significantly. In addition, while the distribution of the items in other cognitive domains decreased, students' average scores increased significantly (Table 7). This disparity may give hints to further researches. It may be possible that students and teachers might focus on the context of the questions in the previous placement tests. It is not said that they were aware of the cognitive background of the questions; however, focusing on the form of the questions from the previous national assessments might implicitly affect students and teachers. Therefore,

- teachers should also consider the cognitive domains that are described in TIMSS 2011 framework, in addition to the content domains, and
- test developers should also consider to have a conceptual framework that strictly describes the distribution of the cognitive domains across the items.

Researchers indicated so many factors affecting students' mathematics achievement (see Sadak, 2019). However, it is essential to know that placement tests are also significant influencers on students and teachers, especially in the centralized educational systems, such as Turkey (Kamens, & McNeely, 2010). When considering the drastic increase in the distribution of the geometry content items and decrease in the numbers content items between OKS 2007 and SBS 2011, it is not a surprise that their scores in geometry increased the most and scores in numbers did not change significantly between TIMSS 2007 and 2011, which is the only one students' scores were not increased significantly among all content domains. By all means, the change in the distribution of the items in these domains may not be powerful explanations for the change in students' performances; however, they may give some hints. Especially, the remarkable disparity between the change in the distribution of cognitive domains between the national assessments and the change in students' performances on these domains on TIMSS provides some hints. Inclusion of the international assessment aspects, at least raising awareness, through the national assessments may help educational systems to compete more successfully with their competitors around the world. Güner et al. (2013) indicated that approximately 48% of the participant teachers, the highest percentage in the study, had expected their students to succeed in numbers content, while only 36%, the lowest percentage, expected the same in geometry, in Turkey. However, the students' average scores refuted these expectations, suggesting the need for further research to determine the reasons for such incompatibility between expectations and reality. This also supports the claim that inclusion of more international assessment aspects in the classroom instruction would make difference in students' performances on these international assessments. Güner et al. (2013) also found that only 31% of the Turkish educators who participated in their study took the TIMSS assessment into consideration. This finding is critical to making sense of the students' performance on the TIMSS. It is essential for teachers to understand the importance of the TIMSS findings in order to use them in a productive way to improve students' success on the international assessment. One suggestion to the further researches, therefore, would be

- to look at the inclusion of these content and cognitive domains in the classroom instruction. How these domains are included in the instruction, especially through the problem-solving activities, could give more hints on students' performances on the international assessments. Considering the content and cognitive domains in the national assessment is not sufficient enough, they should also be considered in the classroom instructional activities.

REFERENCES

Basturk, S. (2011). Negative reflections of preparation process to the university entrance exam on students' mathematics learning. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *40*(40), 69-79.

Belfield, C. R., & Crosta, P. M. (2012). Predicting success in college: The importance of placement tests and high school transcripts. (Working Paper No. 42). New York, NY: Columbia University Community College Research Center

Biber, A. Ç., Tuna, A, Uysal, R., & Kabuklu, Ü. N. (2018). Liselere Geçiş Sınavının Örnek Matematik Sorularına Dair Destekleme ve Yetiştirme Kursu Matematik Öğretmenlerinin Görüşleri [Supporting and Training Course Teachers' Opinions on Sample Mathematics Questions of the High School Entrance Exam]. *Asya Öğretim Dergisi*, *6*(2), 63-80.

Elo, S., & Kyngas, H. (2008). The qualitative content analysis process. *Journal of advanced nursing*, *62*(1), 107-115.

Erden, B. (2020). Türkçe, Matematik ve Fen Bilimleri Dersi Beceri Temelli Sorularına İlişkin Öğretmen Görüşleri [Teachers' Views Related to Skill-Based Questions in Turkish, Mathematics and Science Lessons]. *Academia Eğitim Araştırmaları Dergisi*, *5*(2), 81-103.

Güner, N., Sezer, R., & İspir, O. A. (2013). İlköğretim ikinci kademe öğretmenlerinin TIMSS hakkındaki görüşleri [Elementary school teachers' opinion about TIMSS]. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, *33*(1), 11-29.

İncikabı, L. (2012). After the reform in Turkey: A content analysis of SBS and TIMSS assessment in terms of mathematics content, cognitive domains, and item types. *Education as Change*, *16*(2), 301-312.

Kamens, D. H., & McNeely, C. L. (2010). Globalization and the growth of international educational testing and national assessment. *Comparative Education Review*, *54*(1), 5-25.

Karabacak, K. (2013). The influence of secondary education entrance examinations practiced in Turkey (The Placement Test, SBS) on the students' social life. *Procedia-Social and Behavioral Sciences*, *106*, 2866-2878.

Kellaghan, T., & Greaney, V. (2001). *Using assessment to improve the quality of education*. Paris: UNESCO, International Institute for Educational Planning.

Krippendorff, K. (2004). *Content analysis: An introduction to its methodology* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Martin, M. O., Mullis, I. V., & Foy, P. (2008). TIMSS 2007 international mathematics report. *Findings from IEA's Trends in International Mathematics and Science Study at the fourth and eighth grades*. Chestnut Hill, Mass.: IEA, TIMSS &PIRLS.

Ministry of National Education. (2007a). 2007 OKS degerlendirmesi. [OKS 2007 assessment evaluation] [Online]. Retrieved on February 22nd, 2016 from:
http://edirne.meb.gov.tr/_belgeler/sinavlar/sbs/2007/2007_oks_basarisi.pdf.

Ministry of National Education. (2007b). 64 soruda ortaöğretime geçiş sistemi. [The transition to secondary education system at 64 questions] [Online]. Retrieved on November 9th, 2008 from: http://oges.meb.gov.tr/docs/64_soru.pdf.

Ministry of National Education. (2007c). OKS 2007 sınav soruları [OKS 2007 assessment items] [Online]. Retrieved on November 27th, 2014 from:
http://yegitek.meb.gov.tr/Sinavlar/Sorular/Ook/Ook2007/Oks2007_A.pdf.

Ministry of National Education. (2011a). Ortaöğretim kurumlarına geçiş sistemi, seviye belirleme sınavı e-başvuru kılavuzu [Transition system to secondary education, secondary education placement test e-application guideline]. [Online]. Retrieved on September 25, 2015 from: http://yegitek.meb.gov.tr/Sinavlar/Klavuz/2011/2011_SBS.pdf.

Ministry of National Education. (2011b). Ozel okullar [Private Schools]. [Online]. Retrieved on February 22nd, 2016 from:
http://mebk12.meb.gov.tr/meb_iys_dosyalar/21/15/967807/dosyalar/2013_03/20090107_ogess41nxpowerlite.pptx.

Ministry of National Education. (2011c). SBS 2011 sınav soruları [SBS 2011 assessment items]. [Online]. Retrieved on November 27th, 2014 from:
http://www.meb.gov.tr/duyurular/duyurular2011/egitek/sbs2011/sbs2011_8a.pdf.

Ministry of National Education. (2011d). SBS sisteminin tanıtılması [Introducing the SBS system]. [Online]. Retrieved on November 27th, 2014 from:

http://mebk12.meb.gov.tr/meb_iys_dosyalar/12/01/742616/dosyalar/2013_02/20020446 2013sevyebelrlemesınavısstemnntanıtılması.pptx.

Mullis, I. V., Martin, M. O., Foy, P., & Arora, A. (2012). *TIMSS 2011 International results in mathematics*. International Association for the Evaluation of Educational Achievement. Herengracht 487, Amsterdam, 1017 BT, The Netherlands.

Mullis, I. V., Martin, M. O., Ruddock, G. J., O'Sullivan, C. Y., & Preuschoff, C. (2009). *TIMSS 2011 assessment frameworks*. International Association for the Evaluation of Educational Achievement. Herengracht 487, Amsterdam, 1017 BT, The Netherlands.

NCES. (2015). National Center for Education Statistics, Trends in International Mathematics and Science Study International Data Explorer [online software]. Available from https://nces.ed.gov/timss/idetimss/

Neidorf, T. S., Binkley, M., Gattis, K., & Nohara, D. (2006). Comparing mathematics content in the National Assessment of Educational Progress (NAEP), Trends in International Mathematics and Science Study (TIMSS), and Program for International Student Assessment (PISA) 2003 assessments. Technical report. NCES 2006-029. *National Center for Education Statistics*.

OECD. (2006). *Education at a Glance 2006: OECD Indicators*. Paris: OECD Publishing.

Pektas, M. (2012). Grade 8 biology content in TIMSS and SBS: A comparison study. *Energy Education Science and Technology Part B: Social and Educational Studies, Special Issue*: 1088-1093

Postlethwaite, T. N. (2005). What do international assessment studies tell us about the quality of school systems. *Background paper for EFA global monitoring report*. Smith, G., Wood, L., Coupland, M., Stephenson, B., Crawford, K., & Ball, G. (1996). Constructing mathematical examinations to assess a range of knowledge and skills. *International Journal of Mathematical Education in Science and Technology*, *27*(1), 65-77.

Ritchie, J., & Spencer, L. (1994). Qualitative data analysis for applied policy research. In, Bryman A, Burgess RG (Eds.) *Analyzing Qualitative Data* (pp. 173-194). Abindgon: Routledge.

Sadak, M. (2019). *Teacher characteristics that predict students' mathematics achievement in European countries: An examination of TIMSS 2015 results using Hierarchical Linear Modeling* (Doctoral dissertation, Indiana University, Bloomington, IN, USA).

Sarıer, Y. (2010). Ortaöğretime giriş sınavları (OKS-SBS) ve PISA sonuçları ışığında eğitimde fırsat eşitliğinin değerlendirilmesi [An evaluation of equal opportunities in education in the light of high school entrance exams (OKS-SBS) and PISA results]. *Ahi Evran Üniversitesi Eğitim Fakültesi Dergisi*, *11*(3), 107-129.

Smith, G., Wood, L., Coupland, M., Stephenson, B., Crawford, K., & Ball, G. (1996). Constructing mathematical examinations to assess a range of knowledge and skills. *International Journal of Mathematical Education in Science and Technology*, *27*(1), 65-77.

Uğurel, I., Moralı, H. S., & Kesgin, Ş. (2012). A comparative analysis on the mathematics questions in OKS, SBS and TIMSS under the lens of MATH taxonomy. *Gaziantep University-Journal of Social Sciences*, *11*(2), 423-444.