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Investigating Science Content and Cognitive Domain Scores with regard to Low - and High - Performing Schools in Turkey

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Abstract

TIMSS (Trends in Mathematics and Science Study) which is a project of IAE (International Association for the Evaluation of Educational Achievement) was lastly conducted in 2011 and has drawn interest of many researchers with its fruitful data. 63 countries from all around the world participated TIMSS 2011 at fourth and eighth grade level. Turkey firstly participated this study in both fourth and eighth grade level at TIMSS 2011. Items in science achievement tests at both fourth and eighth grade levels in TIMSS are organized based on science content and cognitive domains. So, beside the average scores of the countries, TIMSS presents average scores with regard to science content and cognitive domains.

Investigating the countries' scores as a whole may trigger to overlook some detailed results which are very crucial for educational policy makers, school administrators, teachers, and students. In this study, school categories such as low-performing schools, medium-performing schools, and high performing schools were created to investigate Turkey's results more deeply. IDB (International Database) Analyzer, which was developed by IAE for analyzing data from IEA's large-scale assessments, was used to investigate the differences between low-performing schools, medium-performing schools, and high performing schools with regard to the students' science content domain scores and their cognitive domain scores at both fourth and eighth grade levels in Turkey. In addition, the aforementioned school groups were examined with respect to the percentages of students who answered science items correctly.

As a result of the analyses, it was found that in both fourth and eighth grade levels the earth science content domain scores relatively lower than the other domain scores for three categories of schools (low-, medium-, and high-performing school). In addition, surprisingly, the results revealed that fourth grade students' average reasoning domain scores are higher than students' both knowing and applying domain scores for three categories of schools. Moreover, the results revealed that even the students in high performing schools in Turkey have some difficulties to answer open-ended questions and reasoning items correctly at both fourth and eighth grade level in TIMSS 2011.

Keywords: TIMSS 2011, low-performing schools, high-performing schools, science cognitive domains, item difficulty.

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INTRODUCTION

International studies such as TIMSS (Trends in Mathematics and Science Study), PISA (Programme for International Student Assessment), and PIRLS (Progress in International Reading Literacy Study) have drawn attention of many researchers all around the world since their importance for education and having fruitful data. TIMSS (Trends in Mathematics and Science Study) which is a project of IEA (International Association for the Evaluation of Educational Achievement) is one of the most well known and largest comparative education studies to assess students' science achievement based on the curriculum of the countries. It was lastly carried out in 2011 and it was one of the chains of four years cycles. TIMSS 2011 included 63 countries from all around the world and encompassed approximately half of a million of students at fourth and eighth grade levels (Martin, Mullis, Foy, & Stanco, 2012).

Items in the science achievement tests that were applied in TIMSS 2011 were organized based on content and cognitive dimensions. The content domains at fourth grade levels are life science, physical science, and earth science which cover 45%, 35%, and 20% of the total items, respectively. In eighth grade level, the content domain was categorized as biology, chemistry, physics, and earth science which comprise 35%, 20%, 25%, and 20% of the total items, respectively. In addition, the cognitive dimension of the items included in TIMSS are categorized as knowing, applying and reasoning and cover 40%, 40%, and 20% of the total items for fourth grade, 35%, 35%, and 30% for eighth grade, respectively (Martin, Mullis, Foy, & Stanco, 2012).

Science Content and Cognitive Domains in TIMSS 2011

Since the majority of the countries' science curriculums cover most of the topics within the life science, physical science, and the earth science content domains for fourth grade and biology, chemistry, physics, and earth science content domains for eighth grade, TIMSS decided to organize the items based on these categorization. For the fourth grade level, the topics of the life science were defined as the characteristics and life processes of living things, life cycles, reproduction, and heredity, interaction with the environment; ecosystems, and human health; the topic of the physical science were defined as classification and properties of matter, sources and effects of energy, forces and motion; the topics of the earth science were defined as earth's structure, physical characteristics, and resources; earth's processes, cycles, and history, earth in the solar system. For the eighth grade level, the topics of the biology were defined as characteristics, classification, and life processes of organisms, cells and their functions, life cycles, reproduction, and heredity, diversity, adaptation, and natural selection, ecosystems, and human health; the topics of the chemistry were defined as classification and composition of matter, properties of matter, and chemical change, the topics of physics were defined as physical states and changes in matter, energy transformations, heat, and temperature, light and sound, electricity and magnetism, forces and motion; the topics of the earth science were defined as earth's structure and physical features, earth's processes, cycles, and

history, earth's resources, their use and conservation, earth in the solar system and the universe (Mullis, Martin, Ruddock, O'Sullivan, & Preuschoff, 2009).

The other categorization of the science questions for both fourth and eighth grades in TIMSS was based on the cognitive domains. The range of cognitive skills was divided into three domains based on what students have to know and do when confronting the various science items that developed for TIMSS 2011. The first cognitive domain which was labeled as knowing includes the need of students to know science facts, procedures, and concepts. The second cognitive domain is applying which covers the students' ability of applying knowledge and conceptual understanding to a science problem. The third domain is reasoning which focuses of unfamiliar situations, complex contexts, and multi-step problems instead of solution of routine science problems (Mullis, Martin, Ruddock, O'Sullivan, & Preuschoff, 2009).

School Effect on Academic Achievement

To ensure equality among schools, all the actors in educational system of the country should be investigated whether school difference in a country impacts students' academic achievement. Beside the contribution of international studies (TIMSS, PISA, and PIRLS) to compare the performance differences among countries, they also enable us to investigate the differences between schools in a country. The extent of the variation in the students' science performance with students attending different schools is one of the focal point of these international studies. With the scope of this aim PISA 2006 reports announced that one third of the variation in students' performances was between schools (OECD, 2007). TIMSS also expressed the explained variance of students' performances with schools (Schmidt, Jorde, Barrier, Gonzala, Moser, & Shimizu, 1996). In addition, in a meta-analyses research carried out based on 103 schools revealed that almost 18% of variance in achievement associated with school difference (Bosker & Witziers, 1996).

After the well-known Coleman report (Coleman, Campbell, Hobson, McPartland, Mood, Weinfield, & York, 1966), school effectiveness on students' achievement has drawn the attention of many researchers. In the literature whereas some researcher expressed the impact of school factors on students' achievements (Greenwald, Hedges, & Laine, 1996; Konstantopoulos, 2006), some could not find any relationship between school factors and students achievement Hanushek, 1986; 1989). In addition, how schooling impacts students' academic achievement have been the one of the aim of many researches in the literature (e.g.,Mortimore, Sammons, Stoll, Lewis, & Ecob, 1988; Teddlie & Stringfield, 1993).

Purpose and Significance of the Study

Examining the results of the TIMSS 2011 is very crucial for Turkey. Since Turkey was first time participated TIMSS 2011 for both fourth and eighth grade levels, Turkey's database should be analyzed very deeply to reveal the unexpected results for improving educational system. In addition, in both fourth and eighth grade level, it was revealed that whereas Turkey has some high-performing schools which

are among the high performing schools all around the world, Turkey also has some low-performing schools which are among the low-performing schools all around the world (Yildirim, Yildirim, Ceylan & Yetisir, 2013). Comparing these schools based on some issues such as science content domains and students' cognitive domains enable us to understand what makes a school more successful than the other ones.

In the light of the literature and the fruitful data that can be obtained from the TIMSS 2011 international database, a study was carried out to investigate the differences between low-performing schools, medium-performing schools, and low performing schools with regard to the students' science content domain scores and cognitive domain scores at both fourth and eighth grade levels in Turkey. In addition, in this study, the schools groups were examined with respect the percentages of students who answered science items correctly (item difficulty). For this aim, some released items were selected based on science content and cognitive domains, than these selected released items will be presented with their item difficulty indices in each school categories.

METHOD

Sample of the Study

63 countries from all around the world participated TIMSS 2011. In TIMSS 2011, two stage stratified cluster sampling in which the first stage involves the selection of schools with probability proportional to size and in the second stage one or more classes were selected randomly from the relevant grades in sampled schools was used (Martin, Gregor, & Stemler, 2000; Gonzales & Miles, 2001; Joncas, 2007). As a result of this sample design, 7479 students from 257 schools were sampled at fourth grade level. 3628 of these students are girls and 3851 of them are boys. In addition, 6928 students from 239 schools were sampled at eighth grade level. This grade level consisted of 3414 girls and 3514 boys.

Instruments

TIMSS 2011 Science Achievement Tests for fourth and eighth grade levels were used for this study. In the science achievement tests for fourth grade level, 205 questions were applied from three different science content domains (life science, physical science, and earth science) and three different cognitive domains (knowing, applying, and reasoning) by using various booklets. 85 items were released from the TIMSS 2011 science questions at fourth grade level. The number of the questions with regard to science content domains such as life science, physical science, and the earth science are 91, 75, and 39, respectively. In addition, 245 questions were applied from four different science content domains (biology, chemistry, physics, and earth science) and there different cognitive domains (knowing, applying, and reasoning) by using various booklets for eighth grade level. The number of the items that released after TIMSS 2001 is 100 at eighth grade level. The number of the items with respect to science content domains such as biology, chemistry, physics, and earth science are 88, 55, 60, and 42, respectively.

In TIMSS 2011 science assessment, IRT (Item Response Theory) scaling methods were used to describe TIMSS achievement measures. Although each student did not respond to all of the items, IRT enabled to obtain proficiency scores in science for all students by using multiple imputations or the "plausible values" method. So, five plausible values were generated for each student (Gonzales & Miles, 2001). In addition, the TIMSS 2011 data set not only included five plausible values for science achievement, but also provided five plausible values for each of the cognitive domains such as knowing, applying, and reasoning.

Analysis

IDB (International Database) Analyzer 3.0 was used to analyze the data. IDB Analyzer which was developed by the IEA Data Processing and Research Center (IEA-DPC) in Hamburg, Germany, is used for combining and analyzing data from IEA's large-scale assessments such as Trends in International Mathematics and Science Study (TIMSS). The IDB Analyzer enables us to handle the use of plausible values. The SPSS code which is generated by IDB Analyzer is used to calculate estimates of achievement and their corresponding standard errors, combining sampling and imputation variance. Descriptive statistics and statistical hypothesis testing among groups can be carried out without having to write any programming code (IAE, 2012).

The achievement level of the students in TIMSS reported based on IRT (Item Response Theory) between 0 and 1000 values. But, the great portion of the scores distributed between 300 and 700. In TIMSS, this scale was divided into four benchmarks (400, 475, 550, and 625) to make this scale more useful for the education community. And, the knowledge and skills were defined to the corresponding scale intervals. These definitions described as the competency levels of the students. In this study, the schools which participated TIMSS 2011 in Turkey were categorized as this competency levels. Firstly, the schools average achievement score were calculated at both fourth and eighth grade level. Then, the schools' averages which were under the benchmark of 400 were defined as "low-performing schools", the schools averages which were above the benchmark of 550 were labeled as "high performing schools". In addition, the rest of the schools were labeled as "medium-performing schools". Table 1 presents the schools distributions and the percentages of students in these schools in Turkey at both fourth and eighth grade level.

Table 1. School and student percentages

	Low-performing Schools (under 400)				**Medium-performing Schools (400-550)**				**High-performing Schools (Above 550)**			
	School %	SE	Student %	SE	School %	SE	Student %	SE	School %	SE	Student %	SE
4th grade	22	(5.4)	15	(2.4)	71	(5.3)	75	(2.8)	7	(1.9)	9	(1.9)
8th grade	8	(2.6)	6	(1.5)	84	(3.1)	81	(2.7)	8	(1.9)	13	(2.2)

RESULTS

As mentioned earlier, firstly, IDB Analyzer was performed to examine the differences between school categories (from low-performing to high performing schools) with regard to science content domains for fourth and eighth grade students in Turkey based on TIMSS 2011 science achievement data.

As indicated in Table 2, the average scores were produced based for low-performing, medium-performing and high-performing schools with respect to fourth grade science content domains such as earth science, life science, and physical science. It was revealed in Table 2 that the average score of Turkey for all schools is 463. Science content scores such as earth science, life science, and physical science which are 456, 460, and 466, respectively do not show any big difference with each other. On the other hand, the earth science content domain's average scores for low-performing, medium performing, and high performing schools which are 338, 466, and 569, respectively show a tendency to be lower when compare to the total average scores of each school categories.

Table 2. Students' average scores with regard to science content domains (4th grade)

	School Level	**All Questions**		**Earth Science**		**Life Science**		**Physical Science**	
		Av. Score	SE	Av. Score	SE	Av. Score	SE	Av. Score	SE
4th grade	Low	353	(11.8)	338	(13.7)	354	(11.4)	357	(12.6)
	Medium	472	(2.8)	466	(3.6)	470	(3.1)	476	(3.3)
	High	566	(4.7)	569	(7.0)	559	(5.8)	572	(6.2)
	Turkey	463	(4.5)	456	(5.1)	460	(4.5)	466	(4.7)

Table 3 indicated eighth grade students' average scores for low-performing, medium-performing, and high-performing schools with respect to science content domains such as biology, chemistry, physics, and earth science. As shown in Table 2, the average score of Turkey for all schools at eighth grade level is 483. Science content domains average scores such as biology, chemistry, physics, and earth science for all schools in Turkey are 484, 477, 494, and 468, respectively. Science content domain average scores of earth science for low-performing, medium-performing, and high-performing schools are 374, 462, and 558, respectively.

Table 3. Students' average scores with regard to science content domains (8th grade)

	School Level	**All Questions**		**Biology**		**Chemistry**		**Physics**		**Earth Science**	
		Av. Score	SE	Av. Score	SE	Av. Score	SE	Av. Score	SE	Av. Score	SE
8th grade	Low	372	(6.0)	367	(5.8)	358	(8.2)	380	(6.4)	374	(6.5)
	Medium	476	(2.7)	476	(3.1)	469	(3.3)	487	(3.0)	462	(3.1)
	High	586	(9.8)	592	(10.1)	589	(12.4)	601	(10.6)	558	(9.3)
	Turkey	483	(3.4)	484	(3.7)	477	(4.0)	494	(3.7)	468	(3.5)

Second, IDB Analyzer was run to investigate the differences between school categories (from low-performing to high performing schools) with respect to science cognitive domains for fourth and eighth grade students in Turkey based on TIMSS 2011 science achievement data.

Fourth grade students' average scores for low-performing, medium-performing, and high-performing schools with regard to science cognitive domains were presented in Table 4. The average score of all schools in Turkey was found 463. Fourth grade students' science cognitive domain such as knowing, applying, and reasoning average scores are 457, 463, and 472, respectively. Surprisingly, the reasoning cognitive domain score was found relatively higher than knowing and applying cognitive domain scores for low-performing, medium-performing, and high performing schools.

Table 4. Students' average scores with regard to science cognitive domains (4^{th} grade)

	School Level	**All Questions**		**Knowing**		**Applying**		**Reasoning**	
		Av. Score	SE	Av. Score	SE	Av. Score	SE	Av. Score	SE
4th grade	Low	353	(11.8)	349	(12.4)	357	(13.0)	364	(13.6)
	Medium	472	(2.8)	466	(3.3)	472	(3.2)	481	(3.9)
	High	566	(4.7)	561	(5.6)	567	(6.5)	576	(6.1)
	Turkey	463	(4.5)	457	(4.7)	463	(4.8)	472	(5.3)

Eighth grade students' averages scores for low-performing, medium-performing, and high-performing schools with respect to science cognitive domains were presented in Table 5. The average score of all schools in Turkey for eighth grade level was found 483. As indicated in Table 5, the low-performing and medium-performing schools' reasoning scores which are relatively higher than their average knowing and applying science cognitive scores were found 375 and 477, respectively. On the other, at eighth grade level, high-performing schools' average reasoning cognitive scores relatively higher than average applying cognitive score but lower than knowing average cognitive score.

Table 5. Students' average scores with regard to science cognitive domains (8^{th} grade)

	School Level	**All Questions**		**Knowing**		**Applying**		**Reasoning**	
		Av. Score	SE	Av. Score	SE	Av. Score	SE	Av. Score	SE
8th grade	Low	372	(6.0)	370	(6.7)	370	(6.0)	375	(5.5)
	Medium	476	(2.7)	481	(3.1)	470	(2.9)	477	(3.0)
	High	586	(9.8)	605	(11.9)	579	(10.1)	579	(9.1)
	Turkey	483	(3.4)	490	(3.8)	478	(3.4)	483	(3.4)

As indicated above, surprising and unexpected results were found when the average scores were examined by dividing the whole country into school categories with respect to their average performances in TIMSS 2011. These results will be discussed in detail in next section of this article.

Third, IDB Analyzer was carried out to investigate selected released items correctly answered percentages, in another word, their item difficulty indices in low-performing, medium performing, and high-performing school categories. Having categorized in different science content and cognitive domains was taken into consideration for selection of the released science items in for both fourth and eighth grade level. The selected items and percentages of students who correctly answered the selected items in low-performing and high-performing schools are presented below as examples in Tables for fourth grade level (TIMSS, 2013).

Table 6. Example of an item for Fourth Grade Level from TIMSS 2011 (S041178)

Plants use energy directly from the sun. What do they use the energy from the sun for?

A. to make food
B. to disperse seeds
C. to fertilize the soil
D. to prevent insect damage

The content domain of this item was labeled as life science, the cognitive domain of this item is defined as applying, and the topic area of this item is determined as ecosystems. Table 6 revealed the item difficulty indices for low- and high-performing groups, and also in other groups.

Table 7. Percentages of students answered item correctly (S041178)

Percentage of Correctly Answered Items					
Low-Per. Sch.	High-Per. Sch.	Turkey	TIMSS Av.	Highest country	Lowest Country
0.62	0.93	0.73	0.51	Korea (0.93)	Denmark (0.08)

62% of the students in low-performing school answered this item correctly. This value is higher than TIMSS international average which is 51%. As indicated in Table 7, Turkey average (73%) for this item is higher than international average.

Table 8. Example of an item for Fourth Grade Level from TIMSS 2011 (S041201A)

The picture below shows a river flowing across a plain.

Farming is carried out on the plain and near the river. There are advantages and disadvantages to along a river.

A. Describe one advantage.
B. Describe one disadvantage.

The content domain of this item is earth science, cognitive domain of this item was determined as applying, and the topic areas which covered by this item specified as earth structure, physical characteristics, and resources. Table 7 presented the correctly answered percentages of students for this item in specific groups.

Table 9. Percentages of students answered item correctly (S041201A).

Percentage of Correctly Answered Items					
Low-Per. Sch.	High-Per. Sch.	Turkey	TIMSS Av.	Highest country	Lowest Country
0.20	0.60	0.36	0.42	Korea (0.83)	Yemen (0.03)

20% of the students in low-performing schools and 60% students in high-performing schools were answered this item correctly. 36% of the students in Turkey answered this item correctly. This percentage is relatively lower than the percentage of all students in TIMSS 2011 who answered this item correctly (42%).

The selected items and the percentages of students who answered these items correctly in low- and high-performing schools are presented as examples and tables for eighth grade levels (TIMSS, 2013).

Table 10. Example of an item for Eighth Grade Level from TIMSS 2011 (S042095)

Robert put two drops of indicator into vinegar, and the color turned to red. He then added drops of ammonia solution until the color disappeared. What process occurred? A. rusting B. melting C. evaporation D. neutralization

The content domain of this item is chemistry, cognitive domain of this item was determined as knowing, and the topic area of this item defined as properties of matter. Table 7 presented the correctly answered percentages of this item in specific groups.

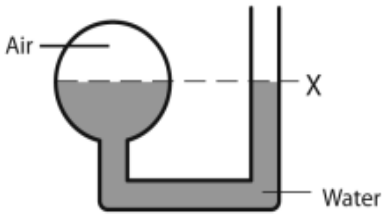
Table 11. Percentages of students answered item correctly (S042095)

Percentage of Correctly Answered Items					
Low-Per. Sch.	High-Per. Sch.	Turkey	TIMSS Av.	Highest country	Lowest Country
0.61	0.82	0.69	0.67	Ch. Taipai (0.91)	Ghana (0.34)

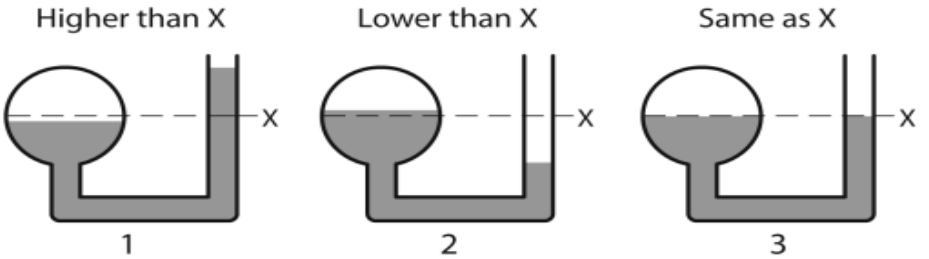
As indicated in Table 11, 61% of the students in low-performing schools and 82% of the students in high-performing schools answered this item correctly. Percentage of students who answered this item correctly in Turkey (0.69) is relatively higher than percentages students who answered this item correctly in all countries (67%).

Table 12. Example of an item for Eighth Grade Level from TIMSS 2011 (S032272)

The figure shows a glass tube open at one end and connected to a closed glass sphere at the other end. The equipment is partly filled with water, as shown, so that there is air above the water in the sphere. The water in the tube reaches level X.



The air in the glass sphere is then heated by a hair dryer. What will be the water in the open glass tube after the sphere is heated? (Circle 1, 2, or 3 below.)



Explain your answer.

The content domain of this item is physics, the cognitive domain of this item was defined as reasoning, and topic areas of this item correspond to energy transformation, heat, and temperature. Table 13 presented the correctly answered percentages of this item in specific groups.

Table 13. Percentages of students answered item correctly (S032272)

Percentage of Correctly Answered Items					
Low-Per. Sch.	High-Per. Sch.	Turkey	TIMSS Av.	Highest country	Lowest Country
0.02	0.28	0.11	0.13	Singapore (0.45)	Ghana (0.01)

As indicated in table 13, 2% of the students in low-performing schools answered this item correctly. Percentage of the students who answered this item correctly in high-performing schools (28%) is relatively lower than percentage of students who answered this item correctly in Singapore (45%) which have the highest percentage.

CONCLUSIONS AND RECOMMENDATIONS

The purpose of the study was to investigate school categories such as low-performing schools', medium-performing schools', and low-performing schools' average scores with regard to science content and cognitive domains at both fourth and eighth grade level in Turkey at TIMSS 2011. In addition, some items were selected from TIMSS 2011 science released items at both fourth and eighth grade levels and analyzed based on the students' percentages of correct answers to these items in specific groups such as in low-performing schools, high performing schools, Turkey, all countries in TIMSS 2011 etc.

At the beginning of the study, the school categories were created based on benchmark scores revealed by TIMSS. Based on this categorization, for fourth grade level, 22% of the school labeled as low-performing schools, 71% of the school labeled as medium-performing schools, and 7% of the schools were named as high-performing school. The percentages of students that corresponds this school percentages are 15%, 75%, and 9%, respectively. For eighth grade level, it was found that low performing schools includes 8% of the schools, medium-performing schools covers 84% of the schools, and high-performing schools includes 8% of the schools. The corresponding student percentiles were found 6%, 81%, and 13%, respectively (Table1). These categorization results indicate that most of the schools gathered under the medium-performing schools. It can be concluded that medium-performing schools have a great contribution to characterize Turkey in TIMSS 2011. In addition, having high-performing schools means that Turkey has approximately 7-8% schools which of these school averages in science are higher than 550. In other words, it can be concluded that some of the schools in Turkey have a higher average score than some of high-performing countries' schools. On the other hand, at fourth grade level, Turkey has 22% schools which of these school averages in science are lower than 400. At eighth grade level, 8% of the schools have average scores in science below 400. These are the scores lower than most of low-performing countries' schools.

The first analyze was conducted with regard to science content domain at both fourth and eighth grade levels. In both fourth and eighth grade levels the earth science content domain scores relatively lower than the other domain scores for three categories of schools (low-, medium-, and high-performing school). The reason of this result should be examined carefully. Since this domain's low score was found for all categories of schools, this problem should be carefully examined by considering the curriculum, course book, and instructional practices in classrooms. In Turkey's science curriculum, the earth science concepts located at the end of year period. This may cause some decrease in students' and teachers' motivations.

The second analyze was carried out with respect to science cognitive domains for three categories of schools at both fourth and eighth grade levels. As realized from the science cognitive domains definitions, knowing domain includes some basic and easy activities when compared with applying and reasoning cognitive domains. In this study, surprisingly, the results revealed that fourth grade students average reasoning domain scores are higher than students' both knowing and applying domain scores for three categories of schools. This result means that students can

correctly answer some items that require applying scientific principles to solve science problems, developing some explanations. The striking thing is; they can demonstrate these skills without having scientific facts, scientific concepts, and knowledge about scientific methodology. The reason of this result should be investigated carefully by considering the curricular issues and especially the activities that employed in the science classrooms at fourth grade level. When the cognitive domain scores examined at eighth grade level for three types of schools, as it is expected, the average knowing cognitive domain score is higher than the other cognitive domains for three types of schools (low-, medium-, and high-performing schools).

The third analyze was conducted to investigate the percentage of students who answered the selected items correctly in low-performing schools and high-performing schools at both fourth and eighth grade level. At fourth grade level, the percentage of science items answered correctly were found 28%, 45%, and 62% for low-performing schools, medium-performing schools, and high-performing schools, respectively. In other words, the number of items answered correctly in high-performing schools more than twice of the number of items answered correctly in low-performing schools. At eighth grade level, the percentage of science items answered correctly were found 27%, 43%, and 63% for low-performing schools, medium-performing schools, and high-performing schools, respectively.

When the items are examined with respect to their item difficulties (percentage of students who answered the item correctly), it was concluded that some items were answered correctly by majority of the students in low-performing schools, some items were answered correctly by majority students in high-performing schools. On the other hand, it was detected that some of the items could not be answered correctly by majority of students in both low- and high-performing schools at both fourth and eighth grade levels. This was taken into consideration when the examples of the science items were selected. For example, at fourth grade level, the example in Table 6 is a typical example to conclude that multiple-choice items in knowing cognitive domain can be answered by majority of students in low-performing schools (62%). However, if an item is an open-ended item in higher cognitive domain (in applying or reasoning), the percentage of students who answered it correctly is getting decrease. For example, the example in Table 8, which is an open-ended item in applying cognitive domain, the percentage of students who answered this item correctly was found 20% in low-performing schools. But, in the high performing group, the percentage of students who answered this item correctly remain relatively high (60%).

When the example items for eighth grade level are examined (in Table 12), students in high-performing schools also have some difficulties to answer the open-ended items in reasoning cognitive domain correctly. The percentage of students who answered the item in Table 12 correctly is 28% in high-performing schools. When it is compared to the percentage of students who answered this item correctly in Singapore (45%), the percentage of students in high-performing schools is relatively low. The reason of this problem may be triggered by the national examination in Turkey (called as SBS) which includes only multiple-choice questions. Students in

Turkey, especially at eighth grade level, are familiar to do multiple-choice questions during the preparation.

Finally, the analyses that were carried out for this study revealed some unexpected results discussed above. Investigation of the average score of students in various schools demonstrated some hidden results that cannot be seen by focusing the average score of whole country. Therefore, subgroups in Turkey, like various school categories, should be carefully analyzed by researchers. In addition, qualitative studies should be designed in the light of these kinds of studies results.

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Fen Öğrenme Alanlarındaki ve Bilişsel Alanlardaki Puanların Türkiye'de Bulunan Alt ve Üst Düzeydeki Okullara göre İncelenmesi

Özet

TIMSS (Uluslararası Fen ve Matematik Eğilimleri Çalışması) en son 2011 yılında gerçekleşmiş ve sağlamış olduğu veri seti ile dünyada birçok araştırmacının dikkatini çekmiş, IAE tarafından gerçekleştirilen bir çalışmadır. Dünya genelinde 63 ülkenin katıldığı bu çalışma dördüncü ve sekizinci sınıf öğrencilerini kapsamaktadır. Türkiye ilk defa bu çalışmaya hem dördüncü hem de sekizinci sınıf düzeyinde 2011 yılında katılmıştır. TIMSS fen başarısı testinde kullanılan sorular fen öğrenme alanlarına ve bilişsel alanlara göre geliştirilmektedir. Böylece ülkelerin ortalama puanları yanında TIMSS öğrenme alanlarında ve bilişsel alanlarda da puanlar üretilmektedir.

Ülkelerin ortalama puanlarını bir bütün olarak incelemesi eğitim politikacıları, okul idarecileri, öğretmenler ve öğrenciler için çok önemli sonuçların gözden kaçmasına neden olabilir. Bu çalışmada, Türkiye'nin TIMSS'deki sonuçlarını daha kapsamlı incelemek için okullar alt, orta ve üst düzey okullar olmak üzere üçe ayrılmıştır. Ayrılan bu alt, orta ve üst düzey okulları, dördüncü ve sekizinci sınıf düzelerindeki öğrenme alanlarındaki ve bilişsel alanlardaki ortalama puanlarına göre incelemek ve farkları ortaya koymak için IAE nin geliştirmiş olduğu "IDB Analyzer" isimli bir program kullanılmıştır. Ayrıca belirtilen bu okullar soruları doğru cevaplayan öğrencilerin yüzdelerine göre de incelenmiştir.

Sonuçlara göre, dördüncü ve sekizinci sınıf düzeylerinde yeryüzü bilimleri alt öğrenme alanındaki ortalama puanlar diğer öğrenme alanlarına göre üç okul düzeyinde de düşük bulunmuştur. Bununla beraber, dördüncü sınıf düzeyinde her üç düzey okullarda bulanan öğrencilerin akıl yürütme bilişsel alanındaki ortalama puanları diğer iki bilişsel alandaki ortalama puanlarına göre daha yüksek bulunmuştur. Son olarak sonuçlar, üst düzey okullarda bulunan öğrencilerin hem dördüncü sınıf hemde sekizinci sınıf düzeyinde açık uçlu soruları doğru yapmakta zorlandıklarını göstermektedir.

Anahtar Sözcükler: TIMSS 2011, alt-düzey okullar, üst-düzey okullar, bilişsel alanları, soru güçlüğü.