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Prof. Dr. Paşa YALÇIN (Ed.)

Focus of Educational Sciences and Future Perspective



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Comparison of Questions in Secondary School Science Course and TIMSS Science Questions

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INTRODUCTION

In the century we live in, the competitive environment that is increasing day by day in all areas in the world forces developed and developing countries to achieve sustainable development. It can be said that these developments in the world have also deeply affected the education system. Its success in international examinations in the field of education is a factor that determines the development level of the society and compares its own education program with other countries (Maya, 2013). These countries, which do not want to fall behind in the technological race, have found the solution to give importance to fields such as science and mathematics and to improve education in line with this importance (Çepni, Ayas, Johnson, & Turgut, 1997). In today's world, it is necessary to develop an understanding of science so that students can make informed decisions.

It is aimed to raise individuals who do not use information directly but produce it, who make this information functional in their daily life, who can produce solutions to problems, who think critically, who are entrepreneurs, who are decision makers, who have effective communication skills, who can use their empathy skills, who contribute to the society and culture of that society (MEB, 2018). Raising individuals suitable for the age is very important for the development of countries. Raising individuals with the specified characteristics has revealed that the impact of science is high and that science education programs should be constantly developed and updated (Ayas, 1995). One of the clearest indications of this is that the curriculum is updated by making changes in science education in parallel with the developments in the world. While preparing the program, international exams such as TIMSS and PISA are taken into account. Since TIMSS and PISA exams are an area where countries can see the similarities and differences of their education and training policies with other countries in the international platform, they are a guide for program managers (İdin & Kaptan, 2017).

In our country, updates and changes are made in the science curriculum in accordance with the conditions of the period. The MEB made changes in the direction of improvement in the science curriculum in 1968, 1992, 2000, 2004 and 2018.

The most recently updated curriculum came into effect in 2018. When the new program is examined, it can be said that it is similar to the 2013 program in terms of important aspects such as teaching strategy, weekly course hours and low number of achievements. With the changes made in the program in 2018, the concept of STEM (science-technology-engineering-mathematics) was included in the program as Science and Engineering Applications. Simplifications were made in the explanations of the units and an effort was made to use clear expressions. The content of the achievements has been emphasise. Values education was implicitly included in the program, where the role of the teacher was highlighted. Attention was paid to associating the achievements with life, the subjects that could attract the attention of each individual and arouse curiosity were emphasized, and the gains were lightened in a way to prevent information overloads that could cause escaping from science. In the context of 21st century skills, innovative and entrepreneurial thinking skills are come into prominence as well as scientific process and life skills. The students learning process includes the skills of exploring, questioning, creating arguments and designing products. In addition, the curriculum serves to provide students with opportunities in the learning environment that allow students to express themselves in writing, verbally and visually, and to develop their communication and creative thinking skills (MEB, 2018).

The International Science and Mathematics Trends Survey (TIMSS), one of the studies conducted in the light of all this information, is a study that has been repeated every 4 years since 1995 and is carried out by the International Association for the Evaluation of Educational Achievement (IEA), which conducts international assessment and evaluation studies. The TIMSS

exam was implemented to 4th and 8th grade students for the first time in the world in 1995. Turkey did not participate in the TIMSS exam held in 1995 and 2003. Turkey participated in the 1999 and 2007 exams only at the 8th grade level, and the 2011, 2015 and 2019 exams at the 4th and 8th grade levels. 47 countries at the 4th grade level and 39 countries at the 8th grade level participated in the TIMSS 2015 exam. 58 countries at the 4th grade level and 39 countries at the 8th grade level participated in the TIMSS 2019 exam. It has been determined that the average age of the students of the countries participating in TIMSS at the fourth grade level is 10.2. Since the average age of the students attending the fourth year level in Turkey is 9.7 and the average age of the fifth year students in Turkey is 10.6, it is closer to the TIMSS average age, as well as Norway and South Africa, the fourth grade application of the TIMSS 2019 cycle is also applied to the fifth grade students from Turkey. Students participated (Mullis et al, 2020; MEB. 2020).

TIMSS applications evaluate the achievements of students in the 4th and 8th grades of the countries participating in this exam in the fields of science and mathematics. Since the data obtained from the study provides detailed information about the successful teaching practices and curricula of the participating countries, it guides education administrators, curriculum developers and researchers in changing and renewed education policies (Bayraktar, 2010).

The general purpose of TIMSS is; To measure the achievements of 4th and 8th grade students in the fields of mathematics and physical sciences in the countries participating in the research, to determine and evaluate how education and training takes place in schools, the effectiveness and efficiency of the education system, and the differences between the education systems of the countries. For this purpose, by using achievement tests and various questionnaires, information about students performance in sciences and mathematics, education systems, curriculum, student characteristics, teachers and school characteristics are collected (Yıldırım, Özgür, Parlak, Gönen, and Polat 2016).

In the modeling study developed by Bos and Kuiper (1999) to determine the factors affecting the mathematics achievement of eighth grade students, they examined the education systems of European countries participating in the TIMSS-R (Third International Study of Mathematics and Science-Repeat). According to the results of the research, it was determined that out-of-school activities have negative effects on success, while home education and attitudes towards mathematics have positive effects on success.

Berberoğlu, Çelebi, Özdemir, Uysal, and Yayan (2003) analyzed Turkey data obtained from TIMSS with linear structural modeling method in order to reveal the factors determining the success of eighth grade students in science and mathematics. According to the results of the study, it was seen that the factors that most affect mathematics and science achievement are students' perception of success and failure and socio-economic level.

Kılıç-Bağcı (2002) In the study, in which the TIMSS 2000 report examines the field of science and Turkey's data from other countries are compared, the factors causing Turkey's failure in TIMSS, the scarcity of hours allocated to science lessons, the effort to teach many subjects, the scientific research and the low attention given to the nature of science. In addition, since most of the questions asked to students in TIMSS aim not only to measure knowledge but also to measure performance, the fact that this exam may have been foreign to our students is shown as the reasons for Turkey's failure in TIMSS.

In their study using the TIMSS database, Papanastasiou and Zembylas (2004) examined a model covering different student characteristics for Australia, Southern Cyprus and the USA in order to determine the factors affecting students' attitudes towards physical sciences "locally" and evaluated the results in terms of cultural characteristics. According to the results of the research, it has been seen that physical science achievement and attitudes towards physical sciences have different effects on each other depending on the characteristic education system of each

country. As a result of the study, a negative relationship was found between Australian, USA and Southern Cypriot students attitudes towards science and their TIMSS science scores.

Bayraktar (2010) in his study titled "State of Science Education in Turkey According to the Results of the International Science and Mathematics Study (TIMSS 2007): Factors Affecting Science Achievement", based on the data of the TIMSS 2007 study and the data on science achievement in 8th grades, examined the factors affecting science achievement. He states that science achievement is related to variables such as the development level of countries, the time allocated to science lessons, the education level of parents, computer and internet access, self-confidence in learning science, and attitudes towards science, and provides statistical information about these variables. It has been stated that the time allocated to science teaching in Turkey is an important factor affecting science achievement.

Karamustafaoğlu, Sontay (2012) took the views of the students who participated in TIMSS 2011 and the teachers who took part in the application about TIMSS. In the findings of the research, it was stated that the students were not generally ready for the TIMSS 2011 exam at the desired level, and especially because the 8th grade students took time to prepare for the Placement Exam, they could not prepare for TIMSS as much as the 4th grade students. It has been revealed that the questions in the TIMSS exam are based on interpretation rather than information, and the open-ended questions make it difficult for the students. It is among the results obtained in the study that the awareness of the practicing teachers about TIMSS is very low, the briefing with the teacher is made very shortly before the exam, and the teachers cannot spare much time to prepare the students for the TIMSS 2011 exam due to the anxiety of educating the curriculum.

Oral and Mcgivney (2013) also investigated the determinants of student performance in the fields of science and mathematics in Turkey according to the results of TIMSS 2011. In this study, the main factors affecting student success in direct proportion are

the availability of books, computers and internet at home, the language spoken at home is Turkish, the education level of the parents is high, the school is located in a socioeconomically advanced region, and course materials and school facilities are not available, determined to be in good condition.

According to the results of the International Science and Mathematics Study (TIMSS 2011) conducted in 2011, Abazaoğlu, Yıldızhan and Yıldırım (2014) reveal the state of Turkey in science education by comparing with the overall success average of the countries participating in the study. For this reason, the reasons affecting students' science achievement in eighth grades in TIMSS 2011 were examined. According to TIMSS 2011 results, Turkey ranked 21st among 42 countries in science achievement. Research results, countries' economic level, school safety and discipline, population density of the school location, computer and internet access, etc. They concluded that the factors affect science learning.

PURPOSE OF THE RESEARCH

According to the TIMSS exam results, Turkey's ranking below the average among other countries is seen as a failure criterion. One of the main reasons for this failure is thought to be due to whether the questions in the textbooks and the measurement tools used by the teachers to measure the students' learning measure the common achievements with the TIMSS exam questions in terms of their qualities.

For this reason, the aim of the research is to compare the unit evaluation questions in the secondary school science textbook and the written exam questions prepared by the teachers and the TIMSS exam science questions in terms of content.

PROBLEM STATEMENT OF THE RESEARCH

In this research, the questions asked in the secondary school science course and TIMSS science were compared. In this context, answers to the following sub-problems were sought.

1. What are the similarities and differences between TIMSS outcomes and Science Curriculum outcomes?

2. What is the relationship between written exam questions and TIMSS proficiency levels?

3. What is the relationship between the questions in the textbook and TIMSS proficiency levels?

4. Do teachers know about the TIMSS exam?

IMPORTANCE OF RESEARCH

TIMSS exam, which is the International Research on Mathematics and Science Trends, has high international validity and allows many countries to update their own education programs and to compare them with the education programs of other countries. In the light of the data obtained, it is important for countries that have problems in education and trying to take innovative steps in this regard that the results of the exams and the results are capable of responding to the problems of the education systems of the countries in terms of more than one factor

Turkey took the TIMSS exam at the 8th grade level in 1999 and 2007, and at the 4th and 8th grade levels in 2011. When the results up to 2015, including the 2011 TIMSS for which the evaluation results are announced, are analyzed, it is seen that Turkey's TIMSS scores are below the TIMSS general success average (Yıldırım et al, 2013). Education is a very important factor in the creation of a sustainable competitive power in the international arena and in the economic development and development of the country. For this reason, the investments made by each country in education are aimed at ensuring quality in education and increasing awareness of education problems. Thus, while the education level of the society increases the development of the country, it also affects the success in international exams (Maya, 2013). International educational research such as TIMSS provides data for the innovations made by the policy and educational reform makers of the countries to increase the scientific literacy

of the society. TIMSS presents a general map, collecting information about the functionality of national and international learning and teaching practices of the participating countries (Abazaoğlu et al, 2015). In particular, the aim of science education is to train individuals to be equipped to continue their lives in accordance with the requirements of the age. However, another aim is to make individuals realize that science is necessary for technological innovations and developments (Hançer et al, 2003).

METHOD

In the research, qualitative research method, case study and content analysis method were used as research pattern. In this study, using the content analysis method, the common and different points between the TIMSS achievements, 2013 and 2018 Science Course achievements were examined, the written exam questions prepared by secondary school

teachers and the questions in the secondary school science textbooks were compared with the TIMSS exam questions. In addition, semi-structured interviews were conducted with 12 science teachers working in secondary schools to obtain information about teacher awareness about the TIMSS exam and what attention was paid in the process of measuring and evaluating the achievements in the current program.

In the study, 118 achievements of TIMSS were examined in order to compare the TIMSS achievements with the 2013 and 2018 Science curriculum. TIMSS outcomes have been prepared in the subject areas of biology, physics, chemistry and earth science by targeting the cognitive areas of knowing, applying and reasoning. While making the comparison, the acquisitions in the secondary school science curriculum were made considering that they contain similar objectives with the TIMSS exam achievements. When the outcomes were examined, it was determined that the TIMSS outcomes and science teaching outcomes had the same target content to a large extent, but the

application levels were different. It was seen that there were similar gains in the 2013 science curriculum and 2018 science curriculum, but the content of the curriculum prepared in 2018 was simplified and the grade levels of the acquisitions were changed according to the 2013 curriculum. The achievements of TIMSS were compared with the achievements in the science curriculum. In line with the data obtained, it was seen that 81.08% of the students had similar achievements in the field of biology, 81.81% in the subject of chemistry, 96.96% in the field of physics, and 88% in the field of earth science.

There are gains that are included in TIMSS but not in the science curriculum. This situation is thought to be a factor that causes low success in the TIMSS exam science subject area. 2013 science curriculum and 2018 science curriculum are similar to each other in terms of achievements.

Looking at the content of TIMSS learning outcomes, there are 36 outcomes in biology, 23 in chemistry, 33 in physics, and 25 in earth science. These achievements were compared with 2013 and 2018 science curriculum achievements.

TIMSS science questions were prepared under four headings according to TIMSS proficiency levels, with question items as low, intermediate, advanced and high level. The data obtained from TIMSS sources were compared with the written exam questions and TIMSS questions, which are the sub-problems of the research, in stated the features specified in Table 1. Written exams used by public school teachers to measure student learning in science classes were examined. 667 questions in the written exams used by the Science teachers examined at the 5^{th}, 6^{th}, 7^{th} and 8^{th} grade levels of secondary school were examined according to their TIMSS proficiency levels. In line with the data obtained, 249 questions at the 5^{th} grade, 109 at the 6^{th} grade, 132 at the 7^{th} grade, and 177 at the 8^{th} grade were analyzed. During the examination, the questions were classified as low, intermediate, advanced and high level according to the characteristics specified in Table 1.

Table 1: TIMSS Proficiency Levels 8th Grade (Yıldırım, A., Liberty, B., Parlak, B., Gönen, E., and Polat M., 2016)

625 and above	Advanced level: Students can make sense of and illustrate abstract concepts and complex phenomena related to biology, chemistry, physics and earth sciences.
Between 550 -625	Top level: Students can demonstrate that science understands the relationship of cycles, systems, and principles to concepts.
Between 475 and 550	Intermediate: Students can understand and apply basic knowledge in different contexts.
Between 400 -475	Lower Level: Students can understand basic facts about life and physical science.

The comparison of unit evaluation questions and TIMSS questions in the science textbook, which is the other sub-problem of the study, was also classified according to the features in Table 1 according to TIMSS proficiency levels. In this context, 1135 questions in the science textbook were examined. In addition, in line with the TIMSS achievements and the secondary school science curriculum achievements, the questions were examined according to the targeted achievement at the secondary school grade levels. Accordingly, 181 questions at the 5th grade level, 449 at the 6th grade level, 326 at the 7th grade level and 179 at the 8th grade level were examined.

Within the scope of the study, semi-structured interviews were conducted with 12 teachers working in public schools to learn about the teachers' knowledge about the TIMSS exam, which is one of the sub-problems. In line with the semi-structured interview, an interview form was prepared for the teachers. The questions in the form were prepared by taking into account the purpose of the study and the opinions of the experts in the relevant field. Permission was obtained from the Provincial Directorate of National Education, where the study was conducted, to interview the teachers.

FINDINGS

"What are the similarities and differences between TIMSS gains and Science Curriculum achievements?" When we look at the findings related to the question, TIMSS outcomes were prepared in the subject areas of biology, physics, chemistry and earth science by targeting the cognitive areas of knowing, applying and reasoning. 118 acquisitions of TIMSS were examined. TIMSS achievements in 4 subject areas, biology, physics, chemistry and earth science, were compared with 2013 Science Curriculum and 2018 Science Curriculum achievements. While making the comparison, the acquisitions in the secondary school science curriculum were made considering that they contain similar objectives with the TIMSS exam achievements. When the outcomes were examined, it was determined that the TIMSS outcomes and science teaching outcomes had the same target content to a large extent, and the application levels were different. It was seen that there were similar gains in the 2013 science curriculum and 2018 science curriculum, but the content of the curriculum prepared in 2018 was simplified and the grade levels of the acquisitions were changed according to the 2013 curriculum.

In the comparison of TIMSS science gains and science curriculum gains, there are a total of 36 TIMSS achievements in the Biology subject area. These achievements were compared with the achievements in the science curriculum. Among these achievements, the similarity rate between the TIMSS achievements in the biology subject area and the science curriculum achievements was determined as 81.08%.

While TIMSS biology outcomes are compared with the biology outcomes in the science curriculum, some outcomes differ in the 2013 and 2018 science curriculum. For example, when the achievements of TIMSS titled "Fossils as evidence of changes in life on Earth over time and the importance of diet, exercise and lifestyle in the preservation of health" were compared with the 2013 and 2018 science curriculum, they were included in the

2013 science curriculum, while in the 2018 science curriculum. is not included.

In the subject area of chemistry, there are a total of 23 acquisitions belonging to TIMSS. These achievements were compared with the 2013 and 2018 science curriculum. The similarity rate between the achievements was determined as 81.81%. 2013 and 2018 science curricula mostly contain similar acquisitions in the subject area of chemistry.

When the achievements were compared, it was determined that TIMSS's acquisitions titled "Physical and chemical properties of matter and basic physical and chemical properties to classify matter" were not included in the 2013 and 2018 science curriculum.

In the field of physics, there are a total of 33 acquisitions belonging to TIMSS. These achievements were compared with 2013 and 2018 science curriculum achievements. The similarity rate between the achievements is 96.96%.It was determined that 2013 and 2018 science curriculum achievements included similar gains and mostly targeted common gains with TIMSS.

When compared with the TIMSS exam outcomes, the acquisitions included in the "Magnets and the properties and uses of electromagnets" are not included in the 2013 and 2018 science curriculum outcomes.

In the field of earth science, approximately 25 achievements of TIMSS and 2013 and 2018 science curriculum achievements were compared. As a result of the findings, it is seen that TIMSS and science curriculum contain similar gains at the rate of 88%. When the achievements are compared, the achievements included in the "Geological processes throughout the Earth's history" topic are included in the 2013 science achievements and TIMSS achievements, but not in the 2018 science achievements.

Another sub-problem of the research, "How is the relationship between written exam questions and TIMSS proficiency levels?" In line with the data obtained from the question, written exams used by teachers working in public schools to measure student

learning in science lessons were examined. Science course written exam questions examined at secondary school 5th, 6th, 7th and 8th grade levels were prepared in line with the achievements in the science curriculum. The questions of the written exams are true-false, fill-in-the-blank, short-answer and multiple-choice questions. 667 questions in the written exams used by science teachers were analyzed according to TIMSS proficiency levels. In line with the data obtained, 249 questions at the 5th grade, 109 at the 6th grade, 132 at the 7th grade and 177 at the 8th grade were analyzed. It was observed that there was no advanced proficiency question item in teacher written exam questions at all grade levels. Looking at the question items at the whole grade level, there are low-level and intermediate-level proficiency questions.

"How is the relationship between the questions in the textbook and TIMSS proficiency levels?" When looking at the question, 1135 questions in secondary school science textbooks were examined on the basis of TIMSS exam proficiency level. Each of the questions was classified as low-level, intermediate, high-level and advanced competencies used in the TIMSS exam. In addition, in line with the TIMSS achievements and the secondary school science curriculum achievements, the questions were examined according to the targeted achievement at the secondary school grade levels. Accordingly, 181 questions at the 5th grade level, 449 at the 6th grade level, 326 at the 7th grade level and 179 at the 8th grade level were examined. When the questions were examined according to TIMSS proficiency levels, it was seen that low level proficiency was high in all grade levels.

"Do teachers know about the TIMSS exam?" Semi-structured interviews were conducted with science teachers working in public schools affiliated to the National Education. Within the scope of the study, 12 science teachers were interviewed. The questions in the semi-structured interview were prepared in order to get information about the awareness of the teachers about the TIMSS exam and the points that the teachers paid

attention to while preparing the measurement tool. According to the data obtained, it was seen that half of the science teachers participating in the study had knowledge about the exam, but their knowledge about the content, purpose, scope and intervals of the exam was not sufficient. In the semi-structured interview, it was stated that most of the teachers used a result-oriented measurement tool. It has been stated that the memorization-based system was applied regarding the low success of the teachers in Turkey in the TIMSS exam, the low reading skills of the students and the different socio-economic status of the students.

DISCUSSION, CONCLUSION AND IMPLICATIONS

Although the results of the 2019 TIMSS exam carried it to the top of our ranking among the countries participating in this exam, in line with the data obtained after the TIMSS exam held in 2015, Turkey ranks 21st among 39 countries at the 8th grade level in the field of science, and ranked 15th in the TIMSS exam held in 2019. In the TIMSS 2015 exam, the average of the TIMSS exam was below the average by getting a score below the accepted 500 score, and our country was above the average with 515 points in the 2019 exam. There are many factors related to the low success ranking in our country's TIMSS exam. Considering these factors, the study was conducted to compare the science questions asked in secondary school science courses and in the TIMSS exam. Within the scope of the study, TIMSS science achievements and science curriculum achievements were compared and similarities and differences were expressed. Since the achievements in the TIMSS exam bring together all the countries participating in the exam on a common denominator, the countries are in an effort to harmonize the achievements of their own education systems with the achievements of the TIMSS exam. Written exam items, one of the measurement tools used in education and training, and unit evaluation questions in the science textbook were compared with the TIMSS exam science

question items. In addition, semi-structured interviews were held with science teachers working in national education.

Studies such as TIMSS carried out in the international arena have forced countries to control the actuality of their education policies. For this reason, countries use the data obtained as a result of the TIMSS exam in arranging their own education policies. Bybee (2007) analyzed the PISA and TIMSS exams conducted in 2003 in an overall way, including sampling, organization, content, assessment cycle, and purpose. Bybee has included tips on how to become a successful country in education, one of the benefits of international studies. In addition, international studies have provided the chance to compare the countries' school systems with those of highly accessible countries. Bybee stated that while US students were successful in curriculum-based studies such as TIMSS or NAEP, they were less successful in contextual assessment, PISA. Therefore, the author concludes that reform of the US school system is necessary in order to cope with economic rivals. This study also shows that countries participating in international exams such as TIMSS need data from these exams in order to reform their education systems.

In the study, TIMSS science achievements and science curriculum achievements were compared. For this purpose, the similarities and differences between the 2013 and 2018 science curriculums in force before and after the TIMSS 2015 exam were determined, as well as the changes made in the curriculum in the country's post-TIMSS 2015 education policy. It was stated with numerical values in the findings that the gains in the TIMSS and science curriculum overlapped at a high rate. The high similarity rates of the outcomes show that the TIMSS exam and science curriculum outcomes target the same contents. It was determined that the 2013 and 2018 science curriculums included similar gains and that after TIMSS 2015, the curriculum was simplified and innovations were made in line with the training of individuals in parallel with the developing science education in the world. Considering the results of these international

exams, as in other aspects of education, the changes made in the curriculum seem to give positive results in favor of our country in the TIMSS 2019 exam results (Mullis et al., 2020; MEB., 2020). In the previous study by Baker and Jones (2005), it was concluded that the findings obtained from international studies such as TIMSS and PISA provide information about how New Zealand is used in efforts to improve science education (such as implementation, policy development and laying the groundwork for future research). The mentioned study also shows that the countries participating in TIMSS are working on updating and improving the science and mathematics curriculum in the light of the information obtained as a result of the TIMSS exam.

In this context, the updated education program to raise students as scientifically literate individuals at an international level in the field of science in Turkey also targets 21st century skills. In this framework, the scientific process and life skills as well as innovative and entrepreneurial thinking skills are highlighted in the program. In the learning process, students have the skills to explore, question, create arguments and design products (MEB, 2018; MEB, 2020). TIMSS aims to ensure that students in the subject area of science can accurately reflect the science concepts they have learned in the science course in all areas of their lives. The results based on the findings obtained in this study support this.

The data obtained from the study showed that the achievements of the science curriculum and the TIMSS exam were similar, and that the achievements of the science curriculum met the needs of the century. In addition, in the TIMSS 2015 report prepared by Yücel and Karadağ (2016) and the MEB (2020) TIMSS 2019 report, it has been stated that the education programs in Turkey are one of the most compatible with the research conducted on international platforms since 2003. The mentioned research supports the study. In the study, when the science curriculum was examined according to TIMSS subject areas, it was concluded that the subject areas in the science curriculum and

TIMSS subject areas were highly similar. In this study, it was determined that the subject areas of physics, chemistry, biology and earth science were included in both TIMSS and science curriculum, and when the target acquisitions were examined, it was determined that there were highly similar acquisitions in both areas.

When we look at the previous studies, Böyük (2017) stated that in his master's thesis named "Examination of the Science Curriculum in the Scope of TEOG and TIMSS Exams", the achievement and content of the TIMSS 2015 and 8th grade science curriculum is mostly in the field of physics and at least in the field of chemistry. concluded that it was compatible. While the stated study supports the study, it has been demonstrated by previous studies that the existing program is sufficient and compatible in the international arena such as TIMSS, but the possibility that there may be problems in practice should be considered. In the study titled "Comparison of Physics Curriculum in Turkey and Hong Kong" by Cerit-Berber (2015), the physics curriculum of Hong Kong students, who performed much better than our country students in the TIMSS and PISA exams in the field of science, was compared with the physics curriculum implemented in our country. Data were obtained by document analysis method. Considering the results of the research, the physics education applied in Hong Kong is given in later classes than the physics education in Turkey. While physics courses are compulsory in our country, it is an elective course in Hong Kong. It has been determined that the learning and teaching process in the Hong Kong physics curriculum is handled in much more detail than in our country.

Özgün Koca and Şen (2002) compared the strengths and weaknesses of 8th grade students' achievement levels, syllabus, teaching materials and methods in the TIMSS-R exam covering 38 countries. It has been determined that the achievement levels of 8th grade students in Turkey are low, the use of materials is less than in other countries, and their in-class activities are in the form of taking notes from the board and listening to lectures.

Another result obtained from the study is that the number of assessment and evaluation exams is higher due to the importance given to evaluation as in other countries, and finally, they have concluded that the curriculum in Turkey is dense compared to other countries. The two studies mentioned show that while the science curriculum in our country is internationally appropriate, the coursework in practice is different depending on the student-teacher factor.

Another sub-problem of the study is whether the measurement and evaluation systems used in Turkey and the TIMSS exam measurement and evaluation systems are similar. Since measurement and evaluation is an indispensable part of education, the measurement tools used in the science lesson of the students in the study were compared with the TIMSS exam measurement and evaluation approach. The question items in the TIMSS exam are divided by TIMSS under four headings as TIMSS proficiency levels (Yıldırım et al. 2016). The question items determined as low, intermediate, high and advanced competency target knowledge, practice and reasoning skills in line with the cognitive domain of TIMSS. Written exams, one of the measurement tools used in education and training, and unit evaluation questions in textbooks were examined based on TIMSS proficiency levels. It was observed that there were no advanced proficiency questions in the teacher written exam questions at all grade levels, but mostly low-level and intermediate-level proficiency questions.

The measurement tools used by the teachers provide data on whether the student's science learning is meaningful or not. Based on these data, it can be said that there is no measurement and evaluation that enables students to show the targeted behaviors in the science course. In addition, the fact that there are more questions at the level of knowledge and practice in the written exams used by the teachers leads the students to the conclusion that they learn with a rote-based approach. When the question items of the written exams used by the teachers are examined, there are traditional measurement techniques such as

short answer, filling in the blanks, matching and multiple choice test items. In this case, it is thought that the student's reading, writing and expressing skills about the subject do not develop.

Looking at the science curriculum, it aims to raise individuals who are suitable for 21st century skills. In this context, it is important to use alternative measurement and evaluation in addition to traditional measurement and evaluation. Traditional measurement and evaluation techniques address the student's knowledge in a limited time frame (Okur & Azar, 2011). Especially important and complex knowledge and skills, which determine the basic knowledge and skills of the student, are the techniques that cannot measure the desired level (Öncü, 2009). In addition, the student does not take a very active part in the teaching process where these techniques are applied and focuses more on the product (Toptaş et al. 2012). This may not develop students' need to use their reasoning ability. In particular, reasoning level questions, which is one of the cognitive domain goals of TIMSS, show that students can use the information they have learned.

In the study, it was shown that the written exams used by the teachers showed that the students, who subjected the students to traditional assessment and evaluation, had sufficient information about only the basic information in the science lesson, but could not provide sufficient data that they could use this information. This may reduce the rate of answering questions that will measure high-level thinking skills in the TIMSS exam by students from Turkey. In the study titled "Comparative Analysis of TIMSS-R (1999) Questions on Life Sciences and High School Entrance Exam (LGS) (1999) Questions" by Afacan and Nuhoğlu (2008), TIMSS-R was applied in Turkey with questions in the title of living sciences. In this study, it is aimed to analyze the question styles according to Bloom's taxonomy by considering the questions related to this subject in the High School Entrance Examination (LGS). TIMSS-R and LGS questions were evaluated within the scope of Bloom's taxonomy and comparisons were made. According to Bloom's taxonomy in TIMSS-R, it is seen that

questions at the level of knowledge and comprehension, application (1 question), analysis (8 questions) are included, while in LGS, there are fewer questions at the level of comprehension, and more at the level of application (3 questions) and analysis (5 questions). conclusion has been reached. In the TIMSS-R study, it is seen that there are questions about the reasoning field. As stated in this study, TIMSS gives more space to questions at the analysis level because it gives importance to reasoning ability. Since one of the key points in the correction of these stated situations is the teacher, it should be ensured that teachers show sufficient sensitivity about TIMSS and PISA exams, and that they reflect the evaluation styles of these exams in the course evaluation exams they take.

Unit evaluation questions in the science textbook, which is another problem of the study, were also classified according to TIMSS proficiency levels. The course book is used by students as a supplementary resource. Since students' learning in the course progresses in parallel with the course book, student learning is evaluated at the end of each unit in the course book. For this reason, unit evaluation questions are seen as a factor affecting the success ranking in the TIMSS exam. As a result of the examination of 1135 questions in secondary school science textbooks based on TIMSS exam proficiency levels, each of the questions was classified as low-level, intermediate, high-level and advanced competencies used in the TIMSS exam. In addition, in line with the TIMSS achievements and the secondary school science curriculum achievements, the questions were examined according to the targeted achievement at the secondary school grade levels. When the questions were examined according to TIMSS proficiency levels, it was seen that low level proficiency was high in all grade levels. It has been determined by the data obtained as a result of the study that there are no questions with high and advanced level qualifications in the textbooks. In this case, it shows that students are inadequate in measuring their reasoning ability. The textbooks, prepared according to the science curriculum updated in 2018, ensured that the students were active with

experiments and activities that would enable them to learn by doing and experiencing in the science lesson.

As a result of the research, it was determined that although the number of activities and experiments in the science textbook is high, the number of low-level and intermediate-level questions is high in general unit evaluation questions. Considering that the textbook is an effective factor in student learning, it is seen that student learning corresponds only to the level of knowing and applying TIMSS from cognitive domains. Considering this situation, the TIMSS exam causes a low rate of answering questions with advanced proficiency. In the study of Pektaş et al., (2015), the questions in the science textbooks were analyzed in terms of learning area, cognitive area and question types handled within the framework of TIMSS 2011 program. In the study, using the content analysis method, the questions in the field of physics in the textbook were compared with the TIMSS exam. In the results of the research, it was concluded that the cognitive domain of knowing comes to the fore in science textbooks and learning areas determined within the framework of the TIMSS program, the majority of science questions are at the level of knowing and application, and the questions about the reasoning process, which is one of the high-level cognitive domains, are not sufficiently included. Looking at similar studies conducted in other countries, the contents of Iranian primary school science textbooks were compared with the United States science curriculum in the study prepared by Ghaderi (2010). Content analysis method was used in the mentioned research. In the study, it was concluded that the questions in the textbooks used in both systems are different. It has been stated that the textbooks used in Iranian science education should be arranged in a way that enables students to actively participate in the activities. It is seen that America's TIMSS exam success average is higher than Iran's success average, and it sheds light on the studies done by countries within the data obtained from the TIMSS exam results.

When we look at the structural framework of the TIMSS exam, surveying students not only academically, but also family, socio-economic structure, school climate, teachers and school administrators enables TIMSS to provide data on education policies of countries. The school-family and teacher factor is very important for the student's education and training to be effective. In the study titled "Identification and Comparison of the Factors Affecting the Science Achievement of 8th Grade Students in Taiwan and Turkey using TIMSS Data" by Öztürk and Uçar (2010), determining the factors affecting the science achievement of a successful country like Taiwan and Turkey, which is at the bottom and to be compared. In the study, 8th grade students from Turkey and Taiwan who participated in TIMSS constitute the study group. The comparison of Turkey and Taiwan was made on the basis of countries' educational strategies, time allocated to science education, educational status of the family, teacher training, budget allocated to education, use of technology and students' attitudes towards science. The reasons for the failure as a result of the said study; language, socio-economic status, teacher education, curriculum, attitude towards science and the time allocated to science education. Considering these factors, TIMSS addresses the student with a holistic approach (Mullis et al., 2020; MEB., 2020).

According to the science curriculum, the teacher is in the position of a guide in the teaching process. In the mentioned study, it shows the effect of teachers on the success of students. The last sub-problem of the study, "What is the level of awareness of the teachers about the TIMSS exam?" 50% of the teachers stated that TIMSS is an international exam and it is conducted in the field of mathematics and science. When we look at the statements made by the teachers, the TIMSS exam is actually known as an international exam only in the field of mathematics and science. The interview shows that the teachers do not have enough information about the quality and quantity of TIMSS. It was determined that only 33% of the teachers were informed about the question structure of the TIMSS exam based on the answers given. The fact that teachers do not have

sufficient knowledge about the TIMSS exam and that appropriate conditions and opportunities are not provided can be cited as some of the reasons why Turkey's success ranking in the TIMSS exam did not rise. It is seen that the teachers prefer traditional measurement and evaluation methods in the answers received from the teachers in response to the questions about the measurement and evaluation techniques they used in the science lesson. Since the written questions in the written exams used by the teachers participating in the study are also examined, the assessment and evaluation approaches in the teaching process do not meet the same goals as TIMSS. Yatağan (2014) made inferences about the effectiveness of the 2005 Science and Technology Curriculum by comparing the changes of some student and teacher factors and their effects on science achievement in Turkey's TIMSS 2007 and TIMSS 2011 applications. In the aforementioned study, it was concluded that although the program suggested new measurement methods, teachers still continued to ask memorized questions that mainly measure achievements at sub-cognitive levels in science lesson exams. Vlaardingerbroek and Taylor (2003) analyzed the data of 13 countries participating in TIMSS and determined that there is a strong relationship between student achievement and teacher characteristics and education programs. According to the findings, they concluded that common and minimum standards should be established for effective teacher education. İn the same way, in the study titled "The Relationship of Science Teacher Characteristics with Student Science Achievement: A Situation Analysis" According to TIMSS 2011 Data" conducted by Abazaoğlu and Taşar (2016), the teacher characteristics discussed were taken from the TIMSS 2011 teacher questionnaire and the 12 teacher characteristics collected in three groups were determined by the students' science success. The effect on the scores was examined. They tried to determine whether the science achievement of 8th grade students in the samples of Singapore, South Korea, Japan, England and Turkey participating in the TIMSS 2011 application was affected by the characteristics of the science teacher and student selected in the

study. Accordingly the results of the science achievement test applied to the 8th grade students participating in TIMSS 2011, the student and science teacher questionnaires, and the answers given to these questionnaires, as a result of the research, there is a significant difference between the increase in the education level of the teachers in Singapore and the students' science achievement scores, and the teachers' professional development training in science. It has been seen that students' science achievement scores have a statistically significant effect.

The mentioned studies show that the share of teachers, who are at the key point in education, is great in international studies that shape the education policy of the country, such as the TIMSS exam. For this reason, teachers should use only the course content and achievements related to the updated curriculum in the course of the course, but they should prefer the usual simple methods in measurement and evaluation, and they should not use alternative assessment methods that are important for gaining the targeted 21st century skills. thought to have contributed to its development.

When we look at the statements taken from the teachers participating in the study, they use a result-oriented evaluation approach, not a process-oriented evaluation. As one of the reasons for this, they show the teaching of central exams as a reason. In particular, the results obtained from the central exams and the placement of students in the next educational institution cause result-oriented evaluation by using the conventional measurement approach while preparing the students for the exams. When the teachers participating in the study were asked the reasons why Turkey's success ranking is lower than the countries with high success in the TIMSS exam, the teachers stated that a rote-based education is applied in the education system, where the teacher is at the center. The teachers stated that they preferred the teaching method by presentation to train the subjects within a certain education period, especially in order to prepare the students for the exams held centrally in our country, and that their students were passive in this process. The

teachers also stated that not every school has equal standards and that the schools are insufficient in terms of technological equipment and laboratory equipment. The teachers who participated in the study stated that they carried out a teacher-centered education in line with the stated inadequacies.

The teachers participating in the study do not consider themselves sufficient in transferring the knowledge and equipment they have to the students. Undoubtedly, professional competence and characteristics of teachers are very important in education and training. When we look at the questionnaires made in the back ground of the TIMSS exam, the questionnaire items asked to the teachers evaluate the teachers with questions about the teacher's years of service, age, education level, gender, methods used in the course, in-service training and field. From these applied questionnaires, information is also obtained about the methods and techniques used by the teachers in the course. Kyoung-oh et al. (2018) emphasized professional development in many countries in their work, while few comparative studies have examined the degree of teachers' involvement in professional development and its impact on teachers. This study analyzes the extent to which teachers participate in professional development in 50 countries participating in TIMSS, using TIMSS 2007 data and examines the relationship between high-quality teachers' professional development, teachers' beliefs, attitudes, and job satisfaction. In the study, it was found that the degree of participation of teachers in professional development activities was surprisingly low. In particular, in 47 countries, teachers rarely participated in active learning. The study also found that high-quality teacher professional development was significantly associated with greater job satisfaction, higher expectations for student performance, and more positive attitudes of teachers towards school curriculum implementation. The stated study shows that it is very important for teachers to develop and renew themselves in terms of professional development. The teachers who participated in the study stated that they could not enrich the teaching sufficiently due to the

limited opportunities in the school environment, the laboratories are not up-to-date, and the central exams.

The data obtained about the TIMSS exam shows that while the information is constantly renewing and updating itself, the people who guide the student need to constantly renew themselves in order to reach this information. For this reason, teachers can enrich teaching by using areas such as natural learning environments, science parks and museums without resorting to the factors of lack of laboratories, lack of tools and equipment, and limited opportunities. For this reason, this study reveals the effect of the teacher factor as one of the reasons why Turkey is ranked lower in the TIMSS exam. In the study of Atar (2014), a total of 54 teacher qualifications and school characteristics such as professional development, affective characteristics, working conditions, science teaching methods, graduated faculty, gender, professional satisfaction, self-confidence, professional experience were determined by the TIMSS 2011 science students in Turkey, aimed to determine its effects on success. By using the two-level Hierarchical Linear Model (HLM), it was aimed to determine the teacher qualifications that most explain the difference in success between schools. It has been found that participation in in-service training programs related to information technologies and the increase in teachers' perception of the importance that the school attaches to academic achievement have a statistically significant effect on the science achievement averages of schools. The stated study also shows that the characteristics of teachers are of a quality that will guide the education policy of the country in the planning of their education and training. Teachers reveal the necessity of being open to all scientific and technological innovations that exist today in order to provide the best way to guide students with the knowledge and equipment they have.

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