CONTRIBUTION OF SOME FACTORS TO EIGHTH GRADE STUDENTS' SCIENCE ACHIEVEMENT IN TURKEY: TIMSS 2007

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ABSTRACT

CONTRIBUTION OF SOME FACTORS TO EIGHTH GRADE STUDENTS' SCIENCE ACHIEVEMENT IN TURKEY: TIMSS 2007

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The purpose of this study is to determine some of the factors that affect science achievement of eighth grade students in Turkey based on data results of Trends in International Science and Mathematics Study (TIMSS 2007). The present study investigated the relationship between the students' achievement in science and certain factors such as student centered activities perceived by students, teacher centered activities perceived by students, students' attitude towards science, and students' need of science.

This study was carried out during the spring semester of 2012. The sample was constituted from TIMSS 2007 data, which was collected from 4498 grade eight students from 146 randomly selected schools all over Turkey. The data was analyzed by using multiple regression analysis to investigate which factors were significantly affecting the grade 8 students' science achievement.

The results showed that science achievement was positively related to all of the variables: attitude towards science, student centered activities, teacher centered activities, and need for science as a whole. However, when analyzing the relationship of each variable on its own with science achievement, it was found that science achievement was positively related to attitude towards science, student centered activities, and teacher centered activities, but not significantly related to need of science.

Keywords: TIMSS 2007, science achievement, attitude towards science, student centered activities, teacher centered activities, need of science

ÖZ

BAZI FAKTÖRLERİN TÜRKİYE'NİN SEKİZİNCİ SINIF ÖĞRENCİLERİNİN FEN BİLGİSİ BAŞARISINA KATKISI: TIMSS 2007

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Bu çalışmanın amacı, Uluslararası Fen ve Matematik Çalışmasında Eğilimler (TIMSS 2007) veri sonuçlarına dayanarak Türkiye'de sekizinci sınıf öğrencilerinin fen başarılarını etkileyen bazı faktörleri belirlemektir. Bu çalışmada öğrencilerin fen başarısı ve öğrenciler tarafından algılanan öğrenci merkezli etkinlikler, öğrenciler tarafından algılanan öğretmen merkezli etkinlikler, öğrencilerin fen'e karşı tutumu ve öğrencilerin fen'e ihtiyacı gibi belirli faktörler arasındaki ilişki araştırıldı.

Bu çalışma 2012 yılı ilkbahar döneminde yürütülmüştür. Datalar tüm Türkiye genelinde rastgele seçilmiş 146 okuldan 4498 sekizinci sınıf öğrencisinden toplanan TIMSS 2007 verilerinden alınmıştır. Veriler hangi faktörlerin 8inci sınıf öğrencilerinin fen bilgisi başarısını önemli olarak etkilediğini araştırmak için çoklu regresyon analizi kullanılarak incelenmiştir.

Sonuçlar tüm değişkenlerin; öğrenci merkezli etkinliklerin, öğretmen merkezli etkinliklerin, öğrencilerin fen'e karşı tutumu ve öğrencilerin fen'e ihtiyacının bir bütün olarak fen başarısıyla pozitif olarak ilişkili olduğunu gösterdi. Ancak, her bir değişkenin fen başarısı ile ilişkisi ayrı ayrı analiz edildiğinde, öğrenci merkezli etkinliklerin, öğretmen merkezli etkinliklerin, ve öğrencilerin fen'e karşı tutumunun fen başarı ile olumlu ilişkisi olduğu, bununla birlikte öğrencilerin fen'e İhtiyacının ise anlamlı ilişkisinin olmadığı bulundu.

Anahtar Kelimeler: TIMSS 2007, fen başarısı, fen'e karşı tutum, öğrenci merkezli etkinlikler, öğretmen merkezli etkinlikler, fen'e ihtiyaç

To My Kids

Fehim and Ayşe KORKMAZ

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TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF ABREVIATIONS AND SYMBOLS

AAAS	American Association for Advancement of Science
ATS	Attitudes Towards Science
CBT	Computer Based Training
DPT	Devlet Planlama Teşkilatı
IAEP	International Assessment of Educational Progress
ICSU	The International Council for Science
ICT	Information and Communications Technologies (ICT)
IEA	International Association for the Evaluation of Educational Achievement
IRT	Item Response Theory
MONE	The Ministry of National Education
NAEP	National Assessment of Educational Progress
NCES	National Center for Education Statistics
NELS	National Education Longitudinal Study
NOS	Need of Science
NRC	The National Research Council
NSF	National Science Foundation
PIRLS	Progress in International Reading Literacy Study
PISA	The Programme for International Student Assessment
SEAMEO	Southeast Asian Ministers of Education Organisation
SES	Socio Economic Status
SCA	Student Centered Activities
TALIS	Teaching and Learning International Survey
TCA	Teacher Centered Activities
TIMSS	Trends in International Mathematics and Science Study
WB	World Bank
ANOVA	Analysis of Variance
b’s	Partial regression coefficient
d	Difference

df	Degrees of freedom
F	F statistics
N	Population size
P	Significance level
r	Correlation coefficient
R^2	The portion of the variance of dependent variable due to the independent variables included in the regression equation
s	Standard deviation of the sample
SE	Standard Error
ss	Sum of squares
t	t statistics

CHAPTER 1

INTRODUCTION

Education is a right of every child in the world. It is a basic universal human right and a universal human principle. The dissemination of education, information, and knowledge to people is the basis of any society's development. In this information century, international comparative studies in educational achievement have been the focus of many governments and educational researchers.

To enhance the quality in education, many countries give attention on national and international research and surveys. Countries would like to compare their situation with their model or competing educational systems, They would like to evaluate and improve their own educational systems. Education policies are redesigned. Though, educational changes usually take many years to have an effect.

In the 21st century, understanding science is very essential, due to global issues such as climate change, global warming, energy issues, technological development, health issues, economical, political issues etc.

Science is a very rapidly changing subject, as new discoveries are made constantly and increasingly sophisticated tools are used to study our world. Since the 1930's, science teaching has undergone many changes due to political, social, technological, economical, and environmental and energy concerns. To help produce scientifically literate citizens, new goals for science teaching are continuously being developed.

The path to individual self-improvement and national prosperity is education and thus education is very valuable. International student achievement studies have shown that governments are reforming their educational systems depending on the national education policymaking (DPT, 2009) in other countries.

According to many national studies and major international studies conducted with there is a huge problem with the science and mathematics education in Turkey. Turkish students' science and mathematics achievement was found to be far below the international average in reputable international research studies such as Program for International Student Assessment (PISA) 2003, PISA 2006, Trends in International Mathematics and Science Study (TIMSS) 1993, and TIMSS 2007.

Thus science education has become a significant priority in the nation, and Turkish schools have been identified as being in urgent need of improvement. This situation is demanding immediate initiatives to be made and implemented by the government.

Education has a very important impact on pursuing the correct social and economic policies looked for by governments. One important part of education these days as it was before and always, certainly is science education.

Science is not only a body of knowledge but also is a dynamic process. That's why American Association for Advancement of Science (AAAS) and the National Research Council (NRC) suggest science teaching be based on inquiry techniques.

Traditional (didactic) science teaching methods are based on a body of facts to be memorized. That's why inquiry based instruction also necessitates a change from traditional (didactic) science teaching methods. (Dewey, 1959; NRC, 1996; Schwab, 1958; Schwab, 1960; Schwab, 1962; Schwab, 1966).

The most effective method in science teaching is inquiry based teaching. A positive correlation between inquiry based learning strategies and science achievement has been reported. (Escalada & Zollman, 1997; Freedman, 1997; Johnson, Kahle &

Fargo, 2006; Kahle, Meece & Scantlebury, 2000; Mattern & Schau, 2002; McCreary, Golde & Koeske, 2006; Morell & Lederman, 1998; Okebukola, 1987; Oliver-Hoyo & Allen, 2005; Parker & Gerber, 2000). Taking these results into account, priority should be given to the inquiry based learning strategies in science education.

According to previous research studies on international data sets, besides inquiry based teaching, factors such as student centered classroom activities, teacher centered classroom activities, and students' attitudes and perception of failure affect students' science achievement. (Ceylan & Berberoğlu, 2007)

Due to economical, cultural, utilitarian, and ethical reasons, understanding science is very important to societies. So the teaching of science is. While some students want to use science in the future career, some others do not. In this information century in our society, scientific knowledge is so widespread and technology is so common.

That's why, science teachers should give enough attention on students' understanding of communicating science to public, and students' understanding of anticipating misunderstandings or unreliable sources of science.

In this information century, the usage of technological tools is so widespread and scientific information is so common in our society. That's why teachers need to ensure that their students comprehend communicating science to the public well, and predicting misinterpreting of science.

We continuously hear scientific information from a variety of resources such as media, doctors, engineers, politicians in the daily life. These scientific information either will be accepted or declined. This is based on the students' knowledge and reasons. Science teachers should relate the scientific knowledge to real life and show its applicability in the real world by bringing reliable examples to their students. (Driver, Leach, Millar, & Scott, 1996)

1.1 Significance of the Study

The Turkish Education system is supervised by the Ministry of National Education (MONE). It coordinates all the private, public and charity educational organizations in the country, as well as developing policies, and planning curricula, establishing new schools, and developing and providing teaching-learning materials. (Cavas, 2011)

Basic formal education in Turkey was divided into 3 cycles:

a) Pre-school education for ages from three to five
b) Primary-school education for ages from six to twelve (year one to eight)
c) Secondary-school education ages from fourteen to seventeen (year nine to twelve)

Formal education is free in the public schools. Primary-school education is compulsory for all nationals. Secondary-school education includes general secondary schools, vocational and technical secondary schools.

Post-secondary and higher education (which includes universities and institutes) is under the responsibility of the Higher Education Council.

In the last 13 years, science curriculum in Turkey has been changed according to constructivist approach. The curriculum was made more student centered, and the name was changed into "Science and Technology Curriculum", in 2000 and 2004 respectively. During all these movements, MONE took into consideration of all the ideas from different sectors involved such as teachers and administrators. (MONE, 2004).

Scientific-literacy and technological-literacy have gained a weight in the new science curricula. Scientific-literacy entails more than being acquainted with the "scientific principles". It involves gaining information on "scientific thinking", “scientific processes’, and “scientific values”. Literacy also involves gaining information on the relations between science, technology and the society. (TUBA, 2005). Recent revision in full school system (2012) reorganized compulsory education starting from grade 1 to 12, in three 4 years cycles. as primary, middle and secondary schools.

Although a considerable amount of studies have been conducted at the local and national level, literature review of international studies has displayed no background on performing science and technology in the classrooms in Turkey. Large scale international studies like Program for International Student Assessment (PISA), Teaching and Learning International Survey (TALIS), and Trends in International Mathematics and Science Study (TIMSS), which have been carried out in Turkey as well, provided rich data that can be used for secondary analysis. (Yıldırım, 2011).

Similar large scale international researches helped educational systems initiate changes in their curricula according to constructivist approach.

Although all these revisions in the science and technology curriculum, there are problems in science and technology education as addressed by Özden (2007) some are: “insufficiency of allocated time”, “intensity of curriculum”, “intensity of teacher centered instruction (chalk and talk)”, “insufficiency of laboratory activities”, “lack of student centered activities (listen and write)”, and “traditional methods of assessment”.

On the other hand, few research have been done to assess specific factors affecting students’ achievement in science, such as inquiry oriented activities, attitudes toward science, necessity to learning science, teacher centered activities, and student centered activities. (Yayan & Berberoglu, 2004)

The primary purpose of the present study is to examine the relationships among the independent variables of teacher centered activities perceived by students, student centered activities perceived by students, students’ attitudes toward science, students' need of science, and the independent variable science achievement of grade eight students in Turkey, and to provide guidance for the improvement of the science curriculum in Turkey.

1.2 Definitions of the Terms

Teacher Centered Activities:

Teacher centered instruction is an educational style which is based on the delivery of information by the teacher. The focus of instruction is on its delivery, rather than its absorption by students. That is "how the teacher delivers information", rather than "how the students absorb it". The teacher-centered activities tend to involve passive learning by the students, where teachers disseminate information through lecturing, and it is up to the students to absorb and process the information. (Grover, 2005). Lecturing is when a teacher simply stands (or sits) at the front of a room and talks to the entire class. The teacher may use certain aids such as slide shows, video, text and overhead projections, but the focus of the class is always on the teacher. In the teacher-centered pedagogy, the students do not work together, do not collaborate, do not discuss things or talk to one another, but rather merely listen to the teacher and take notes.

Student Centered Activities:

Inquiry based learning is a more general term, which involves student-centered learning. In the student-centered activities, the students learn through questioning and gaining information. This differs from the traditional learning that usually takes place in schools - where teachers instruct or give information to students: by making use of inquiry based learning in a science class, critical thinking skills are developed, student attitudes are improved and scientific discovery facilitated. Inquiry based learning activities usually involve group work, where teachers monitor the students as they work and provide valuable feedback to them.

In inquiry based activities, the students can be grouped by ability levels, where specific activities can be provided based on ability level. Alternatively, groups can be designed with mixed abilities, so that higher level students can tutor their lower level peers. Peer tutoring can also be used for helping to catch up students who were absent. In student-centered activities, teachers may be concerned about some students' difficulties in working collaboratively with each other. In such cases, teachers would utilize team building activities prior to the lesson to encourage cooperation among the students.

Inquiry based activities can sometimes be intimidating to educators. However, by using classroom management techniques, inquiry based activities can be successful. They are easier to complete with the help of outside resources. Teachers usually discuss things with the administrators and gain their support in gathering materials. Parents can also be involved in assisting with the set-up, the clean-up or the monitoring of the lessons. Parents as well as older students can help in organizing supplies or rearranging the classroom if necessary. Parent-teacher organizations or other community members may be willing to donate supplies for such kind of activities.

Student centered activities involve writing, discussing, designing, drawing, conducting experiments, conducting research, analyzing, planning, and collaborating.

In student centered learning, according to Landau (2001): “the focus is on the learner rather than on the teacher. Student centered teaching is based on the constructivist model, in which students construct rather than receive or assimilate knowledge”. (FHDA, 2012).

The following quote by Roxanne Star Hiltz (Landau, 2001) clearly describes the student centered constructivist model of teaching:

"Constructivist learning models require active input from students and requires intellectual effort and aids retention. The role of the teacher in student centered learning is to facilitate the students' learning by providing a framework (i.e. activities for students to complete) that facilitates their learning. For example, the teacher posts activities or questions that students complete. Projects include: writing papers, essays, and reports, publishing Web pages, conducting research, answering open-ended questions, creating artwork, and organizing events."

As we see in the quote (Landau, 2001):

“constructivists believe that for higher levels of cognition to occur, students must build their own knowledge through activities that engage them in active learning. Effective learning happens only when students make use of what they already learnt and then move beyond that knowledge”

In constructivist approach, students create mental diagrams on which they accumulate information. Student's with a wider diagram able to learn more. Different types of experiences and different types of data, generates a stronger base. It is stated in the quote that (FHDA, 2012):

“if students construct their own, they are more likely to hold on to the facts learnt about it”

Attitude:

There has been little consensus among researchers on the meaning of attitude, as attitude is in fact a multi-faceted construct. Different researchers defined attitude differently. Ramsden (1998) stated that in the literature, researchers interchangeably use the words attitude, interest, and motivation.

Salta and Tzougraki (2004) defined attitude as “the tendency to think, feel or act positively or negatively towards objects in our environment”. Gardner (1975) described attitude as “a learnt predisposition to evaluate in certain ways objects, people, actions, situations or propositions they are involved in”. Like attitude, the definition of attitude towards science has also been an issue among researchers. (Anwer, Iqbal & Harrison, 2012). According to Osborne, Simon and Collins (2003), attitude consists of different sub-constructs which ultimately result in a person’s attitude towards science. Different components of attitude towards science have been discussed by different researchers (Crawley & Black, 1992; Gardner, 1975; Koballa, 1988; Oliver & Simpson, 1988; Salta & Tzougraki, 2004; Anwer, Iqbal & Harrison, 2012).

According to Hannula, (2002) attitude in general, refers to someone’s basic liking or disliking of a familiar target. Attitude is the individual’s feelings and values related to science and technical issues.

Di Martino and Zan (2001) distinguished two basic approaches to defining attitude towards science: 1) A simple definition, which describes it as “the degree of affect associated with” Science. In this definition, the cognitive element in attitude is ignored. 2) A three-component definition, which distinguishes between emotional response, beliefs, and behavior as components of attitude (Hannula, 2002). This definition of attitude seems incompatible with the widely accepted view of attitude, emotions and beliefs as belonging to the affective domain.

During a student’s engagement in scientific activities, the conditions are usually evaluated unconsciously as related to students’ perceptions and personal goals. This usually is characterized as an emotion, either positive or unpleasant. The achievement of certain steps towards the goal produce positive emotions, and the complications blocking the progress produce negative emotions (such as annoyance, irritation, fear, sorrow). (Hannula, 2002)

Need of Science:

It is important for science teacher to know their students' views of the nature of science, in order to help them enhance their scientific skills and help them become scientifically literate persons. Then, in the real world they can form decisions. When students understand the "nature of scientific knowledge", the "purpose of scientific work", and "science as a social enterprise", they can build up an understanding of the NOS. (Driver, Leach, Millar, & Scott, 1996).

Understanding the nature of science is important, not to became a scientist but to become a scientifically literate person. It is important, because the things that students deal with may require scientific literacy. For example, any scientific issue requiring democratic decisions, and technology development resulted from scientific efforts.

CHAPTER 2

REVIEW OF LITERATURE

Recorded in the literature, there are many research assessed a variety of aspects affecting students' mathematics and science achievement. Each of these studies investigated variables which add important data and insights for the improvement of the education of science.

In the literature, there are extensive research conducted to investigate the variables that have relation with students' science and mathematics achievement. These variables can be categorized into:

a) Variables from the environment, such as social and economic environment the student comes from, the cultural norms, educational standards and technological development in the country, the level of literacy, etc.

b) Variables from the school (school characteristics) such as school quality indicators, school climate/ environment, the school facilities, the classroom atmosphere, the effective use of technology in school, scholastic activities and support, achievement levels of the class, the peer pressure, and the teacher student relationships.

c) Variables from the teaching process, such as the teaching style, the teaching practices in science, such as the use of hands-on science, incorporating ICT into classroom teaching, level of hands-on experience in science, the use of teacher-centered model, the use of inquiry based science instruction, and the use of Earth systems approach, the relevance of the subject matter, the teachers' performances, the feelings of preparedness of teachers to teach the science content, the science content's relevance to student's environment and life, and the outdoor learning environment provided.

d) Variables from the family, such as home life, parental influence, parents' occupation and income, the socio economic status (SES) of the family, parents' level of education, the quantity of books available at home, and the availability of computers and internet at home.

e) Variables from the student learners (student characteristics) themselves, such as gender, and level of grade, students' liking the subject, students' motivation in science, prior science course taking, students' ability or past achievement, students' attitudes toward mathematics and science, students' learning ability, students' self-confidence, students' self-beliefs, and students' need of science, students' perception on various education factors such as their teachers' instructional choice, their teaching learning methodologies.

As can be seen from the above range of variables, student achievement can be influenced by anything, which makes it really complicated to conclude which of the above factors have higher impacts on achievement.

Starting from a more broad perspective, research on environmental factors showed that there are educational problems in rural areas when compared to urban areas. (Webster & Fisher, 2000).

Engin-Demir's findings (2009) indicated that variables such as "student characteristics (like grade, gender, work status, well-being at school, scholastic activities and parental support)" have the highest influence on poor urban students' achievement in Turkey. Engin-Demir also reported "family background characteristics" and "school quality indicators" as variables affecting on academic achievement.

Similarly, Anil’s study (2009) also showed that the most important factors affecting science achievement is the educational level of the parents, the number of books available at home, and the availability of computers and Internet at home.

Other studies, such as in TIMSS 2007, showed that the educational level of the parents was a very strong factor affecting achievement in science. Interestingly however, when compared with other countries, Turkey was the country where higher educational levels of the parents lead to lower percentages of achievement. This finding indicated that in Turkey, the need for higher educational levels is considered to be an economic problem. In countries that have weak economies, higher educational levels can still be observed. Turkey however, needs to focus on education, and if Turkey continues to develop from this point of view, it will reach the required educational level within a short time frame (Anıl, 2009).

In a study conducted by Ceylan (2009) high performing versus low performing schools were compared. The results revealed that the schools were discriminated based on four variables: Low-performing were found to be encouraging more student centered activities (SCA), whereas high-performing schools tended to have students from high socioeconomic status and had high attitude towards science (ATS). In addition, students in high performing schools tended to perform better on daily life related science activities.

Moreover, besides the studies which investigated school environment, other studies like Singh, Granville and Dika’s (2002) study, investigated individual factors such as home life, parental influence, and peer pressure affect on students’ motivation in science.

There are procedural and declarative science knowledge, and learners need both to comprehend science very well. (Champagne, Klopfer & Gunstone, 1982; Eylon & Linn, 1988; Willingham, Nissen & Bullemer, 1989; Lawson, 1995; Glynn & Duit, 1995). In their research Yilmaz and Yalcin (2012) found that students’ success levels do not equally reflect their knowledge levels. As they suggested, this might be due to the difficulties associated with the convertion of procedural knowledge into declarative knowledge. In order to increase students' understanding of both types of knowledge, appropriate learning strategies needed to be practiced in the classroom. As it was explained by Ruby (2001), hands-on activities help learners build links among various knowledge.

Yıldırım in his study (2011) found that there was a significant difference between written curriculum and implemented curriculum, which evidenced that teaching practices in science and technology lessons in Turkish schools tended to render students passive. Teachers emphasized on making students comprehend the subject, instead of developing their skills. The most preferred teaching practices in science and technology lessons were found to be: Checking whether the subject is understood or not, connecting the subject to life, summarizing the previous lesson, getting students to explain the subject, and watching the teachers as they conduct experiments.

Martin (2010) has found that teachers who have feelings of preparedness to teach science content and implement more inquiry based instruction and less didactic instruction, produced high achieving science students. As science teachers obtained the appropriate knowledge in science content and pedagogy, they felt more prepared and would implement inquiry based instruction in science classrooms.

Moreover, Martin (2010) examined the relationship between teachers' self-reported preparedness for teaching science content and their instructional practices to the science achievement of eighth grade science students in the United States as demonstrated by TIMSS 2007. It was found that a negative relationship existed between teachers' self-reported use of inquiry based instruction and preparedness to teaching chemistry, physics and earth sciences. Moreover, a positive relationship existed between science teachers' self-reported implementation of inquiry based instructional practices and student achievement.

While current studies support student centered teaching methods, in the 1980s–90s, countless studies proved the effectiveness of Computer Based Training (CBT) which followed the teacher centered model, but where the teacher was replaced with text and multimedia presentations. So, it was concluded that if motivation exists, teacher centered techniques could, in-fact, be powerful and effective. (FHDA, 2012)

In 2011, Yıldırım studied the preferred teaching methods and techniques that constructed the conceptual background of teaching practices. It was found that the preferred approach was developing skills like questioning, researching and for active citizenship. In the learning paradigm, students were accepted as active agents in the process of obtaining knowledge and inquiring and developing solutions for problems. Discussion, dialog, group activities and writing exercises in the classroom were supported (Tytler, Cripps & Darby, 2009).

Research findings showed that teaching practices in math and science such as experimenting, inquiring, problem-based studying which are expected to be used more frequently in science and technology lessons, were not at the desired level (Karaca, Ulucınar & Cansaran, 2006; Sozbilir, 2006). To make the learning interesting and active appropriate educational strategies, effective educational methods, and related instructional materials are required. (Bag et al., 2007).

Fennema et al. (1990) suggest that Education in math and science which promotes understanding needed to focus on under-achieving groups first. Studies of McNay (2000) showed that students spend a lot of time to observe, to experiment and to do science, without really knowing what they do.

In order to make learning meaningful for students, learning should include and start from students' interest, and students' need of a specific subject, and necessity of learning a specific subject. Students should comprehend why they need to learn a particular topic. This will give power and accelerate learning process. Accordingly, Orion (2007) recommended focusing on both of cognitive and emotional sides of learning, and starting the learning process with “a meaning construction session”, and adjusting the learning for learners with various abilities.

Ruby studied (2001) the relationship of hands-on sciences with students’ science achievement, and found it questionable. According to the results of a number surveys conducted by the International Assessment of Educational Progress (IAEP) and the International Association for the Evaluation of Educational Achievement (IEA), a positive relation was not seen between hands-on science and achievement.

In 1990, the American Association for the Advancement of Science published the policy paper Science for all Americans (AAAS, 1990), this had a strong impact on science education and change of the purpose of science education as quoted by Orion: “from preparing future scientists towards the education of the future citizens.” (Orion, 2007).

Orion (2007) underlined that teacher-centered or student-centered for all instructions motivation is an essential constituents of education. That’s why, the primary job of a teacher is to motivate students’ interests by using pictures, video films, computer software, Internet sites, and written texts;

Extensive research has been conducted as related to how **student characteristics** are affecting student achievement. One of these factors is the gender of the student.

As related to Grade 8 science, gender differences favoring girls were found in 16 countries, 8 of which were Muslim: Egypt, Jordan, the Palestinian Authority, Saudi Arabia, Kuwait, Oman, Bahrain, and Qatar (David H. , 2011).

Other studies have investigated the effect of students’ **need of science (NOS)** on their science achievement. The NOS is part of scientific literacy which includes functional, civic, and cultural scientific literacy. There are three aspects of scientific literacy which include an understanding of the science content, the scientific approach to inquiry, and science as a social enterprise that is used to build the learners' understanding of nature and the status of scientific knowledge. Science itself is important because it prepares quality people for future generation.

Students should have some understanding about the scientific knowledge. However, there is no precise consensus on what should be taught to students to have them achieve scientific literacy. But, there are some points that researchers agree on, which are: **a)** understanding some aspects of science content, **b)** Understanding the scientific approach to inquiry, and **c)** Understanding science as a social enterprise.

Assessing student understanding in science provides educators with essential methods to best assess student proficiency and performance in science.

Student motivation is also closely related to student attitude. Results of the analysis of gender differences in attitude as a function of science type indicate that boys show a more positive attitude toward science than girls in all types of science. The correlation between attitude and achievement for boys and girls as a function of science type indicates that for biology and physics the correlation is positive for both, but stronger for girls than for boys. The results for the analysis of gender differences as a function of the selectivity of the sample indicate that general level students reflect a greater positive attitude for boys, whereas the high-performance students indicate a greater positive attitude for girls. The correlation between attitude and achievement as a function of selectivity indicates that in all cases a positive attitude results in higher achievement. This is particularly true for low-performance girls (Weinburgh, 2006).

Mettas et al. (2006) also point out that students' achievement in science were significantly related to students' self beliefs and students' attitudes.

One of the factors that affect science achievement is as Cavas (2011) suggested, the attitudes that students have as related to knowledge, their motivation levels.

Student attitudes toward mathematics and science and their understanding of the relevance of these subjects to their future aspirations affect their enthusiasm for studying math and science, and help determine whether they will continue on to more advanced studies in these fields. (NSF, 2012)

Research has consistently shown attitudes as an important component of science education (Gardner, 1975; Joyce & Farenga, 2000; Osborne, Simon & Collins, 2003; Schibeci & Riley, 1986) impacting not only pupils' participation and interest (Greenfield, 1996; Koballa, Crawley & Shrigley, 1990; Simpson & Oliver, 1990; Weinburgh, 1995), but also their performance in science (Linn, 1992; Anwer, Iqbal & Harrison, 2012). Some of the ways of improving students' attitude towards science are through schools visits to science museums, showcasing of scientific movies, and conducting science related activities and competitions. Classroom activities should facilitate student understanding and integrate individual and group activities. This would help students to have more positive feelings about science. (Anwer, Iqbal & Harrison, 2012)

Teachers appear to consider that students' attitude to science, and to what is being studied in science lessons, exerts a profound influence on levels of engagement with the subject.

According to Hannula (2002), attitudes have four aspects: 1) emotions aroused in the situation, 2) emotions associated with the stimuli, 3) expected consequences, and 4) relating the situation to personal values. Previous studies have shown that girls usually have more negative attitudes towards math and science than boys, and that attitudes can become more negative as pupils move from elementary to secondary school levels. According to Hannula, the general attitude of the class is related to the quality of teaching and to the socio-psychological climate of the class (Hannula, 2002).

According to the findings of Eren and Giray, there are negative relationships between students' perception of failure in science, student-centered activities, and students' attitudes toward science with the science achievement measures. On the other hand, this study found a positive relationship between teacher-centered activities and science achievement (Ceylan & Berberoğlu, 2007).

Besides attitudes, previous research has also studied the effect of **self-confidence** on student achievement. In 2007, 36 countries participated in the Trends in International Mathematics and Science Study (TIMSS) at grade 4, and 48 participated at grade 8. The results related to "self confidence in learning mathematics and science" indicated that among high self-confident students, significant gender differences favoring boys have been discovered in most countries participating in this study. In Kazakhstan, Kuwait, Qatar and Tunisia, more girls than boys were high self-confident. While in 22 countries, including countries where the actual achievements of girls were higher than those of boys, boys scored higher on self-confidence in math and science learning (Hanna, 2011).

In Grade 8 math and science students in Bahrain, Cyprus, Qatar and Saudi Arabia, girls were the majority students among "high self-confidence in learning", while in no less than 26 countries, there was a significant difference favoring boys in "high self confidence in learning". This could have been understood had boys scored higher in math in these countries, but that was not the case. Of the 26 countries with boys having a majority among high self-confidence students in learning, in most cases there was no actual reason for this high self-confidence, as only in 8 countries boys scored better than girls (Hanna, 2011).

It was concluded that girls' self-confidence in math and science learning needed improvement, even though the girls actually were doing very well in math and science. Evidence showed that belief in one's own ability is the single component which has more influence than any other actual achievements among junior high school students (Hanna, 2009). Thus, girls who do not believe in their math and science ability, have worse prospects to go on learning it, than those who believe in their ability to improve and develop in this area (Hanna, 2011).

Similarly, other studies (Hendley et al., 1995) also found that the security degree of male students' learning ability of mathematics and science was higher than female students'. Female students had lower positive attitudes toward science and were not successful in science. When female students are between the ages of 11 and 16 , their attitudes toward mathematics were variable. The tendencies to mathematics at the age of 16 are gradually lower (Hendley et al., 1995).

2.1 Evaluation of Educational Achievement

Educational achievement in the literature has been measured and evaluated through various national and international organizations. Among these international organizations are the International Association for the Evaluation of Educational Achievement (IEA), the Organization for Economic Co-operation and Development (OECD), and the International Council for Science (ICSU), which all have a very strong reputation.

The international comparative studies have shown both differences and similarities among educational systems in different countries. The evaluation results of these studies are very crucial to plan and develop more accurate systems and policies.

2.1.1 Organization for Economic Co-operation and Development

The Program for International Student Assessment (PISA) is one of the reputable comparative studies in educational achievement initiated by the OECD countries. OECD member countries were originally countries from Western Europe, but now they are all over the globe. PISA was conducted every three years: in 2000, 2003 and 2006. The tests are administered to 15-years-old students. The tests assess how well students were prepared for their full participation in society. (Ceylan & Berberoğlu, 2007)

2.1.2 International Council for Science

The International Council for Science (ICSU) is a non-governmental organization (founded in 1931) which represents a global membership which includes both national scientific bodies (121 national members representing 141 countries) and international scientific unions (30 members). The ICSU 'family' also includes more than 20 interdisciplinary bodies - international scientific networks established to address specific areas of investigation. Through this international network, ICSU coordinates interdisciplinary research to address major issues of relevance to both science and society. In addition, the Council actively advocates for freedom in the conduct of science, promotes equitable access to scientific data and information, and facilitates science education and capacity building. (ICSU, 2011; ICSU, 2012).

2.1.3 International Association for the Evaluation of Educational Achievement

The International Association for the Evaluation of Educational Achievement (IEA) (IEA, 2012) is: "an independent international cooperative of national research institutions and government agencies". IEA has been conducting large scale and worldwide comparative research projects on various aspects of education as well as educational achievement (i.e., science, mathematics, reading, and ICT) since its foundation in 1959".

Within 52 years, IEA accomplished a variety of comparative research studies in about 70 countries. Educational policies, practices, and outcomes were usually at the these studies' center of attention.

IEA focuses on subject curricula and students' achievement in specific time frame. This contributed participating countries comprehend and assess their educational systems and processes. (IEA, 2012)

In the organizational structure of IEA, there is a secretariat which is located in Amsterdam, the Netherlands. This body is the main organizing body within the system. There is a data processing center (DPC) in Hamburg, Germany. There are international study centers at specific locations such as TIMSS & PIRLS International Study Center at Boston College. There is also a national center in each participant country. (IEA, 2012)

All these bodies collaborate to conduct IEA research studies.

2.1.4 Specific Projects Conducted by IEA

Trend in International Mathematics and Science Study (TIMSS) is “an international assessment of student achievement in mathematics and science at the fourth and eighth grades on a regular four-year cycle. It is directed by the TIMSS & PIRLS International Study Center at Boston College, USA. TIMSS gathers information about the contexts for learning mathematics and science from participating students, their teachers, and their school principals, as well as data about the mathematics and science curricula in each country. TIMSS also collects a rich array of information about the schools and home contexts for learning mathematics and science.”

TIMSS’ research studies on education were the largest studies conducted up to now. They included more than 60 countries. (TIMSS-2007, 2012; IEA, 2012)

TIMSS studies were conducted in 1995, 1999, 2003, 2007, and 2011. The next study planned will be in 2015. (IEA, 2012)

This project is supported by the National Center for Education Statistics of the US Department of Education, the US National Science Foundation, the World Bank, the United Nations Development Program, the participating countries, Boston College, and the National Foundation for Educational Research for England and Wales. (IEA, 2012)

Progress in International Reading Literacy Study (PIRLS) is another IEA research study which is conducted in every five years interval. It assesses trends in reading literacy in participating countries' primary schools. (IEA, 2012)

International Civic and Citizenship Education Study (ICCS) 2009 explored students' capacities to carry out their roles as 21st century citizens. (IEA, 2012)

Teacher Education and Development Study in Mathematics (TEDS-M) as another comparative research study deals with the education of mathematics teachers. Different aspects of teacher education in participating countries are examined, such as the association between mathematics teachers' salaries and their students' mathematics achievement. (IEA, 2012)

International Computer and Information Literacy Study (ICILS) is a new study planned to be conducted in 2013 to see students' computer and information literacy in participating countries. (IEA, 2012)

To inform educational policies in the participating countries, these and similar large scale assessments and studies regularly collect a rich array of data.

TIMSS' data is useful to assess differences and similarities between educational systems. It also provides information for each country about their educational policies and practices to follow their change and improvement in time.

TIMSS' data has been making a strong effect on the reform and development processes in mathematics and science education worldwide. (Mullis et al., 2005). (IEA, 2012)

2.2 TIMSS 2007

2.2.1 Trends in International Mathematics and Science Study 2007

TIMSS 2007 was the 4^{th} research study assessing trends in international mathematics and science study.

TIMSS is dedicated to improve mathematics and science education worldwide for all.

Turkey's grade 8 science and mathematics curricula is parallel with TIMSS. Actually, TIMSS is designed with enough care to align with the participating countries' science and mathematics curricula. (IEA, 2012; Martin, Mullis, & Foy, 2008)

2.2.2 Target Population

Grade four and grade eighth students were the two target populations of this study. were. In some countries grade four assessment was administered to grade six, and grade eight assessment was administered to grade nine students. This was done to match the assessment to the students' achievement level.(IEA, 2012)

2.2.3 Participating Education Systems

TIMSS 2007 involved 67 participants (59 countries and 8 benchmarking entities). The countries that participated in TIMSS 2007 (IEA, 2012) were: "Algeria, Armenia, Australia, Austria, Bahrain, Bosnia and Herzegovina, Botswana, Bulgaria, Canada (Alberta, British Columbia, Ontario, and Quebec), Chinese Taipei, Colombia, Cyprus, Czech Republic, Denmark, Egypt, El Salvador, England, Georgia, Germany, Ghana, Hong Kong SAR, Hungary, Indonesia, Iran, Israel, Italy, Japan, Jordan, Kazakhstan, Korea, Kuwait, Latvia, Lebanon, Lithuania, Malaysia, Malta, Mongolia, Morocco, Netherlands, New Zealand, Norway, Oman, Palestinian

National Authority, Qatar, Romania, Russian Federation, Saudi Arabia, Scotland, Serbia, Singapore, Slovak Republic, Slovenia, Spain (Basque Country), Sweden, Syria, Thailand, Tunisia, Turkey, Ukraine, United Arab Emirates (Dubai), United States (with Massachusetts and Minnesota as benchmarking systems), and Yemen".

Countries full participation list for all the conducted TIMSS studies from 1999 to 2011 are available in Appendix B. (Martin, Mullis & Foy, 2008; Olson, Martin, & Mullis, 2008)

2.2.4 Management

TIMSS 2007 was coordinated by the TIMSS and PIRLS International Study Center at Boston College, United States. The co-directors were Michael Martin and Ina Mullis.

The members (IEA, 2012) were: 1) IEA Secretariat, 2) TIMSS and PIRLS International Study Center, 3) the IEA Data Processing and Research Center, 4) Statistics Canada, 5) the Educational Testing Service, and 6) the national research coordinators from each participant country.

In the TIMSS 2007 Assessment Frameworks, IEA was defined as it "has entrusted responsibility for the overall direction and management of the project to its TIMSS & PIRLS International Study Center at Boston College. In carrying out TIMSS, the TIMSS & PIRLS International Study Center works closely with the IEA Secretariat in Amsterdam on country membership and translations verification, the IEA Data Processing Center in Hamburg on database creation and documentation, Statistics Canada in Ottawa on sampling, and Educational Testing Service in Princeton, New Jersey on the psychometric scaling of the data." (Martin, Mullis, & Foy, 2008)

2.2.5 TIMSS 2007 Contextual Questionnaires

The questionnaires were described in the official site of TIMSS & PIRLS International Study Center and the published report TIMSS 2007 Assessment Frameworks: "Learning takes place within a context and not in isolation. There are numerous contextual factors that have an effect on students' learning. For example, the type of school, the school resources, the instructional approaches, the teacher characteristics, the students' attitudes, and home support for learning all contribute heavily to student learning and achievement. For a fuller appreciation of what the TIMSS achievement results mean and how they may be used to improve students' learning in mathematics and science, it is important to understand the contexts in which students learn. TIMSS collects a range of information about these contexts for learning by administering background questionnaires to students, teachers, school principals, and curriculum experts, which, together with assessing students' performance in mathematics and science, provide a rich source of data on student achievement." (Martin, Mullis, & Foy, 2008; TIMSS & PIRLS International Study Center, 2012)

TIMSS 2007 Contextual Questionnaires were based on Contextual Framework. TIMSS & PIRLS International Study Center official web site (2012) lists the 5 areas of the Contextual Framework as 1) curriculum , 2) schools, 3) teachers and their preparation, 4) classroom activities and characteristics, and 5) students. Contextual Framework identifies the major characteristics of the educational and social contexts studied. (TIMSS & PIRLS International Study Center, 2012).

2.2.5.1 Student Questionnaires

One Student Questionnaire was administered to every one student in every selected classroom. It contained items about "home resources, languages spoken in the home, students' learning habits both inside and outside of school, students' self-concept and their attitudes towards mathematics and science, classroom instructional practices related to teaching mathematics and science, and school safety." (TIMSS &

PIRLS International Study Center, 2012; Martin, Mullis & Foy, 2008). (Also see APPENDIX G)

2.2.5.2 Teacher Questionnaires

Teacher Questionnaires were administered to teachers of the assessed classes. It focused on the instructional activities and materials, and the assessment of students' feat in the subjects. There were questions about teachers' professional preparation, and their experience in teaching the target subject. (Martin, Mullis, & Foy, 2008; TIMSS & PIRLS International Study Center, 2012)

2.2.5.3 The Principal of Each School Sampled for School Questionnaires

School Questionnaire were completed by principals. The questions emphasized on "the mathematics and science curriculum in the school", "the availability and use of educational materials", and "the availability of programs and services that school provided for the students and their parents". There were general questions for school principals about "demographic characteristics", "resources", and "environment" of their schools. (Martin, Mullis, & Foy, 2008; TIMSS & PIRLS International Study Center, 2012)

2.2.5.4 Curriculum Questionnaires

The Curriculum Questionnaire was completed by each National Research Coordinator (NRC) in each country. Questions focused on the "defined national" or "regional curriculum" in grades 4 and 8. There were questions about "requirements for teachers" and "how teachers are informed about the mathematics and science curriculum" as well. (Martin, Mullis, & Foy, 2008; TIMSS & PIRLS International Study Center, 2012)

2.2.6 Student Achievement Booklets

TIMSS 2007 has 14 Student Achievement Booklets. TIMSS groups the assessment items into a series of 28 item blocks, with approximately 10-15 items in each block. TIMSS 2007 has 28 blocks in total, 14 containing mathematics items and 14 containing science items. Student achievement booklets were assembled from various combinations of these item blocks. (Martin, Mullis, & Foy, 2008)

Each student booklet consists of 4 blocks of items, 2 blocks of mathematics items and two of science items.

"The estimated amount of time needed by eighth-grade students to complete each block was 22.5 minutes. Consequently, the 28 blocks of items contain an estimated 10½ hours of testing time." (Martin, Mullis, & Foy, 2008)

The assessment time for each student booklet was 90 minutes. An additional 30 minutes was given for a student questionnaire.

2.2.7 Key Findings

2.2.7.1 Student Achievement in Mathematics and Science

The majority of students in Asian countries reached the advanced international benchmarks for mathematics and science. Singapore had the highest score, and be the first in the science ranking of the participating educational systems. Turkey stayed far below international average. (See Appendix C). (IEA, 2011; Martin, Mullis, & Foy, 2008). As it is quoted in the official web site (IEA, 2011):

"*in mathematics, about 40% of 4th grade students in Singapore and Hong Kong SAR, and 45% to 40% of 8th grade students in Chinese Taipei, Korea, and Singapore achieved at or above the Advanced International Benchmark. The median* *percentage of students reaching this benchmark was 5% at the fourth grade and 2% at the eighth grade*"

As it is quoted in the same web site (IEA, 2011):

"*in science, the highest performing countries (Singapore and Chinese Taipei) at the 4th grade had 36% and 19% of their students, respectively, achieving at or above the Advanced International Benchmark. At the 8th grade, Singapore and Chinese Taipei had 32% and 25% of their students, respectively, achieving at or above the Advanced International Benchmark. The median percentage of students reaching this benchmark was 7% at the fourth grade and 3% at the eighth grade*"

2.2.7.2 Gender Differences

While the effect of gender differences on grade 4 science and mathematics achievement was insignificant in approximately half of the countries, girls' achievement was higher about half and boys' achievement was higher in the other half of the remaining countries. 8th grade girls' science and mathematics achievement was higher than 8th grade boys', across the participating countries. (IEA, 2011). This was negligible for Turkey. (See APPENDIX C), (Martin, Mullis, & Foy, 2008)

2.2.7.3 Students' Background and Attitudes

Higher achievement in science and mathematics was reported for the grade 4 and 8 students who always/almost speak the language of the test at home. There was a significant correlation between "parents' educational level" and eighth grade students' achievement in mathematics and science, in approximately all countries. (IEA, 2011)

TIMSS reported that students with "positive attitudes toward mathematics and science", students with "higher level of self-confidence in learning mathematics and science", and students with "higher value on mathematics and science as important to future success" had higher achievement in mathematics and science. (Martin, Mullis, & Foy, 2008; IEA, 2011)

2.2.7.4 School Factors

Grade 4th and 8th students' average achievement in mathematics and science was the highest in schools whose principals and teachers had "a positive view of the school climate (including high levels of teacher job satisfaction, high expectations for student achievement, and parental support)". (IEA, 2011)

Achievement of the students with highest attendance rate (90%) was found highest. A positive relationship was reported between "students' achievement" and "students' perceptions of being safe in school". (Martin, Mullis, & Foy, 2008; IEA, 2011)

2.2.7.5 Teachers

Mathematics and science teachers aged 30s and 40s taught majority of the students at both the fourth and eighth grades internationally, those aged 50s and older taught one fourth of the students, and the teachers aged below 30 years old taught relatively few students. (Martin, Mullis, & Foy, 2008; IEA, 2011)

It was reported that, teachers who had studied mathematics or science taught majority of the grade 8 students. 4th grade teachers were reported to have little specific training or specialized education, especially in science. (Martin, Mullis, & Foy, 2008l IEA, 2011)

2.3 The value of TIMSS

In the TIMSS publications the value of TIMSS was listed (Martin, Mullis, & Foy, 2008; Mullis et al., 2009) as below: "By participating in TIMSS, Turkey and the other countries can:"

1) "have comprehensive and internationally comparable data about what mathematics and science concepts, processes, and attitudes students have learned by the fourth and eighth grades".

2) "assess progress internationally in mathematics and science learning across time for students at the fourth grade and for students at the eighth grade".

3) "identify aspects of growth in mathematical and scientific knowledge and skills from fourth grade to eighth grade".

4) "monitor the relative effectiveness of teaching and learning at the fourth as compared to the eighth grade, since the cohort of fourth-grade students is assessed again as eighth graders".

5) "understand the contexts in which students learn best. TIMSS enables international comparisons among the key policy variables in curriculum, instruction, and resources that result in higher levels of student achievement".

6) "use TIMSS to address internal policy issues. Within countries, for example, TIMSS provides an opportunity to examine the performance of population subgroups and address equity concerns. It is efficient for countries to add questions of national importance (national options) as part of their data collection effort".

To provide particularly relevant data for decision makers and school policy implementers, TIMSS assesses students at grade 4 and grade 8. Grades 4 and 8 were supposed to be the end of primary and the end of lower-secondary schools respectively.

CHAPTER 3

PROBLEMS AND HYPOTHESES

In this part, the main problem, sub-problems, and hypotheses are presented.

3.1 The Main Problem

The main purpose of this study is to identify the role of student centered activities perceived by 8^{th} grade students (SCA), teacher centered activities perceived by 8^{th} grade students (TCA), students' attitudes toward science (ATS), and students' need of science (NOC) on their science achievement in TIMSS 2007.

3.2 The Sub-problems

1. What are the effects of student centered activities, teacher centered activities, attitudes toward science, and need of science together on eighth grade students' science achievement?

2. What are the effects of student centered activities perceived by 8^{th} grade students on their science achievement?

3. What are the effects of teacher centered activities perceived by 8^{th} grade students on their science achievement?

4. What are the effects of eighth grade students' attitudes toward science on their science achievement?

5. What are the effects of eighth grade students' need of science on their science achievement?

3.3 Hypotheses

Based on the reviews of the literature in this study, the following hypotheses that are relevant to the problems were set to be tested. They are stated in null form at a significant level of 0.05.

Ho1 : There is no significant contribution of student centered activities perceived by eighth grade students, teacher centered activities perceived by eighth grade students, students' attitudes toward science, and students' need of science together to the variation in their science achievement.

Ho2 : There is no significant contribution of student centered activities perceived by eighth grade students to the variation in their science achievement.

Ho3 : There is no significant contribution of attitudes toward science to the variation in their science achievement.

Ho4 : There is no significant contribution of teacher centered activities perceived by eighth grade students to the variation in their science achievement.

Ho5 : There is no significant contribution of student centered activities perceived by eighth grade students to the variation in their science achievement.

Ho6 : There is no significant contribution of need of science perceived by eighth grade students to the variation in their science achievement.

CHAPTER 4

METHODOLOGY

4.1 Sample

TIMSS-2007 included 67 countries all around the world (8 of which were benchmarking entities). The target population of TIMSS can be defined as all the four and eighth grade students in most of the participating countries. TIMSS-2007 used sample design, named as a two stage stratified cluster sampling, and has basically two stages: In the first stage, schools were randomly selected with probability proportional to size, and one or more classes were selected randomly from the relevant grades in sampled schools (Martin, Gregory & Stemler, 2000; Gonzales & Miles, 2001; Joncas, 2008; Olson, Martin, & Mullis, 2008). As a result of this sample design, 4498 students from 146 schools, included both private and public schools, were sampled at eighth grade level in Turkey. In this sample, the percentages of boys and girls were 53 and 47 respectively. This consisted of 2114 girls and 2384 boys. (Olson, Martin, & Mullis, 2008)

4.2 Instruments

The data used in this study was retrieved from TIMSS 2007 results which were obtained by administering the following questionnaires:

1. Science Achievement Test
2. Student Questionnaire

Students' responses on Student Questionnaire and Science Achievement Test were used for this study. The student questionnaire was administered to gather information about students' background characteristics (e.g. parent's education levels, home resources, language spoken at home), students' self-concept and their attitudes toward science and mathematics, classroom instructional practices related to teaching science and mathematics, students' habits outside of the schools, and students' homework (Martin et al., 2008). (See APPENDIX F, APPENDIX G)

4.3 Measurement of Science Achievement

In this study, science achievement data was used from TIMSS 2007. 14 Student Achievement Booklets have been administered to the 4498 grade eight students of 146 randomly selected schools all over Turkey. The average age at the time of testing was 14. The number of schools were 16,112 schools and the number of students were 1,163,830 in the real population. The number of students in the estimated population were 1,091,653 students. (Olson, Martin, & Mullis, 2008)

TIMSS grouped the assessment items into a series of 28 item blocks, with approximately 10-15 items in each block. TIMSS 2007 had 28 blocks in total, 14 containing mathematics items and 14 containing science items. Student achievement booklets were assembled from various combinations of these item blocks.

Each student booklet consists of 4 blocks of items, 2 blocks of mathematics items and two of science items.

The estimated amount of time needed by eighth-grade students to complete each block was 22.5 minutes. Consequently, the 28 blocks of items contain an estimated 10½ hours of testing time.

In the Science Achievement Test, there were 94 science items that include four different content domains (Biology, Chemistry, Physics, and Earth Science) and three different cognitive domains (knowing, applying, and reasoning). (See APPENDIX D, APPENDIX E, APPENDIX F). In the TIMSS-2007 science assessment, Item Response Theory (IRT) scaling methods were used to describe TIMSS achievement measures. Although each student did not respond to all of the items, IRT enabled TIMSS 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-2007 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. In the present study, all of the five overall science reasoning plausible values were used to represent students’ science reasoning achievements.

Thus, the assessment time given for each student booklet is 90 minutes. An additional 30 minutes was given for a student questionnaire.

The data of the Student Achievement Booklets were used in this study. Grade 8 students’ Science Achievement was measured with the Science Achievement Test, consisting of a total of 227 Science; of which 82 were Biology, 60 Physics, 42 Chemistry, and 43 Earth Science questions (both multiple choice and open ended). The booklets contain multiple choice questions and open ended questions. An effort was made to place more emphasis on questions and tasks that offer better insight into students’ analytical, problem-solving, and inquiry skills and capabilities. These Booklets measured the existing science achievement of the respondents. (Olson, Martin, & Mullis, 2008) , (See APPENDIX F).

4.4 Measurement of Attitudes Toward Science (ATS)

Item 11 of the Science in School section of the Student Questionnaire measured the students’ attitudes toward science. (See APPENDIX G)

How much do you agree with these statements about learning science?

*Fill in **one** circle for each line*

		Agree a lot	Agree a little	Disagree a little	Disagree a lot
a)	I usually do well in science	①	②	③	④
b)	I would like to take more science in school	①	②	③	④
c)	Science is more difficult for me than for many of my classmates	①	②	③	④
d)	I enjoy learning science	①	②	③	④
e)	Science is not one of my strengths	①	②	③	④
f)	I learn things quickly in science	①	②	③	④
g)	Science is boring	①	②	③	④
h)	I like science	①	②	③	④

4.5 Measurement of Need of Science (NOS)

Item 12 of the Science in School section of the Student Questionnaire measured the students' need of science. (See APPENDIX G)

How much do you agree with these statements about science?

*Fill in **one** circle for each line*

		Agree a lot	Agree a little	Disagree a little	Disagree a lot
a)	I think learning science will help me in my daily life	①	②	③	④
b)	I need science to learn other school subjects	①	②	③	④
c)	I need to do well in science to get into the <university> of my choice	①	②	③	④
d)	I need to do well in science to get the job I want	①	②	③	④

4.6 Measurement of Student Centered Activities (SCA) and Measurement of Teacher Centered Activities (TCA)

Item 13 of the Science in School section of the Student Questionnaire measured both the student centered activities and the teacher centered activities perceived by eighth grade students. (See APPENDIX G).

How often do you do these things in your science lessons?

*Fill in **one** circle for each line*

		Every or almost every lesson	About half the lessons	Some lessons	Never
a)	We make observations and describe what we see	①	②	③	④
b)	We watch the teacher demonstrate an experiment or investigation	①	②	③	④
c)	We design or plan an experiment or investigation	①	②	③	④
d)	We conduct an experiment or investigation	①	②	③	④
e)	We work in small groups on an experiment or investigation	①	②	③	④
f)	We read our science textbooks and other resource materials	①	②	③	④
g)	We memorize science facts and principles	①	②	③	④
h)	We use scientific formulas and laws to solve problems	①	②	③	④
i)	We give explanations about what we are studying	①	②	③	④
j)	We relate what we are learning in science to our daily lives	①	②	③	④
k)	We review our homework	①	②	③	④
l)	We listen to the teacher give a lecture-style presentation	①	②	③	④
m)	We work problems on our own	①	②	③	④
n)	We begin our homework in class	①	②	③	④
o)	We have a quiz or test	①	②	③	④
p)	We use computers	①	②	③	④

4.7 Analysis of Data

4.7.1 Principle Component Analysis (Factor Analysis)

Some of the items in the questionnaire related to students' background characteristics, their attitudes toward science, their out of school activities, and instructional practices in science classrooms were selected as variables to obtain factor scores by performing factor analysis. Besides gathering factor scores, conducting factor analysis allowed for seeing the number of dimensions and delineating the dimensions of the 30 selected variables (items). These 30 variables (items) were selected based on some studies in the literature (Aypay, Erdogan & Sozer, 2007; Ceylan & Berberoglu, 2007; Yayan & Berberoglu, 2004; Papanastasiou, 2002). Students' responses to each selected variable (item) were examined to understand whether there were missing values exceeding 10% of the total cases in the sample. Since the missing values did not exceed the 10% criteria, missing values were replaced with mean values of related variables (Tabachnick & Fidel, 2001).

Kaiser-Mayer-Olkin (KMO) and Barlett's test of sphericity were used to understand whether the assumptions of the factor analysis were met. These tests are used to test both multivariate normality and sampling adequacy (adequacy of the variables in the factor analysis). KMO value was obtained as 0.863 for our study. This value indicated that the distribution of values in our study was meritoriously (Kaiser's levels) adequate for conducting factor analysis. Moreover, a significant value ($p<0.05$) was found in Barlett's test of sphericity which indicated that the multivariate normality assumption was met (George & Mallery, 2007).

After checking the assumptions, the selected 30 items were analyzed using principle component analysis to obtain factor scores and to see the dimensions of these items. Besides the eigenvalues of 1 and more than 1, the Scree Test was used to retain and determine the number of factors in the analysis (Stevens, 2002). Seven factors with the eigenvalues of 5.410, 3.204, 2.311, 1.818, 1.293, 1.055, and 1.041 were obtained for further analysis. The explained variance for each factor found 10.032 %, 10.681 %, 7.704 %, 6.061 %, 4.310 %, 3.518 % and 3.471 % respectively. Moreover, the Scree Test validated this result by indicating the seven plots in the sharp descent and the other plots began to level off. Table 4.1 presents the dimensions as a result of the factor analysis, with their respective factor loadings. Items with 0.40 and lower of factor loadings were not taken into consideration. 53.778 % of the total variance was explained by the seven factors in this particular analysis.

Table 4.1 Factor Structures and Factor Loadings for Factor Analysis

ITEMS	F1	F2	F3	F4	F5	F6	F7
• **Designing or planning an experiment or investigation**	.816						
• **Conducting an experiment or investigation**	.809						
• **Working in small groups on an experiment or investigation**	.686						
• **Making observations and describe what is seeing**	.674						
• **Teacher demonstrates an experiment or investigation**	.665						
• **Enjoying learning science**		.828					
• **Degree of liking science**		.827					
• **Taking more science in school**		.670					
• **Learning things quickly in science**		.643					
• **Thinking learning science that will help me in daily life**		.470					
• **Home possesses internet connection**			.792				
• **Home possesses computer**			.745				
• **Using internet before or after the school**			.696				
• **Playing computer games before or after the school**			.603				

Table 4.1 Factor Structures and Factor Loadings for Factor Analysis(**Continued**)

ITEMS	F1	F2	F3	F4	F5	F6	F7
• **Using scientific formulas and laws to solve problems**				.713			
• **Memorizing science facts and principles**				.691			
• **Reading the textbook and other source materials**				**.587**			
• **Giving explanations about what is being studied**				.491			
• **Having a quiz or test**				**.432**			
• **Need to do well in science to get a job**					.848		
• **Need to do well in science to get into the university**					.830		
• **Need science to learn other school subjects**					.606		
• **Home possesses study desk**						.673	
• **Number of books at home**						.638	
• **Home possesses <country specific>**						.636	
• **Home possesses <country specific>**						.496	
• **Playing or talking with friends before or after the school**							.718
• **Playing sports before or after the school**							.656
• **Watching TV and videos before or after the school**							.586

Factor analysis results indicate that first factor (student centered activities perceived by students) composed of five variables, second factor (attitude towards science) composed of five variables, third factor (Computer related activities) composed of four variables, fourth factor (teacher centered activities) composed of five variables, fifth factor (need of science) composed of three variables, sixth factor (socio-economic status) composed of four variables, and seventh factor (out of school activities) composed of three variables. The seven factors were named based on the common characteristics of the items loaded on the same factor and some related literature (Aypay, Erdogan & Sozer, 2007; Ceylan & Berberoglu, 2007). The names of the factors and the items loaded on these factors were presented in Table 4.2 Factor Names and the Items Under Each Factor.

Table 4.2 Factor Names and the Items Under Each Factor

FACTOR NAME	ITEMS (Variables)
• **Student centered activities perceived by students**	• Designing or planning an experiment or investigation • Conducting an experiment or investigation • Working in small groups on an experiment or investigation • Making observations and describe what is seeing • Teacher demonstrates an experiment or investigation
• **Attitude towards science**	• Enjoying learning science • Degree of liking science • Taking more science in school • Learning things quickly in science • Thinking learning science that will help me in daily life
• **Computer related activities**	• Home possesses internet connection • Home possesses computer • Using internet before or after the school • Playing computer games before or after the school
• **Teacher centered activities perceived by students**	• Using scientific formulas and laws to solve problems • Memorizing science facts and principles • Reading the textbook and other source materials • Giving explanations about what is being studied • Having a quiz or test
• **Need of science**	• Need to do well in science to get a job • Need to do well in science to get into the university • Need science to learn other school subjects
• **Socioeconomic status**	• Home possesses study desk • Number of books at home • Home possesses <country specific> • Home possesses <country specific>
• **Out of school activities**	• Playing or talking with friends before or after the school • Playing sports before or after the school • Watching TV and videos before or after the school

In this study, four of these seven factors were used. These were student centered activities, attitudes towards science, teacher centered activities, and need of science.

4.7.2 Multiple Regression

The data obtained from TIMSS 2007 was selected and analyzed using the multiple regression analysis of the SPSS package program.

The purpose of multiple regression analysis is to evaluate the effects of two or more independent variables on a single dependent variable. The independent variables in this study were attitudes towards science, need of science, student centered activities and teacher centered activities. The dependent variable was the students' achievement in science.

In general, the multiple regression equation of $\boldsymbol{Y}$ on $\boldsymbol{X_1, X_2, \ldots, X_n}$ is given by:

$$Y = a + b_1X_1 + b_2X_2 + \ldots\ldots b_nX_n + \varepsilon$$

In the model, $\boldsymbol{Y}$ is the dependent variable, $\boldsymbol{X_1, X_2, \ldots, X_n}$ are independent variables, $\boldsymbol{a, b_1, b_2, \ldots, b_n}$ are coefficients (unknown parameters) and $\boldsymbol{\varepsilon}$ is the error term. (Unver & Gamgam, 2006)

In this study, the multiple regression model was composed of 4 independent variables.

Y : Students' science achievement
X_1 : Student centered activities perceived by students
X_2 : Students' attitudes toward science
X_3 : Teacher centered activities perceived by students
X_4 : Students' need of science

CHAPTER 5

RESULTS AND CONCLUSION

In this chapter, the results obtained from testing the hypotheses and conclusion are presented. Multiple regression analysis was used to test the hypotheses used in this study.

5.1 Results

Table 5.1 Analysis of Variance (ANOVA)a for The Total Model, shows whether or not the 4 predictors (student centered activities, teacher centered activities, attitudes toward science and need of science) were totally accepted for a significant portion of science achievement.

Table 5.1 Analysis of Variance (ANOVA)[a] for The Total Model

Model	Sum of Squares	df	Mean Square	F	Sig
Regression	1897469.408	4	474367.352	57.528	.000[b]
Residual	29314030.09	3555	8245.859		
Total	31211499.50	3559			

a Dependent Variable: Science Achievement

b Predictors: (Constant), student centered activities, attitudes toward science, teacher centered activities, need of science

This total model was used to test hypothesis 1 stating that there is no significant contribution of student centered activities perceived by students, teacher centered activities perceived by students, students' attitudes toward science, and students' need of science together to the variation in their science achievement.

F value for full regression model was significant ($F= 57.528$, $p < 0.05$).

The four predictor variables (student centered activities perceived by students, teacher centered activities perceived by students, students' attitudes toward science, and students' need of science) together accounted a significant portion of variance in science achievement.

Table 5.2 represents the summary table for the regression of science achievement in TIMSS 2007 on student centered activities, teacher centered activities, need of science, and attitudes toward science.

Table 5.2 Summary Table for the Regression of Science Achievement in TIMSS 2007 on Student Centered Activities, Teacher Centered Activities, Need Of Science, And Attitudes Toward Science.

Dependent Variable	**Predictor Variables**	**B**	**SE**	**t**	**P**
Science Achievement	(Constant)	468.188	1.522	307.629	0.000
	Student centered activities	-9.517	1.522	-6.252	0.000
	Attitudes toward science	13.983	1.522	9.187	0.000
R^2=0.061	Teacher centered activities	15.627	1.522	10.267	0.000
	Need of science	**1.682**	**1.522**	**1.105**	**0.269**

Table 5.2 was used to test hypotheses 2, 3, 4, and 5.

The results showed that, student centered activities, attitudes toward science, and teacher centered activities each made a significant contribution to the variation in science achievement. However, the need of science did not make a significant contribution to the variation in science achievement.

5.2 Conclusion

Student centered activities perceived by students , students' attitudes toward science, teacher centered activities perceived by students, and students' need of science each was a strong predictor for science achievement.

CHAPTER 6

DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

This chapter presents a discussion and interpretation of the results reported in Results and Conclusion chapter, and the implications and recommendations for further research.

6.1 Discussion

The current study investigated the relationship of student centered activities perceived by students, students' attitudes toward science, teacher centered activities perceived by students, and students' need of science on grade eight students' science achievement in TIMSS 2007.

A significant link was found between students' attitudes toward science, student centered activities perceived by students, teacher centered activities perceived by students, students' need of science and students' achievement in science. The results of this study showed that science achievement was significantly related to all of the independent variables: students' attitudes toward science, student centered activities perceived by students, teacher centered activities perceived by students, students' need of science when analyzed together.

The measures used in the TIMSS study, albeit somewhat unsophisticated, have found a consistent relationship between attitude and achievement (Beaton et al. 1996). Within all of the literature, there is some disagreement about the nature of the causal link and whether it is attitude or achievement that is the dependent variable.

In previous literature, it was found that laboratory instruction influenced, in a positive direction, the students' attitude toward science, and influenced their achievement in science knowledge.

It was found that student centered activities are significantly related to high achievement of grade 8 students in science.

This is due to the fact that student centered activities such as problem-solving, collaboration, multiple intelligence, real world applications and the use of technology, improve both the teaching and the learning in Science (Haruta & Stevenson, 1999). These student centered teaching methods lead to an increase in student enrollment patterns and create a general favorable impression among students on innovative materials and methods. Student centered activities also lead to students feeling a sense of autonomy, which results in the students gaining power over themselves and gaining control of their own lives (Spurlock, 2001). In sum, the student centered activities help students to develop positive school experiences, such as: being motivated in school, feeling competent in their abilities, and feeling connected to teachers and peers, and to self-expression and self-discovery, which all ultimately lead to high test scores. Apart from that, the student centered curriculum provides more opportunities to develop skills necessary for self-regulation.

Teacher centered activities perceived by students were found to be significantly correlated to achievement of grade 8 students in science.

This result might be due to expert knowledge base, planning and conducting science course, disciplining education, and regulating students' assessment. Students are accustomed to the teachers' direct teaching and the way the science course proceeds. Teacher guides students' learning, and adjusts the pace for classroom. One advantage of teacher centered instruction is that the stage of students' learning is known by instructor, and the progress is assessed better.

Grade 8 students who understand the need of science (NOC) were found to be high achievers in science, and grade 8 students who don't understand the need of science (NOC), were found to be low achievers in science.

This study in line with TIMSS 2007 general international results which was reported that students with "positive attitudes toward mathematics and science", students with "higher level of self-confidence in learning mathematics and science", and students with "higher value on mathematics and science as important to future success" had higher achievement in mathematics and science. (Martin, Mullis, & Foy, 2008; IEA, 2011). This was true when the factors analysed together.

Moreover, when analyzing the relationship of each variable on its own with science achievement, it was found that achievement in science was significantly correlated to students' attitudes toward science, student centered activities perceived by students, and teacher centered activities perceived by students, but not significantly correlated to students' need of science. The fact the need of science was found not to be significantly related to students' achievement in science is not in congruency with the researcher's expectations.

In the literature, student centered activities (SCA) were found to be encouraging in low-performing schools, as opposed to high performing schools, and students with high attitude towards science (ATS). In addition, students in high performing schools tended to better perform on daily life related science activities. (Ceylan, 2009).

Although the fact that some other previous studies (Eren & Berberoğlu, 2007) found negative relationships between student centered activities, and students' attitudes toward science with the achievement in science, the results of the current study, supports that more student centered activities lead to higher achievement in science, regardless of school quality factors, or characteristics of the environment.

As related to the effect of teacher centered activities perceived by students on students' achievement, in the current study, a significant relationship was found, and this actually is supporting the literature (Eren & Berberoğlu, 2007).

As related to the need of science (NOS), in the literature (Cavas, 2011) it was found that students' attitudes were related to their knowledge and their motivation levels. The result of the current study is contradictory to previous studies, and this may be related to the fact that the need of science is closely related to motivation and learning, which affects student achievement positively. Perhaps this relationship needs to be re-examined by taking into account the factors of attitude and motivation.

6.2 Implications

1. Student centered activities perceived by students are a negative strong predictor for science achievement. It should be considered by the teacher to design instructional environment as inquiry based oriented form.

2. Students' attitudes toward science are a strong predictor of science achievement. The science courses should be designed to develop students‘ relevant and intrinsic motivation toward the subjects taught.

3. Teacher centered activities perceived by students are a strong predictor. Students in schools throughout Turkey, are accustomed to teacher centered activities. When Turkeys place in the TIMSS 2007 rank is considered, the achievement is far below international average. Student centered learning strategies facilitate student learning and success. Students should become more active mentally, and learning activities need to be shifted from the teacher centered level to the student centered level. The common instructional strategy for high achieving educational systems is student centered one.

6.3 Recommendations

Depending on the findings of the current study, the researcher recommends that:

1. The same research study should be repeated with TIMSS 2011 data which is going to be released in December 2012.

2. The same study should be done for developed counties, USA, Canada, Australia, New Zeeland, UK and European countries, and compared with Turkey.

3. A similar comparative study should be repeated for Turkey and Singapore specifically. Singapore had the highest score in science achievement, while Turkey stayed below international average.

4. Similar research studies are needed for different grade levels and different subject matters.

5. Further comparative studies should be performed on the factor variables of targeted education systems (e.g., Canada, Australia, UK, Singapore etc.). Findings will enlighten the transition of Turkey's educational system from teacher centered to student centered one.

6. Professional development training on "inquiry based learning" and "student centered activities" should be provided to teachers in service professionally.

7. Although the science curriculum was recently redesigned according to the constructivist approach, it should be revised and made more appropriate for student centered activities.

8. Enough care and importance given to teacher education.

9. The Educational Technology Department of the Ministry of Education and EARGED should coordinate well to develop professional personnel to study, design and develop appropriate student centered activity materials.

10. Teachers' attitudes toward the constructivist and student centered activities should be studied and necessary precautions taken into considerations.

11. School managements should be given more responsibility to find ways to support student centered learning and provide enough guidance to teaching staff.

12. Classrooms should be redesigned for activities, group work and student cooperation to be done efficiently.

13. Science instruction should contain regular laboratory activities.

14. Student numbers per class should be adjusted according to the international best standards.

15. Teacher assistants and teaching support staff should support the students in lessons with intense activity.

16. Each school may have a corner / hall to be named as independent interactive learning center. This should include simulation programs and tools.

Student-oriented learning environments are perceived to be more interesting, enjoyable and valuable than teacher centered approaches. Hence, it is worthwhile to include student-oriented approaches and open learning environments in the curriculum. Active learning and support of a student's autonomy may enhance students' achievement and psychological development.

Moreover, the researcher has identified several issues that may contribute to a bias of this past work as well as have implications for current policy. These issues include the need to control the variables which may be linked to all of the independent variables: attitude towards science, student centered activities, teacher centered activities, need for science and student achievement.

Also, the need to consider the multiple facets of attitude towards science, such as the values, general beliefs, specific beliefs and behavior, and self-confidence of the students as related to Science. More research should be conducted in the measuring of attitudes towards science, as the questions used in TIMSS 2007 for the measurement of attitude are very simple and do not reflect the complexity of attitudes. The concept of attitude needs to be broken down into a number of separate concepts, which are considered as parts of student attitude towards science: values, general beliefs, specific beliefs and behavior, and self-confidence.

The findings of this study could be further examined with students from alternate grades, and by making use of more sophisticated questionnaires for the measurement of attitudes towards science. It would be more helpful in understanding the complexity of how to measure the attitudes than a single overall measure of attitudes, which includes only a few basic questions.

The results obtained from this study provide guidance on developing science education in Turkey. This study also provides valuable information and insights to universities and teachers, students, parents, school administrators, people in the MOE, curriculum developers, researchers in education, and authors.

REFERENCES

Akbaş, A., & Kan, A. (2007). Affective factors that influence chemistry achievement (motivation and anxiety) and the power of these factors to predict chemistry achievement. *Journal of Turkish Science Education, 4*(1), pp. 10-20.

Akkus, R., Günel, M. and Hand, B. (2007). Comparing an inquiry-based approach known as the science writing heuristic to traditional science teaching practices. *International Journal of Science Education, 29*(4), 1745–1765.

Al-Nhar, T. (1999). Determinants of grade eight achievement in Jordan: a multilevel analysis approach. *Educational Psychology, 19* (1), pp. 37–45.

Ames, C. (1992). Classrooms: Goals Structures, and Student Motivation. *Journal in Educational Psychology, 84*(3), pp. 261-271.

Anıl, D. (2009). Uluslararası oğrenci başarılarını değerlendirme Programı (PISA)' ında Türkiye'deki öğrencilerin fen bilimleri başarılarını etkileyen faktörler. *Eğitim ve Bilim, 34*(152), pp. 87-100.

Anwer, M., Iqbal, H. M., & Harrison, C. (2012). Students' Attitude towards Science: A Case of Pakistan. *Pakistan Journal of Social and Clinical Psychology and Clinical Psychology, 9*(2), pp. 3-9.

Aypay, A., Erdogan, M., & Sozer, M. A. (2007). Variation Among Schools on Classroom Practices in Science Based on TIMSS-1999 in Turkey. *Journal of Research in Science Teaching, 44*(10), pp. 1417–1435.

Bacolod, M., & Tobias, J. (2005). *Schools, School Quality and Academic Achievement:Evidence from the Philippines.* Retrieved July 3, 2006

Bag, H., Tasar, M. F., & Gough, A. (2007). *The Eurasia Journal of Mathematics, Science and Technology Education (EJMSTE), 3*(3). Retrieved August 1, 2012, from www.ejmste.com

Baharudin, R., & Luster, T. (1998). Factors related to the quality of the home environment and children's achievement. *Journal of Family Issues, 19*(4), 375–403.

Barlia, L., & Beeth, M. (1999). High school students' motivation to engage in conceptual change learning in science. *Paper presented at the annual meeting of the National Association for Research in Science Teaching.* Boston, MA.

Beaton, A., Mullis, I., Martin, M., Gonzalez, E., Kelly, D., & Smith, T. (1996). *Mathematics Achievement in the Middle School Years, Centre for the Study of Testing, Evaluation and Educational Policy.* Boston: Boston College.

Ben-zvi-Assaraf, O., & Orion, N. (2005). The development of system thinking skills in the context of Earth System education. *Journal of Research in Science Teaching, 42*, pp. 1-43.

Berberoğlu, G. (2003). *Modeling of the Factors Affecting Science Achievement of Eighth Grade Turkish Students Based on the Third International Mathematics and Science Study – Repeat (TIMSS - R) Data.* Middle East Technical University.

Brophy, J. (1998). *Motivating students to learn.* Madison, WI: McGraw Hill.

Çavaş, B., & Kesercioğlu, T. (2004). Fen Eğitiminin Uygunluğu: Rose Projesi. İstanbul: Marmara University, Atatürk Education Faculty.

Çavaş, B., and Kesercioğlu, T. (2004). Fen Eğitiminin Uygunluğu: Rose Projesi . *VI. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi.* İstanbul: Marmara University, Atatürk Education Faculty.

Cavas, P. (2011, March). Factors affecting the motivation of Turkish primary students for science learning. *Science Education International, 22* (1), pp. 31-42.

Ceylan, E. (2009). PISA 2006 Sonuçlarina Göre Türkiye'de Fen Okuryazarliğinda Düşük Ve Yüksek Performans Gösteren Okullar Arasindaki Farklar. *Eğitim Fakültesi Dergisi, VI*, pp. 55-75. Retrieved August 1, 2012, from http://efdergi.yyu.edu.tr

Ceylan, E., & Berberoğlu, G. (2007). Öğrencilerin Fen Başarısını Açıklayan Etmenler: Bir Modelleme Çalışması. *Education and Science, 32*(144).

Champagne, A., Klopfer, L., & Gunstone, R. (1982). Cognitive Research and the Design of Science Instruction. *Educational Psychologist, 17*(1), pp. 31-53.

Chevalier, A., Lanot, G., . (2002). The relative effect of family characteristics and financial situation on educational achievement. *Education Economics, 10*(2), pp. 165–181.

Choudhury, A. (2009). *Multiple Regression Analysis. Retrieved 15 Aug. 2012 from Experiment Resources: http://www.experiment-resources.com/multiple-regression-analysis.html.* Retrieved August 15, 2012, from http://www.experiment-resources.com/multiple-regression-analysis.html

Coleman, J., Campbell, E., Hobson, C., McPartland, J., Mood, A., & Weinfield, F. (1966). Equality of Educational Opportunity., (pp. National Center for Educational Statistics,). Washington, DC.

Crawley, F. E., & Black, C. B. (1992). Causal modeling of secondary science students' intentions to enroll in physics. *Journal of Research in Science Teaching, 29*, pp. 585-599.

Crawley, F. E., & Koballa, T. R. (1994). Attitude research in science education: Contemporary models and methods. *Science Education, 78*(1), pp. 35–55.

Dede, Y., & Yaman, S. (2007). A Questionnaire for Motivation toward Science Learning: A Validity and Reliability Study (in Turkish). *Journal of Science and Mathematics Education, 2*(1), pp. 19-37.

Dewey, J. (1910). Science as subject matter and as method. *Science, 31*(787), pp. 121-127.

Dewey, J. (1959). *My Pedagogic creed. In Dewey on Education.* New York, USA: Columbia University, Teachers College, Bureau of Publications.

Di Martino, P., & Zan, R. (2001). Attitude toward mathematics: some theoretical issues. *Proceedings of PME 25, 3*, pp. 351-358.

Driver, R., Leach, J., Millar, R., & Scott, P. (1996). *Young people's images of science.* Buckingham, PA: Open University Press. Retrieved August 1, 2012, from University of Missouri: http://web.missouri.edu/~hanuscind/8710/Chapter2POMS.pdf

Engin-Demir, C. (2009). Factors influencing the academic achievement of the Turkish urban poor. *International Journal of Educational Development, 29*, pp. 17–29.

Eren, C., & Berberoğlu, G. (2007). Öğrencilerin Fen Başarısını Açıklayan Etmenler: Bir Modelleme Çalışması. *Education and Science, 32*(144).

Escalada, L., & Zollman, D. A. (1997). An investigation on the effects of using interactive digital video in a physics classroom on student learning and attitudes. *Journal of Research in Science Teaching, 34*(5), 467-489.

Eylon, B.-S., & Linn, M. (1988). "Learning and Instruction: An Examination of 4 Research Perspectives in Science Education". *Review of Educational Research, 58*(3), pp. 251-301.

Farkas, G., Sheehan, D., & Grobe, R. (1990). Coursework mastery and school success: gender, ethnicity, and poverty groups within an urban school district. *American urban school district. Educational research Journal, 27*(4), 807–827.

Fennema, E., Peterson, P. L., Carpenter, T. P., & Lubinski, C. A. (1990). Teachers' attributions and beliefs about girls, boys, and mathematics. *Educational Studies in Mathematics, 21*, pp. 55-69.

FHDA. (2012). Class Notes: Constructivism and the Student Centered Approach, Topic 2: Evaluate Student-Centered and Teacher-Centered Lessons. *Foothill-De Anza Community College District*. Retrieved August 1, 2012, from Foothill-De Anza Community College District: http://pixel.fhda.edu/id/Survey/survey_notes_b.html

FHDA. (2012). *Topic 2: Survey of Student-Centered and Teacher-Centered Approach*. (Instructional Design Intensive Workshop) Retrieved August 1, 2012, from http://pixel.fhda.edu/id/Survey/survey_notes_b.html

Foy, P. P., & Olson, J. F. (Eds.). (2009). *TIMSS 2007 User Guide for the International Database.* Chestnut Hill, MA, Boston, USA: Boston College.

Freedman, M. (1997). Relationship among laboratory instruction, attitude toward science, and achievement in science knowledge. *Journal of Research in Science Teaching, 34*(5), 342-357.

Fuchs, T., & Woessmann, L. (2004). *What accounts for international differences in student performance? A re-examination using PISA data.* CESifo Working Paper No. 1235.

Fuller, B., & Clarke, P. (1994). Raising school effects while ignoring culture? Local conditions and the influence of classroom tools, rules and pedagogy. *Review of Educational Research, 64,* pp. 122–131.

Gardner, P. (1975). Attitude to science: A review. *Studies in Science Education, 2*, pp. 1-41.

George, D., & Mallery, P. (2007). *SPSS for Windows step by step: A simple guide and reference* (4 ed.). Boston: Allyn and Bacon.

Gieger, M. M. (1973). *A study of scientific attitudes among junior college students in Mississippi. Unpublished Doctoral Dissertation.* Mississippi: The University of Southern Mississippi.

Glynn, S., & Duit, R. (Eds.). (1995). *Learning Science in the Schools, Lawrence (eds.).* Mahwah, NJ: Lawrence Earlbaum Associates.

Gonzalez, E. J., & Miles, J. A. (Eds.). (2001). *TIMMS 1999 User Guide for the International Database.* Chestnut Hill, MA: Boston College.

Greenfield, T. A. (1996). Gender, ethnicity, science achievement, and attitudes. *Journal of Research in Science Teaching, 33*(8), pp. 901-933.

Griffith, J. (1999). School climate as ‘‘social order’’ and social action’’: a multi-level analysis of public elementary school student perceptions. *Social Psychology of Education, 2*, pp. 339–369.

Grover, S. (2005). *Teacher Centered Activities*. Retrieved August 1, 2012, from eHow: http://www.ehow.com/info_7895620_teacher-centered-activities.html

Guncer, B., & Kose, R. (1993). Effects of family and school on Turkish students' academic performance. *Education and Society, 11*(1), pp. 51–63.

Hamilton, L., Nussbaum, M., Kupermintz, H., Kerkhoven, J., & Snow, R. (1995). Enhancing the Validity and Usefulness of Large-Scale Educational Assessments: II. NELS:88 Science Achievement. *American Educational Research Journal, 32*(3), pp. 555-581.

Hanna, D. (2009). *The influence of gender, religion, grade, class-type, and religiosity on mathematical learning in the Israeli junior high school.* Saarbrücken, Germany : VDM Verlag.

Hanna, D. (2011, October). Overcoming the Gender Gap in Math, Science and Technology: A 21st Century View. *Journal of Educational and Social Research, Vol. 1*(3).

Hannula, M. S. (2002). Attitude towards Mathematics: Emotions, Expectations and values . *Educational Studies in Mathematics*, pp. 25-46.

Haruta, M. E., & Stevenson, C. B. (1999). *Integrating student-centered teaching methods into the First Year SMET Curriculum: The University of Hartford model for institution-wide reform.* The University of Hartford: ERIC Document Reproduction Service No. ED440977.

Hendley, D., Parkinson, J., Stables, A., & Tanner, H. (1995). Gender differences in pupil attitudes to the National Curriculum foundation subjects of English, mathematics, science and technology in key stage 3 in South Wales. *Educational Studies, 21*(1), pp. 85-97.

Heyneman, S., & Loxley, W. (1983). The effect of primary school quality on academic achievement across 29 high- and low-income countries. *American Journal of Sociology, 88*, 1162–1194.

Hodson, D. (1996). Laboratory work as scientific method: three decades of confusion and distortion. *Journal of Curriculum Studies, 28*, pp. 115-135.

Hodson, D. (1998). Science Fiction: the continuing misrepresentation of science in the school curriculum. *Curriculum Studies, 6*(2).

Hofstein, A., & Lunetta, V. (1982). The Role of the Laboratory in Science Teaching: Neglected Aspects of Research. *Review of Educational Research, 52*(2), pp. 201-217.

ICSU. (2011). *Report of the ICSU Ad-hoc Review Panel on Science Education.* International Council for Science, Paris.

ICSU. (2012). *About Us*. Retrieved August 1, 2012, from International Council for Science: http://www.icsu.org/about-icsu/about-us

IEA. (2011). *TIMSS 2007*. (IEA) Retrieved August 1, 2012, from International Association for the Evaluation of Educational Achievement: http://www.iea.nl/timss_2007.html

IEA. (2012). Retrieved August 1, 2012, from International Association for the Evaluation of Educational Achievement: http://www.iea.nl/

IEA. (2012). *IEA Studies*. (IEA, Producer) Retrieved August 1, 2012, from International Association for the Evaluation of Educational Achievement: http://www.iea.nl/studies.html

Johnson, C., Kahle, J., & Fargo, J. (2006). Effective teaching results in increased science achievement for all students. *Science Education,, 91*, 372-383.

Joncas, M. (2008). TIMSS 2007 sample design. In J. Olson, M. Martin, & I. Mullis (Eds.), *TIMSS 2007 Technical Report* (pp. 77-92). Chestnut Hill, MA: International Study Center, Boston College.

Joyce, B. A., & Farenga, S. J. (2000). Young girls in science: Academic ability, perceptions, and future participation in science. *Roper Review, 22*(4), pp. 261-262.

Kahle, J., Meece, J., & Scantlebury, K. (2000). Urban African-American middle school science students: Does standards-based teaching make a difference. *Journal of Research in Science Teaching, 37*(9), 1019-1041.

Karaca, A., Ulucınar, S., & Cansaran, A. (2006). Determining difficulties in laboratory studies in Science Lesson. *Millî Eğitim Dergisi, 170*, pp. 250–259.

Koballa, E. R., Crawley, F. E., & Shrigley, R. L. (1990). A summary of science education-1988. *Science Education, 74*(3).

Koballa, T. R. (1988). Attitude and related concepts in science education. *Science Education, 72*, 115–126.

Landau, V. (2001). *Constructivism and the Student-Centered Approach*. Retrieved August 1, 2012, from Round World Media: http://www.roundworldmedia.com/cvc/module3/notes3.html?&lang=en_us&output=json

Lawson, A. (1995). *Science Teaching and the Development of Thinking.* Belmont, CA: Wadsworth Publishing,.

Lee, O., & Brophy, J. (1996). Motivational patterns observed in sixth-grade science classrooms. *Journal of Research in Science Teaching, 33*(3), pp. 585–610.

Linn, M. C. (1992). Science education reform: Building the research base. *Journal of Research in Science Teaching, 29*, pp. 821-840.

Ma, X. (1997). A multiple regression analysis of mathematics achievement in the Dominican Republic. *International Journal of Educational Development, 17*(3), 313–321.

Machin, S. (2006). *Social disadvantage and education experiences.* DELSA/ELSA/WD/SEM. OECD.

Martin, L. A. (2010). *Relationship Between Teacher Preparedness And Inquiry-Based Instructional Practices To Students' Science Achievemen: Evidence From Timss 2007.* Indiana University of Pennsylvania.

Martin, M. O., Gregory, K. D., & Stemler, S. E. (2000). In *TIMSS 1999 Technical Report.* Chestnut Hill, MA: Boston College.

Martin, M., & Mullis, I. (2004). Overview of TIMSS 2003. In M. O. Martin, I. V. Mullis, & S. J. Chortowski (Eds.). Chestnut Hill, MA.

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

Mattern, N., & Schau, C. (2002). Gender differences in science attitude-achievement relationships over time among white middle-school students. *Journal of Research in Science Teaching, 39*(4), 324-340.

Mc Ewan, P., & Marshall, J. (2004). Why does academic achievement vary across countries? Evidence from Cuba and Mexico. *Education Economics, 12* (3), pp. 205–217.

McCreary, C. L., Golde, M. F., & Koeske. (2006). Peer instruction in the general chemistry laboratory: Assessment of student learning. *Journal of Chemical Education, 83*(5), pp. 804-810.

McNay, M. (2000). The conservative political agenda in curriculum: Ontario's recent experience in science education. *Journal of Curriculum Studies, 32*(6), pp. 749-756.

Medupe, R. (1999). A Perspective on the Problems of Science Education in South Africa. *International Symposium on Astrophysics Research and Science Education.* Vatican Observatory.

MONE. (2004). *MEB Müfredat Geliştirme Süreci*. Retrieved from http://ttkb.meb.gov.tr/programlar/prog_giris/prog_giris_1.html

MONE. (2005). *Basic Education in Turkey BACKGROUND REPORT*. MONE. Retrieved August 1, 2012, from www.oecd.org/edu/reviews/nationalpolicies

Morell, P. D., & Lederman, N. G. (1998). Students' attitudes toward school and classroom science: Are they independent phenomena? *School Science and Mathematics, 98*(2), 76-83.

Mullis, I. V., Martin, M. O., & Foy, P. (Eds.). (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, MA, Boston, USA: Boston College.

Mullis, I. V., Martin, M. O., Olson, J. F., Berger, D. R., Milne, D., & Stanco, G. M. (Eds.). (2008). *TIMSS 2007 encyclopedia: A guide to mathematics and science education around the world* (Vols. 1-2). Chestnut Hill, MA, Boston, USA: Boston College.

Mullis, I. V., Martin, M. O., Ruddock, G. J., O'Sullivan, C. Y., & Preuschoff, C. (2009). *TIMSS 2011 Assessment Frameworks.* Boston College, Lynch School of Education. Chestnut Hill, MA: TIMSS & PIRLS International Study Center. Retrieved August 1, 2012, from http://www.education.gov.za/LinkClick.aspx?fileticket=Ub4vJ%2BeV9ds%3D&

Mullis, I., & Jenkins, L. (1988). *The Science Report Card: Elements of Risk & Recovery Trends and Achievements Based on the 1986 National Assessment of Educational Progress, ETS Report #17-S-01.* New York: Princeton.

Mullis, I., Martin, M., Ruddock, G., O'Sullivan, C., Arora, A., & Erberber, E. (2005). *TIMSS 2007 Assessment Frameworks.* Chestnut Hill, MA, Boston, USA: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College.

NCES. (2012). *National Education Longitudinal Study of 1988 (NELS:88)*. Retrieved August 2012, from The National Center for Education Statistics (NCES): http://nces.ed.gov/surveys/nels88/

NRC. (1996). *National Science Education Standards.* Washington, DC: National Academy Press.

NSF. (2012). *Student Attitudes Toward Math and Science*. (Capital Technology Information Services) Retrieved August 1, 2012, from National Science Foundation: http://www.nsf.gov/statistics/seind93/chap1/doc/1c793.htm

OIliver, J. S. & Simpson, R. D. (1988). Influences of Attitude toward Science, Achievement Motivation, and Science Self Concept on Achievement on Science: A Longitudinal Study. *Science Education, 72,* pp. 143-155.

Okebukola, P. (1987). Students' performance in practical chemistry: A study of some related factors. *Journal of Research in Science Teaching, 24*(2), 119-126.

Oliver, J. S., & Simpson, R. D. (1988). Influences of attitude toward science, achievement motivation, and science self concept on achievement in science: A longitudinal study. *Science Education, 72*(2), pp. 143-155. doi:http://dx.doi.org/10.1002/sce.3730720204

Oliver-Hoyo, M., & Allen, D. (2005). Attitudinal effects of a student-centered active learning environment. *Journal of Chemical Education, 82*(6), 944-949.

Olson, J. F., Martin, M. O., & Mullis, I. V. (Eds.). (2008). *TIMSS 2007 Technical Report.* Chestnut Hill, MA, Boston, USA: TIMSS & PIRLS International Study Center,Lynch School of Education, Boston College. Retrieved August 1, 2012, from http://timssandpirls.bc.edu

Olson, S., & Loucks-Horsley, S. (2000). *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning.* (N. R. Committee on the Development of an Addendum to the National Science Education Standards on Scientific Inquiry, Ed.) Washington,D.C., USA: National Academies Press. Retrieved August 1, 2012, from http://www.nap.edu/catalog/9596.html

Orion, N. (1993). A practical model for the development and implementation of field trips, as an integral part of the science curriculum. *School Science and Mathematics, 93,* pp. 325-331.

Orion, N. (2007, February 12). A Holistic Approach for Science Education For All. *Eurasia Journal of Mathematics, Science, and Technology Education*.

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes Toward Science: A Review of the Literature and its Implications. *International Journal of Science Education, 25*(9), pp. 1049-1079.

Özden, M. (2007). Problems with Science and Technology Education in Turkey. *Eurasia Journal of Mathematics, Science & Technology Education, 3*(2), pp. 157-161.

Papanastasiou, E. (2002). Factors that differentiate mathematics students in Cyprus, Hong Kong, and the USA. *Educational Research and Evaluation, 8*, pp. 129–146.

Parcel, T., & Dufur, J. (2001). Capital at home and at school: effects on student achievement. *Social Forces, 79 (3)*(3), pp. 881–911.

Parker, V., & Gerber, B. (2000). Effects of a science intervention program on middle-grade student achievement and attitudes. *School Science and Mathematics, 100*(5), 236-242.

Ramsden, J. (1998). Mission impossible? Can anything be done about attitudes to science? International Journal of Science Education. *20*, 125-137.

Resnick, L., & Klopfer, L. (Eds.). (1998). *Toward the thinking curriculum: current cognitive research.* Alexandria, VA: Association for Supervision and Curriculum Development.

Riess, F. (2000). Problems with German science education. *Science & Education, 9*, pp. 327-331.

Ruby, A. (2001). *Hands-on Science and Student Achievement.* Santa Monica, CA: RAND Corporation. Retrieved August 1, 2012, from Santa Monica, CA: RAND Corporation, 2001.: http://www.rand.org/pubs/rgs_dissertations/RGSD159/RGSD159.ch3.pdf

Salta, K., & Tzougraki, C. (2004). Attitudes Toward Chemistry Among 11th Grade Students in in High Schools in Greece. *Science Education, 88*, pp. 535-547.

Sammons, P. (1995). Gender, ethnic and socio-economic differences in attainment and progress: a longitudinal analysis of student achievement over 9 years. *British Educational Research Journal, 21*, 465–485.

Schibeci, R. A., & Riley, J. P. (1986). Influence of students' background and perceptions on science attitudes and achievement. *Journal of Research in Science Teaching, 23*(3), pp. 177-187.

Schiller, K., Khmelkov, V., & Wang, X. (2002). Economic development and the effects of family characteristics on mathematics achievement. *Journal of Marriage and Family, 64*, 730–742.

Schouse, R. (1996). Academic press and sense of community: conflict, congruence and implications for student achievement. *Social Psychology of Education, 1*, pp. 47–68.

Schwab, J. (1962). The teaching of science as enquiry. (J. J. Schwab, & P. F. Brandwein, Eds.) *The teaching of science*, pp. 1-103.

Schwab, J. J. (1958). The teaching of science as inquiry. *Bulletin of the Atomic Scientists, 14*(9), pp. 374-379.

Schwab, J. J. (1960). Enquiry, the science teacher, and the educator. *The Science Teacher, 27*, pp. 6 - 11.

Schwab, J. J. (1966). *The teaching of science.* Cambridge, MA: Harvard University Press.

Schwirian, P. N. (1968). On measuring attitudes toward science. *Science Education, 52*, pp. 172-179.

Sciences, T. T. (2005). *(TUBA)'s General Views and Suggestions of New Curricula http://www.tuba.gov.tr/files_tr/haberler/mufredat.doc.*

Shulam, L., & Tamir, P. (1973). Research on Teaching in the Natural Sciences. In R. Travers (Ed.), *Second Handbook of Research on Teaching.* Chicago: Rand McNally.

Simpson, R. D., & Oliver, J. S. (1990). A summary of major influences on attitude towards and achievement in science among adolescent students. *Science Education, 74*(1), pp. 1-18.

Singh, K., Granville, M., & Dika, S. (2002). Mathematics and Science Achievement: Effects of Motivation, Interest, and Academic Engagement. *The Journal of Education Research, 95*(6), 323-332.

Sozbilir, M. S. (2006). From students' perspective teaching methods and techniques used by teachers in science lesson. *Millî Eğitim Dergisi, 172*, pp. 169–176.

Spurlock, H. L. (2001). The impact of student-centered pedagogy and students' feelings of autonomy, competence, and relatedness on motivation: Implications for test motivation and test performance. *Dissertation Abstracts International, 63*(01A), p. 88.

Stevens, J. (2002). *Applied Multivariate Statistics for the Social Sciences* (4 ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Sullivan, C., & Weiss, A. (1999). *"Student Work and Teacher Practices in Science," NCES 1999-455*. Washington, DC: U.S.: Department of Education, Office of Educational Research and Improvement.

Swanson-Gehrke, R. (2005). Poor schools, poor students, successful teachers. *Kappa Delta Pi, 42*(1), pp. 14-17.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using Multivariate Statistics.* Pearson/Allyn & Bacon.

Tansel, A. (2002). Determinants of schooling attainment for boys and girls in Turkey: individual, household and community factors. *Economics of Education Review, 21*, pp. 455–470.

Tansel, A., & Bircan, F. (2006). Demand for education in Turkey: a tobit analysis of private tutoring expenditures. *Economics of Education Review, 25*, pp. 303–313.

TIMSS 2007. (2012). Retrieved August 1, 2012, from http://nces.ed.gov/timss/idetimss/variables.aspx

TIMSS&PIRLS. (2009). *TIMSS 2007 User Guidefor the International Database.Released Items, Science – Eighth Grade.* Boston College, Lynch School of Education. TIMSS & PIRLS International Study Center.

TIMSS&PIRLS. (2012). *TIMSS & PIRLS International Study Center*. Retrieved August 1, 2012, from Boston College: http://timssandpirls.bc.edu/index.html

TIMSS & PIRLS International Study Center. (2012). TIMSS 2007 Contextual Questionnaires. (T. &. Center, Producer, & Lynch School of Education, Boston College) Retrieved August 1, 2012, from TIMSS 2007: http://timss.bc.edu/TIMSS2007/context.html

TIMSS-2007. (2012). Performance at the TIMSS 2007 International Benchmarks for Science Achivement. In *IEA's Trends in International Mathematics and Science Study (TIMSS) 2007.* Lynch School of Education, Boston College: TIMSS & PIRLS International Study Center.

Tuan, H., & Chin, C. (1999). *Promoting junior high school students' motivation toward physical science learning (I).* Taiwan National Research Council , .

Tuan, H., & Chin, C. (2000). *Promoting junior high school students' motivation toward physical science learning (III).* Taiwan National Research Council.

Tuan, H.-L., Chin, C.-C., & Shieh, S.-H. (2005). The development of a questionnaire to measure students' motivation towards science learning. *International Journal of Science Education, 27*(6), 634-659.

TUBA. (2005). The Turkish Academy of Sciences: TUBA's General Views and Suggestions of New Curricula. Retrieved August 1, 2012, from http://www.tuba.gov.tr/files_tr/haberler/mufredat.doc

Tytler, R., Cripps, J., & Darby, L. (2009). Educating the whole child through science: a portrait of an exemplary primary science teacher. *Teaching Science, 55*(3), pp. 22–27.

Ünver, Ö., Gamgam, H. (2006). *Uygulamalı Temel İstatistik Yöntemler.* Ankara: Seçkin Yayıncılık, Ankara. 198.

Van Houtte, M. (2004). Why boys achieve less at school than girls: the difference between boys' and girls' academic culture. *Educational Studies, 30*(2), pp. 159–173.

Veenstra, R., & Kuyper, H. (2004). Effective students and families: the importance of individual characteristics for achievement in high school. *Educational Research and Evaluation, 10*(1), 41–70.

Von Glasersfeld, E. (1998). Cognition, construction of knowledge and teaching. In M. R. Matthews (Ed.), *Constructivism in Science Education* (pp. 11–30). Dordrecht: Kluwer Academic.

Webster, B. J., & Fisher, D. L. (2000, August 09). Accounting for Variation in Science and Mathematics Achievement: A Multilevel Analysis of Australian Data Third International Mathematics and Science Study (TIMSS). *School Effectiveness and School Improvement: An International Journal of Research, Policy and Practice, 11*(3), pp. 339-360.

Weinburgh, M. (1995). Gender differences in student attitudes toward science: A meta-analysis of literature from 1970 to 1991. *Journal of Research in Science Teaching, 32*(4), pp. 387-398.

Weinburgh, M. (2006, August 18). *Journal Of Research in Science Teachng, 32*. doi:10.1002/tea.3660320407

Wellington, J. (Ed.). (1998). *Practical Work in School Science: Which Way Now?* London: Routledge.

White, R., & Tisher, R. (1985). Chapter 30, Research on Natural Sciences. In M. Wittrock (Ed.), *Handbook of Research on Teaching.* New York: Macmillan.

Willingham, D. B., Nissen, M. J., & Bullemer, P. (1989). On the development of procedural knowledge. *Journal of Experimental Psychology, 15*(6), pp. 1047-1060.

Willms, D., & Somers, M. (2001). Family, classroom, and school effects on children's educational outcomes in Latin America. *School Effectiveness and School America. School Effectiveness and School Improvement, 12* (4), pp. 409–445.

Woßmann, L. (2003). Schooling resources, educational institutions and student performance: the international evidence. *Oxford Bulletin of Economics and Statistics, 65*(2), pp. 0305–9049.

Wu, S., & Tuan, H. (2000). A case study of students' motivation in a ninth grader physical science class. In D. Fisher, & J. H. Yang (Eds.), *Proceedings of the Second Conference on Science,Mathematics and Technology Education* (pp. 341–350). Perth: Curtin University of Technology.

Yayan, B., & Berberoglu, G. (2004). A re-analysis of the TIMSS 1999 mathematics assessment data of the Turkish students. *Studies in Educational Evaluation, 30*, pp. 87–104.

Yıldırım, K. (2011, March). Depending on International Research Data Teaching Practices in Science and Technology Lessons in Primary Schools in Turkey. *Journal of Turkish Science Education, 8*(1). Retrieved August 1, 2012, from http://www.tused.org

Yilmaz, I., & Yalcin, N. (2012, March). The Relationship of Procedural and Declarative Knowledge of Science Teacher Candidates in Newton's Laws of Motion to Understanding. *American International Journal of Contemporary Research, 2*(3). Retrieved September 10, 2012, from http://www.aijcrnet.com/journals/Vol_2_No_3_March_2012/5.pdf

APPENDIX A

COMPANION CD

The followings are included in the accompanied CD:

1. The softcopy of the Master's thesis (doc and pdf)
2. The TIMSS 2007 Data from Turkey
3. The TIMSS 2007 School, Student and Grade 8 Science questionnaires are available as PDF files in the CD.

APPENDIX B

LIST OF COUNTRIES PARTICIPATED IN TIMSS

TABLE A.1 List of Countries Participated in TIMSS

	TIMSS 1995			TIMSS 1999	TIMSS 2003		TIMSS 2007		TIMSS 2011	
	4th grade	8th grade	End of secondary school	8th grade	4th grade	8th grade	4th grade	8th grade	4th grade	8th grade
Algeria							o	o		
Argentina		o		o		o				
Armenia					o	o	o	o	o	o
Australia	o	o	o	o	o	o	o	o	o	o
Austria	o	o	o				o		o	
Azerbaijan									o	
Bahrain						o		o	o	o
Belgium (Flemish)		o		o	o	o			o	
Belgium (French)		o								
Bosnia & Herc								o		
Botswana						o		o	o	o
Bulgaria		o		o		o		o		
Canada	o	o	o	o						
Chile				o		o			o	o
Chinese Taipei				o	o	o	o	o	o	o
Colombia		o					o	o		
Croatia									o	
Cyprus	o	o	o	o	o	o	o	o		
Czech Republic	o	o	o	o			o	o	o	
Denmark		o	o				o		o	
Egypt						o		o		
El Salvador							o	o		
England	o	o		o	o	o	o	o	o	o
Estonia						o				
Finland				o					o	o
France		o	o							

TABLE A.1 List of Countries Participated in TIMSS **(Continued)**

	TIMSS 1995			**TIMSS 1999**	**TIMSS 2003**		**TIMSS 2007**		**TIMSS 2011**	
	4^{th} grade	8^{th} grade	End of secondary school	8^{th} grade	4^{th} grade	8^{th} grade	4^{th} grade	8^{th} grade	4^{th} grade	8^{th} grade
Georgia							o	o	o	o
Germany		o	o				o		o	
Ghana						o		o		o
Greece	o	o	o							
Honduras									o	o
Hong Kong SAR	o	o		o	o	o	o	o	o	o
Hungary	o	o	o	o	o	o	o		o	o
Iceland	o	o	o							
Indonesia				o		o		o		o
Iran, Islamic Republic	o	o		o	o	o	o	o	o	o
Ireland	o	o							o	
Israel	o	o		o		o		o		o
Italy	o	o	o	o	o	o	o	o	o	o
Japan	o	o		o	o	o	o	o	o	o
Jordan				o		o		o		o
Kazakhstan									o	o
Korean Republic	o	o		o		o		o	o	o
Kuwait	o	o					o	o	o	
Latvia	o	o	o	o	o	o	o			
Lebanon						o		o		o
Lithuania		o	o	o	o	o	o	o	o	o
Macedonia, Republic of				o		o				o
Malaysia				o		o		o		o
Malta								o	o	
Moldova				o	o	o				
Morocco				o	o	o	o		o	o
Netherlands	o	o	o	o	o	o	o		o	
New Zealand	o	o	o	o	o	o	o		o	o
Northern Ireland									o	
Norway	o	o	o		o	o	o	o	o	o
Oman								o	o	o
Palestinian Authority						o		o		o

TABLE A.1 List of Countries Participated in TIMSS **(Continued)**

	TIMSS 1995			**TIMSS 1999**	**TIMSS 2003**		**TIMSS 2007**		**TIMSS 2011**	
	4^{th} grade	8^{th} grade	End of secondary school	8^{th} grade	4^{th} grade	8^{th} grade	4^{th} grade	8^{th} grade	4^{th} grade	8^{th} grade
Philippines				o	o	o				
Poland									o	
Portugal	o	o							o	
Qatar							o	o	o	o
Romania		o		o		o		o	o	o
Russian Federation		o	o	o	o	o	o	o	o	o
Saudi Arabia						o		o	o	o
Scotland	o	o			o	o	o	o		
Serbia						o		o	o	
Singapore	o	o		o	o	o	o	o	o	o
Slovak Republic		o		o		o	o		o	
Slovenia	o	o	o	o	o	o	o	o	o	o
South Africa		o	o	o		o				o
Spain		o							o	
Sweden		o	o			o	o	o	o	o
Switzerland		o	o							
Syria						o				o
Thailand	o	o		o				o	o	o
Tunisia				o	o	o	o	o	o	o
Turkey				o				o	o	o
Ukraine							o	o		o
United Arab Emirates									o	o
United States	o	o	o	o	o	o	o	o	o	o
Yemen					o				o	
Total	27	43	23	39	26	48	35	46	52	45

o = participating country

NOTE: Only countries that completed the necessary steps for their data to appear in the reports from the International Study Center are listed. List does not include "benchmarking" participants, such as U.S. states and Canadian provinces which, on occasion, participate separately from the nation.

APPENDIX C

TIMSS 2007 INTERNATIONAL REPORT

Science Achievement

Country	Average Scale Score
Singapore	567
Chinese Taipei	561
Japan	554
Korea, Rep. of	553
England	542
Hungary	539
Czech Republic	539
Slovenia	538
Hong Kong SAR	530
Russian Federation	530
United States	520
Lithuania	519
Australia	515
Sweden	511
TIMSS Scale Average	500
Scotland	496
Italy	495
Armenia	488
Norway	487
Ukraine	485
Jordan	482
Malaysia	471
Thailand	471
Serbia	470
Bulgaria	470
Israel	468
Bahrain	467
Bosnia and Herzegovina	466
Romania	462
Iran, Islamic Rep. of	459
Malta	457
Turkey	454
Syrian Arab Republic	452
Cyprus	452
Tunisia	445
Indonesia	427
Oman	423
Georgia	421
Kuwait	418
Colombia	417
Lebanon	414
Egypt	408
Algeria	408
Palestinian Nat'l Auth.	404
Saudi Arabia	403
El Salvador	387
Botswana	355
Qatar	319
Ghana	303
Morocco	402
Benchmarking Participants	
Massachusetts, US	556
Minnesota, US	539
Ontario, Canada	526
British Columbia, Canada	526
Quebec, Canada	507
Basque Country, Spain	498
Dubai, UAE	489

TABLE A.2 TIMSS 2007 Average Science Achievement by Gender in Turkey

	Girls		Boys		Difference (Absolute Value)
	Percent of Students(se)	Average scale score	Percent of Students	Average scale score	
Turkey	47 (0.8)	457 (4.0)	53 (0.8)	452 (4.0)	5 (3.0)
International Avg.	**50 (0.2)**	**469 (0.8)**	**50 (0.2)**	**463 (0.7)**	**6 (0.7)**

se Standard errors appear in parentheses
(Martin, Mullis, & Foy, 2008)

Although girls had higher achievement than boys in Turkey, the difference was not statistically significant. The difference was statistically significant in International Average.

TABLE A.3 Percentages of Students Reaching the TIMSS 2007 International Benchmarks of Science Achievement in Turkey

	Advanced Benchmark (625)	High Benchmark (550)	High Benchmark (475)	High Benchmark (400)
Turkey	3 (0.5)	16 (1.2)	40 (1.7)	71 (1.5)
International Avg.	**3**	**17**	**49**	**78**

se Standard errors appear in parentheses
(Martin, Mullis, & Foy, 2008)

Table A.4 Average Achievement in the Science Content Domain in Turkey, TIMSS 2007

	Average Scale Scores for Science Content Domains			
	Biology	Chemistry	Physics	Earth Science
Turkey	462 (3.4)	435 (5.2)	445 (4.3)	466 (3.3)
TIMSS Scale Avg.	**500**	**500**	**500**	**500**

se Standard errors appear in parentheses
(Martin, Mullis, & Foy, 2008)

Turkey performed relatively better in biology than in science overall, and performed relatively less well in chemistry. Turkey showed relatively better performance in earth science.

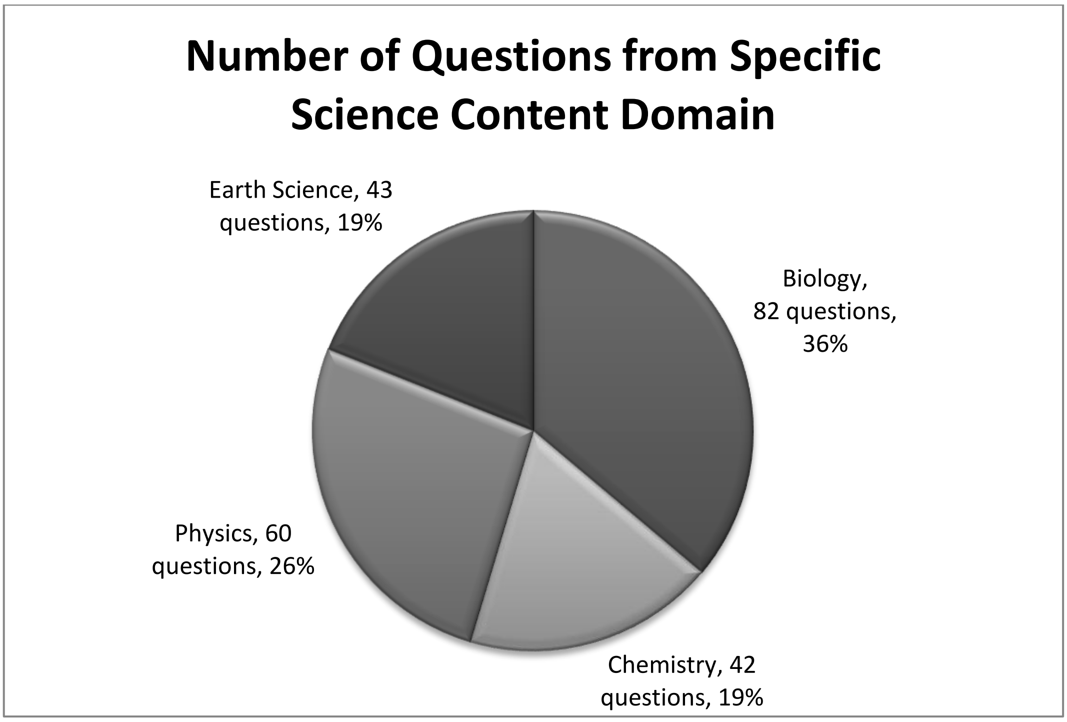
Table A.5 Average Achievement in the Science Cognitive Domain in Turkey, TIMSS 2007

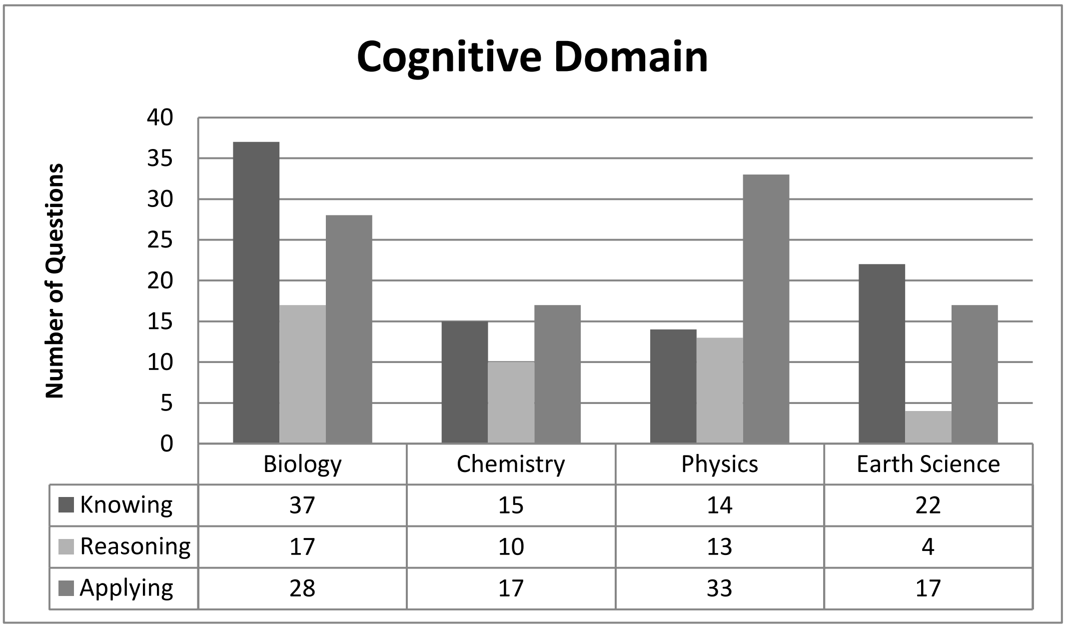
	Average Scale Scores for Science Cognitive Domains		
	Knowing	**Applying**	**Reasoning**
Turkey	462 (3.6)	450 (3.6)	462 (3.4)
TIMSS Scale Avg.	**500**	**500**	**500**

se Standard errors appear in parentheses
(Martin, Mullis, & Foy, 2008)

APPENDIX D

SCIENCE CONTENT AND COGNITIVE DOMAINS FOR GRADE 8





APPENDIX E

SCIENCE CONTENT DOMAINS AND TOPIC AREAS FOR GRADE 8

Content Domains	**Topic Areas**
Biology	Characteristics, classification, and life processes of organisms Cells and their functions Life cycles, reproduction, and heredity Diversity, adaptation, and natural selection Ecosystems Human health
Chemistry	Classification and composition of matter Properties of matter Chemical change
Physics	Physical states and changes in matter Energy transformations, heat, and temperature Light Sound Electricity and magnetism Forces and motion
Earth Science	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

(Olson, Martin, & Mullis, 2008)

The content of the following lists are from **T07_G8_ItemInformation** from TIMS and PIRLS.

SCIENCE (BIOLOGY) CONTENT DOMAIN FOR GRADE 8

Topic Area	Cognitive Domain	Item Label
Ecosystems	Knowing	Reason for increase in population True statement about producers Growth of algae in a lake Which organism is a producer Volcanic eruption effects
	Reasoning	Human population graphs Complete the food web Sharks when tuna becomes scarce Oxygen/carbon dioxide cycle Relation of rabbit-fox populations Number of lynxes in 1996 vs. 2004 Population in 2 countries/predict Population in 2 countries/land use Population in 2 countries/pollution Antelope population graph
	Applying	Problems due to population Draw the direction of energy flow Year of highest rabbit population Importance of removing weeds Eagles cannot survive without plants Population of rabbits and lynxes Advantage for viceroy butterfly O_2-CO_2 release-removal/animals O_2-CO_2 release-removal/plants O_2-CO_2 release-removal/photosynthesis
Diversity, adaptation, and natural selection	Knowing	Animal on Earth longest time Where organisms appeared on Earth
	Reasoning	How organism survives low tide
	Applying	At the bottom of ocean At the bottom of ocean At the bottom of ocean/DERIVED Giraffes with short and long necks Difference in shell colors of snails
Characteristics, Classification and Life Processes of Organisms	Knowing	Complex molecules are broken down Animal with scales and lungs What is organ X Characteristic found only in mammals One function of the uterus O_2-CO_2 exchange in an animal skin
	Reasoning	Heart rate increasing with exercise
	Applying	Body temperature in hot/cold climate Classification of animals Lungs in bird/which organ in frog Eyes react to changes Function lungs-skin-kidneys share Characteristic to classify organisms

SCIENCE (BIOLOGY) CONTENT DOMAIN FOR GRADE 8 **(Continued)**

Topic Area	Cognitive Domain	Item Label
Human Health	Knowing	Highest percentage of protein Which one caused by a virus Gall bladder stores bile Cells that destroy bacteria Exercise is important for health Long-term immunity against disease
	Applying	Why one friend did not get influenza Vaccinating people against influenza
Cells and their Functions	Knowing	Cells that conduct messages Function of chlorophyll Life function of Paramecium Structure found in plant cells Factors for photosynthesis Factors for photosynthesis Factors for photosynthesis/DERIVED Function of the cell membrane Process of respiration Purpose of cellular respiration Organelle that produces energy
	Reasoning	CO_2 concentration and photosynthesis
	Applying	Organization in living things Function of cell part X
Life Cycles, Reproduction, and Heredity	Knowing	Which one forms after fertilization Whether two people are related Conditions for germination Conditions for germination Conditions for germination/DERIVED Number of kidneys son has at birth
	Reasoning	Predict the height of pea plants Investigation of green/red peppers Designing plant growth experiment
	Applying	What kind of reproduction Life cycle stage monarch grows Life cycle stage monarch develops

SCIENCE (CHEMISTRY) CONTENT DOMAIN FOR GRADE 8

Topic Area	Cognitive Domain	Item Label
Classification and Composition of Matter	Knowing	Correct model of atomic particles Number of atoms in H_2SO_4 molecule Definition of a compound Formula for carbon dioxide Good conductor of heat-electricity Which one is a mixture
	Reasoning	Density of salt solution Different results for mass Different results for volume Group measured the closest density Identify iron, water and oxygen Volume of the neck chain Complete table 3 with percent gold
	Applying	Materials sorted into two groups Neck chain with most gold Diagram representing water molecules Which rod causes the bulb to light Classify elements/compounds/mixtures Diagram for structure of matter Identify if substance is metal Why oil floats on top of water Wood or metal container to keep ice
Properties of Matter	Knowing	Sugar dissolving in water
	Reasoning	Separation of salt/sand/leaves Solubility/temperature graphs
	Applying	Which solution is more dilute Why plastic bottle cracked
Chemical change	Knowing	Gas needed for rust to form Observation of bubbling electrode Gas necessary for combustion NOT a chemical change Observations for reaction Example of acidic solution Ammonia solution mixed with vinegar Process in which energy is absorbed
	Reasoning	Balance after HCL-NaOH are mixed
	Applying	Mass for Figure 2 Type of change in the milk Energy released during a reaction Which nails rusted most Sodium bicarbonate mixed in vinegar Flakes on an iron nail

SCIENCE (PHYSICS) CONTENT DOMAIN FOR GRADE 8

Topic Area	Cognitive Domain	Item Label
Physical states and changes in matter	Knowing	Liquid compared to a gas Conserved in thermal expansion Mass/volume of frozen water
	Reasoning	Freezing salt water experiment Flasks contain fresh and salt water
	Applying	Temperature of boiling water Arrangement of particles in a metal Mass of freezing water Change-stay the same/density Change-stay the same/mass Change-stay the same/volume Change-stay the same/molecule size Change-stay the same/molecule speed Change-stay the same/DERIVED
Energy Transformations, Heat, and Temperature	Knowing	Molecules of a liquid when it cools Type of energy in compressed spring Energy conversion in a flashlight Molecules of gas when heated
	Reasoning	Position of thermometer One variable kept constant Conclusion from the graph Water level in heated container
	Applying	Heat conductivity experiment Expansion in thermometer Heat flow in metal cubes Heat conduction through copper rod Which ice block will melt first Gaps between metal rail spans
Light	Knowing	Speed of light through substances Shadow of a tree on a sunny day
	Applying	Color of an object and light waves Path of light ray through periscope Seeing lightning and hearing thunder Student reading a book
Sound	Knowing	Sound waves of large/small amplitude Sound of plucked guitar string
	Reasoning	Relative speed of sound
	Applying	Transmission of sound on the moon Sound from electric bell inside jar

SCIENCE (PHYSICS) CONTENT DOMAIN FOR GRADE 88 **(Continued)**

Topic Area	**Cognitive Domain**	**Item Label**
Electricity and magnetism	Knowing	Iron nail with wire coiled around it
	Reasoning	Current/voltage table Find out if metal 2 is a magnet Strength of a magnet
	Applying	Advantage of parallel circuits Magnets 1-2 touch but 2-3 do not Bulbs in series/parallel circuit What is the resistance in a circuit
Forces and Motion	Knowing	Example of a lever Force causing the ball to fall
	Reasoning	Graph interpretation of bicycle ride Densities of liquids and disk Water level in U-tube
	Applying	Matching diagram with lever parts Force exerted by each man Diagram of a person doing work Forces on students sitting on wall Gravity acting on parachute jumper Why does a balloon with helium rise Why bottle collapses in the valley Ball bouncing up again

SCIENCE (EARTH SCIENCE) CONTENT DOMAIN FOR GRADE 8

Topic Area	Cognitive Domain	Item Label
Earth's structure and physical features	Knowing	Percentage of fresh water on earth How soil is formed Location of fresh water on Earth Gas increasing in atmosphere
	Reasoning	Topographic map/ river path
	Applying	Topographic map/ identify X Changes at high elevations Changes at high elevations Changes at high elevations/DERIVED
Earth processes, cycles and history	Knowing	Energy for Earth's water cycle Pollution of underground water Where active volcanoes are found Water cycle processes Evaporated water ending up as rain Soil change due to natural causes What causes an earthquake
	Reasoning	Acid rain from sulfur dioxide Location of jungle
	Applying	Physical causes of weathering Chemical causes of weathering Effect of cutting down the trees Weather in towns 4 and 5 on Tuesday Oil spills Global warming Liquid on outside of pitcher Order of steps in the water cycle Direction river flows
Earth's Resources, Their use and Conservation	Knowing	Why recycling is important Which resource is nonrenewable Effect of dam on wildlife Material that breaks down quickly
	Reasoning	Table of fertilizer/rice yield data
	Applying	Reducing soil erosion
Earth in the Solar System and the Universe	Knowing	Earth year Diagram of an eclipse of the moon What causes the phases of the moon Major cause of tides What rotation of Earth causes Difference between planets and moons Result of gravitational pull of moon
	Applying	Caused by tilt of Earth's axis Light from sun and moon Moon seen differently

APPENDIX F

SAMPLE ITEMS FROM RELEASED SCIENCE ACHIEVEMENT QUESTIONNAIRE

(TIMSS&PIRLS, TIMSS 2007 User Guidefor the International Database.Released Items, Science – Eighth Grade., 2009)

Item ID	S032115	Subject	S	Grade	8	Block	S01	Block Seq	01

TIMSS2007

Science

Eighth Grade

Which of the following is closest to the percentage of the total water on earth that is fresh water?

Ⓐ 100%
Ⓑ 90%
Ⓒ 70%
Ⓓ 3%

S032115

Content Domain
Earth Science

Cognitive Domain
Knowing

Maximum Points
1

Key
D

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S032565	Subject	S	Grade	8	Block	S01	Block Seq	02

	Temperature	Dissolved Salt	Volume of Water	Density
Pure Water	25°C	0 g	100 ml	1.0 g/ml
Salt Solution	25°C	10 g	100 ml	?

The incomplete table above compares some data for pure water and for a salt solution.

What is the density of the salt solution?

(Check one box.)

- ☐ 1.0 g/ml
- ☐ Less than 1.0 g/ml
- ☐ Greater than 1.0 g/ml

Explain your answer.

S032565

TIMSS2007

Science
Eighth Grade

Content Domain
Chemistry

Cognitive Domain
Reasoning

Maximum Points
1

Key
See scoring guide

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S032565	Subject	S	Grade	8	Block	S01	Block Seq	02

Note: To receive credit, responses must check >1g/ml AND give an explanation. Credit will be given both for higher-level explanations based on the added mass from dissolved salt (Code 10) as well as responses with minimal explanations indicating factual knowledge that the density of salt water is greater (Code 11).

Code	Response	Item: S032565
	Correct Response	
10	**>1g/ml** with an explanation based on the added mass from dissolved salt (and the volume staying essentially the same). *Examples:* *When the salt is added to the water, it dissolves and gives into the water another g/ml.* *Pure water has 0 g of salt and 100 ml water. If salt solution has 10 g more salt than pure water, the density should be greater than 1g/ml.* *As the dissolved salt increases, the density will increase because of the increase in mass which makes the particle per unit more.* *The density is 1.1 g/ml [(100g of water + 10g of salt)/100 ml]*	
11	**>1g/ml** with minimal explanation. *Examples:* *The density always goes up when you add salt.* *Salt will make the water heavier.* *There is more salt which has dissolved.* *Impure solutions have greater densities.* *Because it's salt water. Pure water doesn't have any salt in it.*	
19	Other correct	
	Incorrect Response	
70	**>1g/ml** with no explanation or an incorrect explanation. *Examples:* *25 X 100/10 = 20.5 g/ml* *You will need more hot water to dissolve the salt.*	
71	**1g/ml** with or without explanation. *Examples:* *The salt just dissolves and nothing happens.* *Salt solution equals pure water.*	
72	**<1g/ml** with or without explanation. *Examples:* *Salt disappears when it dissolves.* *The more you heat the salt, the quicker it will dissolve. So, in the end nothing will be left.* *Density is 0.1 g/ml (10g salt /100 ml).*	
79	Other incorrect (including crossed out/erased, stray marks, illegible or off task)	
	Nonresponse	
99	Blank	

Item ID	S032403	Subject	S	Grade	8	Block	S01	Block Seq	03

Which statement is true about the particles of a liquid compared to the particles of a gas?

Ⓐ Particles of a liquid are slower and farther apart.
Ⓑ Particles of a liquid are faster and farther apart.
Ⓒ Particles of a liquid are slower and closer together.
Ⓓ Particles of a liquid are faster and closer together.

S032403

TIMSS2007

Science

Eighth Grade

Content Domain
Physics

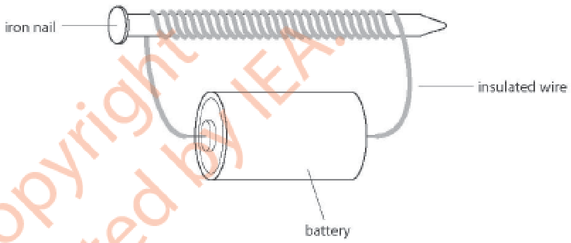
Cognitive Domain
Knowing

Maximum Points
1

Key
C

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S032273	Subject	S	Grade	8	Block	S01	Block Seq	04



The figure shows an iron nail with an insulated wire coiled around it. The wire is connected to a battery.

What will happen to the nail when current flows through the wire?

Ⓐ The nail will melt.

Ⓑ Electric current will flow through the nail.

Ⓒ The nail will become a magnet.

Ⓓ Nothing will happen to the nail.

S032273

TIMSS2007

Science

Eighth Grade

Content Domain
Physics

Cognitive Domain
Knowing

Maximum Points
1

Key
C

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S032019A	Subject	S	Grade	8	Block	S01	Block Seq	05

The weathering (gradual breaking down) of rocks can be caused by both physical and chemical processes. Write down one physical process and one chemical process. Explain how each can cause the weathering of rocks.

Physical Process:

Chemical Process:

S032019

TIMSS2007

Science

Eighth Grade

Content Domain
Earth Science

Cognitive Domain
Applying

Maximum Points
1

Key
See scoring guide

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S032019A	Subject	S	Grade	8	Block	S01	Block Seq	05

Note: To receive credit, a response must include an explanation. Responses that only give the name of a process/agent without further explanation are scored as incorrect (Code 70). Destructive forces due to sudden action are scored as incorrect (Code 71), as they are not the result of a gradual weathering process.

Code	Response	Item: S032019A
	Correct Response	
10	Identifies a physical process or agent and explains how it can cause weathering. *Examples:* *Rocks expand and contract due to changes in temperature.* *Water collects in cracks and freezes and causes the rocks to break apart.* *Water pours down a rock face, causing it to weather.* *Wind blowing across rocks causes pieces to break off.* *Rain slowly makes rocks break down.* *Glaciers or water can cause rocks to break away.* *When water runs down a stream it carries away tiny pieces of rock downstream.* *Plants grow into the cracks of rocks.*	
19	Other correct	
	Incorrect Response	
70	Names a physical process or agent without further explanation. *Examples:* *Erosion, wind, rain, weather, exfoliation.*	
71	Refers to a destructive force caused by sudden action (not the result of a gradual weathering process). *Examples:* *Rocks can be broken down using the force of a hammer.*	
79	Other incorrect (including crossed out/erased, stray marks, illegible, or off task)	
	Nonresponse	
99	Blank	

Item ID	S032019B	Subject	S	Grade	8	Block	S01	Block Seq	05

The weathering (gradual breaking down) of rocks can be caused by both physical and chemical processes. Write down one physical process and one chemical process. Explain how each can cause the weathering of rocks.

Physical Process:

Chemical Process:

S032019

TIMSS2007

Science

Eighth Grade

Content Domain
Earth Science

Cognitive Domain
Applying

Maximum Points
1

Key
See scoring guide

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S032019B	Subject	S	Grade	8	Block	S01	Block Seq	05

Note: To receive credit, a response must include an explanation. Responses that only give the name of a process/agent without further explanation are scored as incorrect (Code 70).

Code	Response	Item: S032019B
	Correct Response	
10	Identifies a chemical process or agent and explains how it can cause weathering. *Examples:* *Oxygen combines with metals in rocks to break them down.* *Carbon dioxide dissolved in water dissolves limestone.* *Acid rain can affect rocks by disintegrating them slowly.* *When we don't dispose of our waste properly it may contain some substance that can break down the rocks when it seeps into the soil.* *Chemicals secreted by living organisms such as lichen and mosses dissolve rock.* *Some chemicals (maybe acid) that is put onto rocks will react with the elements and cause it to erode.*	
19	Other correct	
	Incorrect Response	
70	Names a chemical process or agent without further explanation of how it causes weathering. *Examples:* *Acid rain.* *Acid.* *Lava and fire.* *It is a chemical process when two or more substances are joined.* *Rocks are broken down by mixing up chemicals.* *A chemical seeps into the rocks.*	
71	Identifies a physical process. *Examples:* *Erosion and wind.* *Melting.* *Water gets in and creates cracks and it collapses.*	
79	Other incorrect (including crossed out/erased, stray marks, illegible, or off task)	
	Nonresponse	
99	Blank	

Item ID	S032516	Subject	S	Grade	8	Block	S01	Block Seq	06

TIMSS2007

Science

Eighth Grade

In a rural area, there are many trees. The people living in the area decide to cut down the trees for wood.

Give one possible long-term effect of their decision on the environment.

S032516

Content Domain
Earth Science

Cognitive Domain
Applying

Maximum Points
1

Key
See scoring guide

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

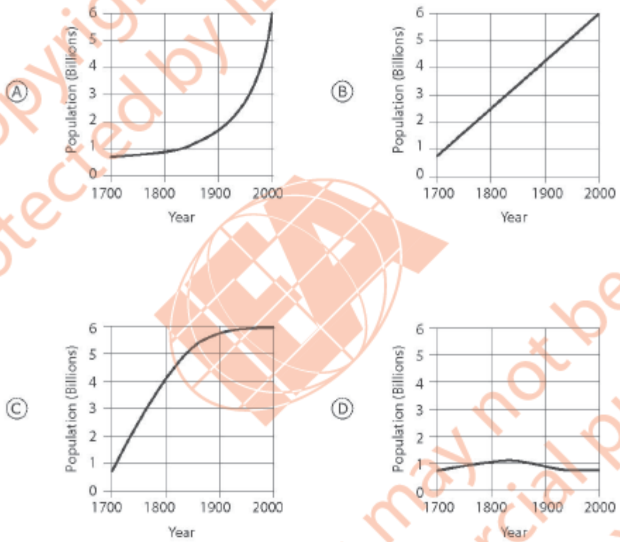
Item ID	S032516	Subject	S	Grade	8	Block	S01	Block Seq	06

Note: Credit is given both for responses that give a negative (Code 10) or a neutral/positive (Code 11) long-term effect on the environment (plants/animals, land, water, atmosphere, etc.). Responses that refer only to the loss of trees or an effect on humans are scored as incorrect. If more than one effect is included, the code corresponding to the first correct effect should be given even if other incorrect effects are included. Since only one effect is asked for, the incorrect portion is not considered unless it negates the correct portion of the response.

Code	Response	Item: S032516
	Correct Response	
10	States a **negative** effect on the environment (e.g., loss of habitat for plants/animals, soil erosion, atmospheric changes, desertification, changes in rainfall, etc.). *Examples:* *Some animals will lose their homes and die.* *It can affect the animals because some of them need to eat off the trees.* *Animals will die or move to another location.* *No trees to absorb water, therefore rain and wind will erode the soil.* *There will be floods a lot more often.* *It will lead to global warming because the trees won't use up carbon dioxide anymore.* *There will be no more trees to give off oxygen.* *When all the trees are cut down there will be less rain in the area.* *The area can become like a desert without any trees.*	
11	States a **neutral** or **positive** effect on the environment (e.g., a change in the balance of plant life, increased habitat for some types of animals/plants, etc.). *Examples:* *When all the trees are cut down there will be more room for some types of animals and plants.* *Different types of plants could now grow there.*	
19	Other correct	
	Incorrect Response	
70	Mentions only the loss of trees. *Examples:* *All the trees might eventually be gone.* *The trees will take a long time to grow back.*	
71	Mentions only an effect related to human use of wood or cleared land. [Long-term effect on the environment not clear.] *Examples:* *They would have more firewood.* *More free space for houses, malls and businesses.* *Won't have enough trees in the future for stuff like houses and paper.*	
79	Other incorrect (including crossed out/erased, stray marks, illegible, or off task)	
	Nonresponse	
99	Blank	

Item ID	S032620	Subject	S	Grade	8	Block	S01	Block Seq	07

Which of the following graphs best shows how the human population of the world has changed over the last 300 years?



S032620

TIMSS2007

Science

Eighth Grade

Content Domain
Biology

Cognitive Domain
Reasoning

Maximum Points
1

Key
A

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

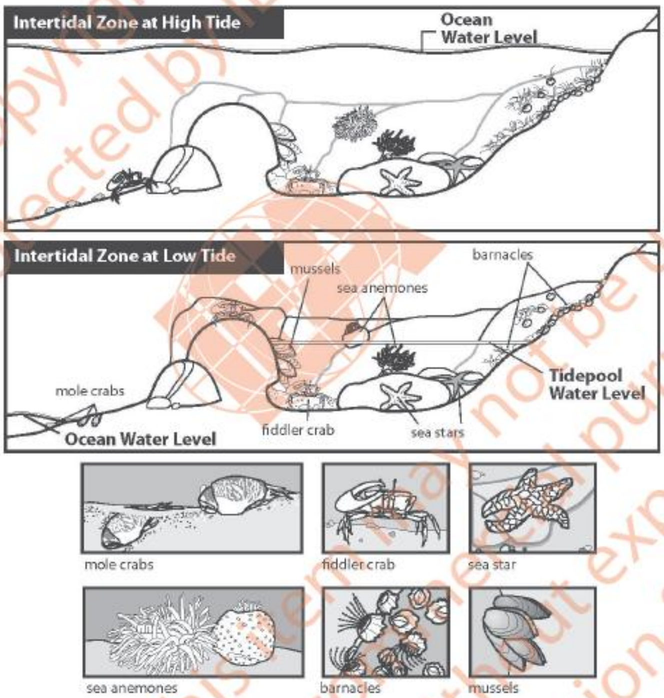
Item ID	SP32695	Subject	S	Grade	8	Block	S01	Block Seq	09

TIMSS2007

Science

Eighth Grade

The intertidal zone is found along the ocean shore between the low-tide and high-tide lines. The diagrams below show a cross-section of an intertidal zone at high tide and at low tide and some of the organisms living there.



Questions for Life in the Oceans continue.

SP32695

Content Domain

Cognitive Domain

Maximum Points

Key

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S032695	Subject	S	Grade	8	Block	S01	Block Seq	09

TIMSS2007

Science

Eighth Grade

The organisms that live in the intertidal zone have special adaptations that allow them to survive the effects of tides.

Select an organism from the intertidal zone. Identify a physical feature or behavior of this organism. Explain how this feature or behavior helps the organism to survive low tide.

Name of organism: ______________________________

Feature or behavior: ______________________________

____

Explanation:

S032695

Questions for Life in the Oceans continue.

Content Domain
Biology

Cognitive Domain
Reasoning

Maximum Points
2

Key
See scoring guide

Item ID	S032695	Subject	S	Grade	8	Block	S01	Block Seq	09

Note: For full credit, responses must identify an organism in the diagram, describe a feature or behavior of this organism, AND explain how this feature/behavior helps the organism to survive at least one effect of low tide: lack of water, lack of food, exposure to predators or elements, changes in salinity, or effects of wave action. Following is a list of specific features/behaviors expected for each organism and the effect of low tide that the adaptation helps the organism to survive. All of the organisms also have special gill structures that allow them to exchange gases (oxygen/carbon dioxide) with very little water, and this also is to be considered as a correct response.

Sea Anemones	Close up (lack of water, salinity, predators); live in clusters (lack of water reduces exposed body surface area); attach to rocks (wave action)
Mole Crabs	Burrow into the sand (lack of water, predators); hard shell (wave action, lack of water, predators)
Mussels and Barnacles	Attach to rocks (wave action); hard shell (wave action, lack of water, predators); close up (lack of water, salinity, predators); lowers metabolism rate (lack of food, lack of water for removing toxic waste build-up)
Fiddler Crabs	Burrow into sand or crawl into crevices (lack of water, predators); legs/mobility (lack of water/food, predators); hard shell (wave action, lack of water, predators)
Sea Stars	Suction cups/attach to rocks (wave action); tube feet/mobility (lack of water/food, predators, gas exchange); hard/spiny surface (wave action, lack of water, salinity, predators)

Code	Response	Item: S032695
	Correct Response	
20	Identifies an organism, describes a feature/behavior, AND gives an explanation. *Examples:* *Sea anemones. They close up. It keeps them from drying out during low tide.* *Mole crabs. They dig into the sand, They are not exposed at low tide.* *Mussels. They have hard shells. They can store water inside their shells.* *Fiddler crabs. They have legs and can crawl into the tidepool and rocks to find food.* *Barnacles. They close up and have hard shells. The predators cannot eat them.* *Sea stars. Suction cups on their legs. Attach to the rocks and not get swept to sea.*	
29	Other fully correct	
	Partial Response	
10	Identifies an organism and describes a feature/behavior; NO explanation or inadequate explanation given. *Examples:* *Sea Anemones. They close up; Mole crabs. They can dig into the sand; Mussels. Have shells.*	
19	Other partially correct	
	Incorrect Response	
70	Only identifies an organism from the diagram but with no or incorrect description of feature/behavior.	
79	Other incorrect (including crossed out/erased, stray marks, illegible or off task)	
	Nonresponse	
99	Blank	

Item ID	S032697	Subject	S	Grade	8	Block	S01	Block Seq	10

S032697

Fewer species of organisms (plants and animals) have been found living in the depths of the oceans than in the regions closer to the surface. Organisms living at the bottom of the ocean must be adapted to the conditions there.

Name two conditions that are found at the bottom of the ocean that make it difficult for most plants and animals to live there.

1.

2.

End of Life in the Oceans section.

TIMSS2007

Science
Eighth Grade

Content Domain
Biology

Cognitive Domain
Applying

Maximum Points
2

Key
See scoring guide

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S032697	Subject	S	Grade	8	Block	S01	Block Seq	10

Note: Each of the two responses is coded separately. Each correct diagnostic code (10,11,12,13) may be used only once. If the two responses are essentially the same, the second response should be coded as 79. For example, if a response states "the sunlight cannot penetrate that deep" and "not enough light for photosynthesis", then the first response is given Code 10, and the second is given a Code 79. If only one response is given, the second should be given Code 99.

Code	Response	Item: S032697A,B
	Correct Response	
10	Mentions lack of light.	
11	Mentions low temperatures.	
12	Mentions high pressure.	
13	Mentions lack of food.	
19	Other correct *Examples:* *It is too salty at the bottom, so some species cannot live there.* *There are poisonous gases from volcanic vents at the bottom of the ocean.* *Low visibility.*	
	Incorrect Response	
70	Mentions **only** lower oxygen (carbon dioxide, air) levels in deep water. [NOT a general condition found at great ocean depths.] *Examples:* *There would not be enough oxygen for the fish to breathe.* **Note:** While lower oxygen levels do occur in some regions of the ocean, it is not a general condition that exists purely due to depth (gas saturation increases with decreasing temperature and increasing pressure). The level of oxygen is a complex function of depth with a minimum-oxygen zone in the 500 – 1000 meter range, related to the breakdown of organic matter below the photic zone and convection that mixes the deep ocean water. Responses that refer ONLY to low oxygen levels will, therefore, be scored as incorrect. For more sophisticated responses that describe the minimum oxygen zone at intermediate depths, a Code 19 may be given.	
71	Mention **only** predators (or similar). [NOT specific to the bottom of the ocean.]	
79	Other incorrect (including crossed out/erased, stray marks, illegible or off task)	
	Nonresponse	
99	Blank	

Item ID	S042009	Subject	S	Grade	8	Block	S02	Block Seq	01

S042009

In living things, large and complex molecules are broken down into small and simple molecules.

What is this process called?

Ⓐ excretion
Ⓑ absorption
Ⓒ digestion
Ⓓ circulation

TIMSS2007

Science
Eighth Grade

Content Domain
Biology

Cognitive Domain
Knowing

Maximum Points
1

Key
C

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S042313	Subject	S	Grade	8	Block	S02	Block Seq	02

Keith had influenza. He played a game with two friends. One of his friends caught influenza, but the other friend did not.

What could have been the reason why one of the friends did NOT catch influenza?

S042313

TIMSS2007

Science

Eighth Grade

Content Domain
Biology

Cognitive Domain
Applying

Maximum Points
1

Key
See scoring guide

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S042313	Subject	S	Grade	8	Block	S02	Block Seq	02

Code	Response	Item: S042313
	Correct Response	
10	Refers either directly or indirectly to the immune system. *Examples:* *He may have had it already.* *He was vaccinated.* *He has a good immune system.*	
11	Refers to not being in close contact or taking preventative measures. *Examples:* *He didn't let Keith sneeze on him.* *He washed his hands after playing.* *He wasn't in contact with his saliva.* *He might not have had body contact with Keith.* *He may have stayed farther away than the other friend.*	
19	Other correct	
	Incorrect Response	
70	Refers to just being healthier or not getting sick as easily. *Examples:* *His health might be stronger.* *Because maybe he doesn't get sick that easily.*	
71	Refers to having a good diet. *Examples:* *Maybe he eats a balanced diet.* *Maybe he eats lots of fruit with vitamins.*	
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	Nonresponse	
99	Blank	

Item ID	S042276	Subject	S	Grade	8	Block	S02	Block Seq	07

The color of an object such as an apple is the same as the color of the light waves

Ⓐ that travel through the object

Ⓑ that are absorbed by the object

Ⓒ that are reflected by the object

Ⓓ that travel around the object

S042276

TIMSS2007

Science

Eighth Grade

Content Domain
Physics

Cognitive Domain
Applying

Maximum Points
1

Key
C

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S042083	Subject	S	Grade	8	Block	S02	Block Seq	09

TIMSS2007

Science

Eighth Grade

Content Domain
Chemistry

Cognitive Domain
Reasoning

Maximum Points
2

Key
See scoring guide

Thato fell off his bicycle and spilled the bag of salt he was carrying. He collected the salt off the ground together with sand and tree leaves and put the mixture in a plastic bag.

In the table below, describe the steps used by Thato to separate the salt from the mixture of salt, sand, and leaves. State a reason for doing each step.
The first step has been done for you.

Step	Description of Step	Reason for Carrying Out the Step
1.	Put the mixture through a sieve.	This will remove the leaves.
2.		
3.		
4.		

S042083

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S042083	Subject	S	Grade	8	Block	S02	Block Seq	09

Note: i) Fully correct responses include:
Step 2. Reference to addition of water to dissolve the salt or reference to a salt solution (implies addition of water).
Step 3. Reference to the mixture being filtered (sifted, decanted) to remove the sand.
Step 4. Reference to the salt water being boiled (heated, left out in the sun) to evaporate the water (and leave the salt behind).

ii) Fully correct responses may only use the spaces beside steps 2 and 3.

Code	Response	Item: S042083
	Correct Response	
20	Refers to the processes in steps 2, 3, and 4 as indicated in the note above.	
	Partially Correct Response	
10	Describes a partial method that includes dissolving and/or filtering. *Examples:* *Step 2. Add water to dissolve salt (correct). Step 3. Pour the water off (correct). Step 4. This will give you salt (incorrect).* *Step 2. Fill the mixture with water to let the salt dissolve in water (correct). Step 3. Boil the mixture to separate the salt from the sand (incorrect). Step 4. Cool the mixture to prevent the salt from hardening (incorrect).* *Step 2. Filter the salt solution (correct). Step 3 The sand will be left in the filter (correct).*	
	Incorrect Response	
79	Incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	Nonresponse	
99	Blank	

Item ID	S042106	Subject	S	Grade	8	Block	S02	Block Seq	10

The mass of substances A and B are measured on a balance, as shown in Figure 1. Substance B is put into the beaker and substance C is formed. The empty beaker is put back on the balance, as shown in Figure 2.

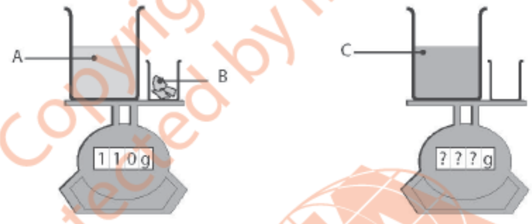


Figure 1 Figure 2

The scale in Figure 1 shows a mass of 110 grams.

What will it show in Figure 2?

(Check one box.)

- ☐ More than 110 grams
- ☐ 110 grams
- ☐ Less than 110 grams

Explain your answer.

S042106

TIMSS2007

Science

Eighth Grade

Content Domain
Chemistry

Cognitive Domain
Applying

Maximum Points
1

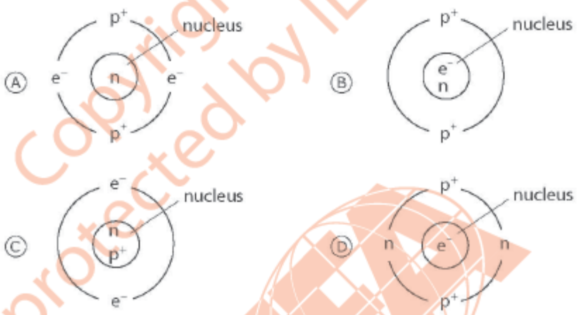
Key
See scoring guide

Item ID	S042106	Subject	S	Grade	8	Block	S02	Block Seq	10

Code	Response	Item: S042106
	Correct Response	
10	**110 grams** with an explanation that refers to conservation of mass (or nothing lost or gained). *Examples:* *The mass of the reactants equals the mass of the products.* *No extra substances were added.* *If you mix A and B together to get C, the weight will not change.*	
11	**Less than 110 grams** with an explanation that refers to gas production. *Examples:* *Maybe a gas is produced that escapes, so the mass would change.*	
	Incorrect Response	
70	**110 grams** with an incorrect or no explanation. *Examples:* *The same because there is liquid in figure 2.*	
71	**Less than 110 grams** with an incorrect or no explanation. *Examples:* *Figure 2 has no substance B in the beaker. So it may be much lighter than figure 1.* *Because if the solid B was a solid, it would weigh more.*	
72	**More than 110 grams** with an incorrect or no explanation. *Examples:* *The mass of the solid (B) increases when heated as it expanded. Thus adding on to the weight.* *Because substance B is mixed with substance A, so I think it will be heavier.*	
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	Nonresponse	
99	Blank	

Item ID	S042071	Subject	S	Grade	8	Block	S02	Block Seq	11

Which model shows the correct positions of protons (p^+), electrons (e^-) and neutrons (n) in an atom?



S042071

TIMSS2007

Science

Eighth Grade

Content Domain
Chemistry

Cognitive Domain
Knowing

Maximum Points
1

Key
C

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S042244A	Subject	S	Grade	8	Block	S02	Block Seq	15

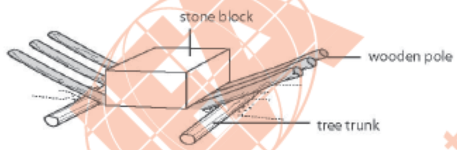
TIMSS2007

Science

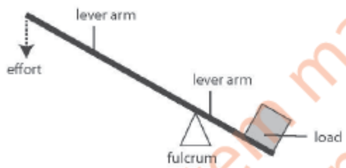
Eighth Grade

Peter and Joan are learning about the Great Pyramid of Cheops (Khufu) that is found in Egypt.

They wondered how the ancient Egyptians managed to lift the stone blocks to build the pyramid. They did some research on the Internet and found the diagram shown below.



Peter was not sure he understood the diagram so Joan drew a diagram to help him understand how the stone was lifted. Her diagram is shown below.



A. Match the parts of the Egyptian levers to the diagram of the lever Joan drew. One has been done for you.

Joan's Diagram	Egyptian Levers
Effort	Downward pull of the worker
Load	
Fulcrum	
Lever arm	

S042244_1

Content Domain
Physics

Cognitive Domain
Applying

Maximum Points
1

Key
See scoring guide

Item ID	S042244A	Subject	S	Grade	8	Block	S02	Block Seq	15

Code	Response	Item: S042244A
	Correct Response	
10	Matches **three** parts of the lever correctly as shown below.	

Joan's Diagram	Egyptian Levers
Effort	Downward pull of worker
Load	**stone block (stone)**
Fulcrum	**tree trunk (tree)**
Lever arm	**wooden pole (wood)**

Code	Response
	Incorrect Response
70	Matches **two** parts of the lever correctly.
71	Matches **one** part of the lever correctly.
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)
	Nonresponse
99	Blank

Item ID	S022022	Subject	S	Grade	8	Block	S03	Block Seq	04

Some students used an ammeter (A) to measure the current in a circuit for different voltages.

The table shows some of the results. Complete the table.

Voltage (Volts)	Current (milliamperes)
2	15
4	30
	60

S022022

TIMSS2007

Science
Eighth Grade

Content Domain
Physics

Cognitive Domain
Reasoning

Maximum Points
1

Key
See scoring guide

TIMSS & PIRLS International Study Center Lynch School of Education, Boston College

Item ID	S022022	Subject	S	Grade	8	Block	S03	Block Seq	04

Code	Response	Item: S022022
	Correct Response	
10	8	
	Incorrect Response	
70	6	
79	Other incorrect (including crossed out/erased, stray marks, illegible, or off task)	
	Nonresponse	
99	Blank	

Item ID	S022244	Subject	S	Grade	8	Block	S03	Block Seq	09

The Central City Power Station burns coal to generate power for the city. As the coal burns, sulfur that is present in the coal reacts with oxygen to form sulfur dioxide, which is given off as a gas.

How does this process result in acid rain?

S022244

TIMSS2007

Science

Eighth Grade

Content Domain
Earth Science

Cognitive Domain
Reasoning

Maximum Points
1

Key
See scoring guide

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S022244	Subject	S	Grade	8	Block	S03	Block Seq	09

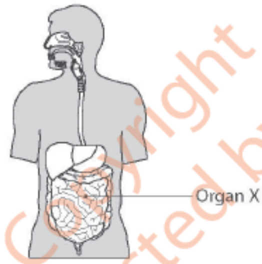
Note: To receive credit, responses must include some reference to a chemical reaction of sulfur dioxide in the atmosphere or an interaction involving sulfur dioxide and water (clouds) in the atmosphere (mixing, dissolving, etc.). Naming a specific acid formed (sulfuric or sulfurous) is not required to receive a Code 10.

Code	Response	Item: S022244
	Correct Response	
10	Refers to a chemical reaction of sulfur dioxide (with water) in the atmosphere (to form acid). *Examples:* *The sulfur dioxide changes into sulfuric acid when it combines with water in the atmosphere.* *The sulfur dioxide reacts with water vapor in clouds to form acid.* *A reaction takes place when sulfur dioxide mixes with the clouds.* *The sulfur dioxide changes to sulfuric acid when it reacts with the air.* *A reaction takes place when sulfur dioxide gets into the atmosphere.*	
11	Refers only to the mixing or dissolving of the sulfur dioxide in the water (or clouds) in the atmosphere. (No explicit mention of a reaction). *Examples:* *The gas mixes in the water vapor. Then when the vapor condenses, it falls with the water making acid rain.* *The sulfur dioxide has acid in it, and that goes into the clouds and rains down.*	
19	Other correct	
	Incorrect Response	
70	Refers only to the evaporation and/or formation of sulfur dioxide clouds. (Confuses acid rain with steps of water cycle; no mention of mixing with water or clouds). *Examples:* *When it evaporates, it forms clouds and generates acid rain.* *The gas rises and when there is too much, it rains.* *The sulfur dioxide condenses to form clouds of acid rain.*	
79	Other incorrect (including crossed out/erased, stray marks, illegible, or off task)	
	Nonresponse	
99	Blank	

Item ID	S042006	Subject	S	Grade	8	Block	S04	Block Seq	02

TIMSS2007

Science
Eighth Grade



What is organ X?

Ⓐ liver
Ⓑ stomach
Ⓒ small intestine
Ⓓ large intestine

S042006

Content Domain
Biology

Cognitive Domain
Knowing

Maximum Points
1

Key
C

Item ID	S042109	Subject	S	Grade	8	Block	S04	Block Seq	10

Which substance is necessary for burning to take place?

Ⓐ ozone
Ⓑ oxygen
Ⓒ hydrogen
Ⓓ carbon dioxide

S042109

TIMSS2007

Science
Eighth Grade

Content Domain
Chemistry

Cognitive Domain
Knowing

Maximum Points
1

Key
B

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Item ID	S032555	Subject	S	Grade	8	Block	S07	Block Seq	11

A plot of land was divided into 10 equal areas. A different amount of fertilizer was added to each area. Rice was planted in each area. The table below shows the amount of fertilizer added and the yields of rice for each area.

	Area									
	1	2	3	4	5	6	7	8	9	10
Amount of fertilizer added (units of nitrogen per area)	0	30	50	60	70	80	100	120	140	160
Yield of rice (kg of rice per area)	7.1	8.3	14.2	25.4	26.2	26.2	26.2	26.1	17.6	14.4

Look at the data in the table. Provide an explanation for the effect of the amount of fertilizer on the yield of rice.

S032555

TIMSS2007

Science

Eighth Grade

Content Domain
Earth Science

Cognitive Domain
Reasoning

Maximum Points
1

Key
See scoring guide

Item ID	S032555	Subject	S	Grade	8	Block	S07	Block Seq	11

Note: Although the question asks for an 'explanation', credit will be given for responses that describe the effect of fertilizer on the yield of rice based on the data in the table.

Code	Response	Item: S032555
	Correct Response	
10	Explanation refers explicitly to all three regions of the data table: i) Rice yield (growth) increases as fertilizer level is increased up to the optimum level (70). ii) Rice yield (growth) is greatest over an optimum fertilizer range (70-100). iii) Rice yield (growth) decreases as the fertilizer level is increased above the optimum level (100). *Examples:* *The yield of rice increases for a while, but then it decreases. It should be between 70-100 units. There are not enough nutrients at the low levels and at high levels the fertilizer can kill the plants.* *Adding fertilizer will increase rice yields, but adding too much will decrease it. This proves that only a certain range of fertilizers will be best.* **Note**: Responses may be quantitative or qualitative in nature. No credit is lost for incorrect or no units.	
11	Refers to an optimum level (range) of fertilizer but description of high or low fertilizer regions (i or iii) is incomplete or incorrect. *Examples:* *Just the right amount of fertilizer must be added.* *The best level of fertilizer is between 70 and 100. Above that, the plants start dying.* *The rice yield increases up to a maximum level.*	
12	Refers to lower rice yields at high and low fertilizer levels, but description of optimum region (ii) is incomplete or incorrect. *Examples:* *Too much fertilizer produces less rice. Also too little fertilizer produces less rice.* *As you put more fertilizer on, more rice grows. If you put too much, though, the amount of rice will diminish.*	
19	Other correct	
	Incorrect Response	
70	Mentions ONLY that the rice yield increases with increasing fertilizer level. [No description of regions ii and iii.] *Examples:* *It increased as the fertilizer increased because plants need fertilizer to grow.*	
71	Mentions ONLY that rice plants will die at high fertilizer level (or similar). [No description of regions i and ii.] *Examples:* *If you put too much fertilizer on, the plant will die.*	
79	Other incorrect (including crossed out/erased, stray marks, illegible or off task)	
	Nonresponse	
99	Blank	

APPENDIX G

GRADE 8 STUDENT QUESTIONNAIRE

Identification Label

Student ID:

Student Name:

Trends in International Mathematics and Science Study

TIMSS 2007

TIMSS 2007

Student Questionnaire

<Grade 8>

<TIMSS National Research Center Name>
<Address>

International Association for the Evaluation
of Educational Achievement

General Directions

In this questionnaire, you will find questions about yourself. Some questions ask for facts while other questions ask for your opinions.

Read each question carefully and answer as accurately as possible. You may ask for help if you do not understand something or are not sure how to respond.

Each question is followed by a number of answers. Shade in the circle next to the answer of your choice as shown in Examples 1, 2, and 3.

Example 1

Do you go to school?

*Fill in **one** circle only*

Yes	●
No	②

Example 2

How often do you do these things?

*Fill in **one** circle for each line*

	Every day	At least once a week	Once or twice a month	A few times a year	Never
a) I listen to music	①	②	●	④	⑤
b) I talk with my friends	●	②	③	④	⑤
c) I play sports	①	●	③	④	⑤

Science in School

11

How much do you agree with these statements about learning science?

*Fill in **one** circle for each line*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I usually do well in science	①	②	③	④
b) I would like to take more science in school	①	②	③	④
c) Science is more difficult for me than for many of my classmates	①	②	③	④
d) I enjoy learning science	①	②	③	④
e) Science is not one of my strengths	①	②	③	④
f) I learn things quickly in science	①	②	③	④
g) Science is boring	①	②	③	④
h) I like science	①	②	③	④

12

How much do you agree with these statements about science?

*Fill in **one** circle for each line*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I think learning science will help me in my daily life	①	②	③	④
b) I need science to learn other school subjects	①	②	③	④
c) I need to do well in science to get into the <university> of my choice	①	②	③	④
d) I need to do well in science to get the job I want	①	②	③	④

13

How often do you do these things in your science lessons?

*Fill in **one** circle for each line*

		Every or almost every lesson	About half the lessons	Some lessons	Never
a)	We make observations and describe what we see	①	②	③	④
b)	We watch the teacher demonstrate an experiment or investigation	①	②	③	④
c)	We design or plan an experiment or investigation	①	②	③	④
d)	We conduct an experiment or investigation	①	②	③	④
e)	We work in small groups on an experiment or investigation	①	②	③	④
f)	We read our science textbooks and other resource materials	①	②	③	④
g)	We memorize science facts and principles	①	②	③	④
h)	We use scientific formulas and laws to solve problems	①	②	③	④
i)	We give explanations about what we are studying	①	②	③	④
j)	We relate what we are learning in science to our daily lives	①	②	③	④
k)	We review our homework	①	②	③	④
l)	We listen to the teacher give a lecture-style presentation	①	②	③	④
m)	We work problems on our own	①	②	③	④
n)	We begin our homework in class	①	②	③	④
o)	We have a quiz or test	①	②	③	④
p)	We use computers	①	②	③	④