A case study of gender differences in 8th grade students' performance in TIMSS 2011 science test in United Arab Emirates, Dubai schools

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DECLARATION

I hereby declare that "**A case study of gender differences in 8th grade students' performance in TIMSS 2011 science test in United Arab Emirates, Dubai schools"** is my own work and that all of the sources I have used or quoted have been indicated and acknowledged by means of complete references.

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DEDICATION

This dissertation is dedicated with love and thanks to my entire family. It is only through their support that this work and all things are possible. I also want to thank my colleague and best friend, **Monica J Grant** for her continued support and motivation over the years. Her continued persistence, feedback and suggestions were invaluable in this process.

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ABSTRACT

The UAE suffers from a serious shortage of professional scientists, mathematics and science teachers, engineers and technologists due to low levels of engagement and reduced enrollment in science, technology, engineering, and mathematics disciplines, also referred to as the STEM disciplines. Within the United Arab Emirates (UAE) in the 1900s, women were not required by society, tradition or religion to contribute financially to the family. The responsibility of financially supporting a family was relegated to men, while females were given the primary role of care givers over that of career women (Sidani, 2005). However, since the 1990s, a concerted effort has been made by the Ministry of Education (MoE) of Dubai to increase females' access to education and to enhance their participation in scientific fields. In the light of the aforementioned factors, this study sought, firstly, to explore if there was a gender difference in 8^{th} Grade UAE learners' performance in the Trends in International Mathematics and Science Study (TIMSS) science test in 2011 in Dubai schools.

The research questions that guided this study were:

1. What gender difference is evident in 8^{th} grade learners' performance in the TIMSS 2011 science tests with regard to:
    1.1. The science content dimension (biology, chemistry, physics and earth sciences)?
    1.2. The science cognitive dimension (knowing, applying, reasoning)?
2. What contextual factors in the TIMSS 2011 science test could possibly account for the observed gender difference, if any?

This study made use of secondary data from the TIMSS test questionnaires to answer the research questions. Bourdieu's (1977) Theory of Cultural Capital and Social Reproduction was used as a framework as it had a direct link to the research focus of this study. Bourdieu (1977) asserts that the major role of educational systems is the reproduction of power relationships and privilege between social classes or groups, where social inequality is reproduced and legitimated. Bourdieu's concepts of capital and habitus were used during the comparative analysis of the data.

The findings of this study indicate that the 8^{th} grade female science students outperformed boys in both the content and cognitive domains of the 2011 TIMSS test. Furthermore, the findings raised questions about the quality of the science investigations being conducted in schools, as well as the type of professional development available to teachers as the vast majority of teachers teaching science in the UAE are foreign qualified teachers.

Key words: Content domain, cognitive domain, gender differences, science achievement, TIMSS.

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LIST OF ACRONYMS

ADEC	Abu Dhabi Education Council
DEC	Dubai Education Council
ICC	International Coordinating Center
IEA	International Association for the Evaluation of Educational Achievement
LoLT	Language of Learning and Teaching
MENA	Middle East and North Africa
MoE	Ministry of Education
PIRLS	Progress in Reading Literacy Study
SES	Socio-economic status
STEM	Science, Technology, Engineering and Mathematics disciplines
TIMSS	Trends in International Mathematics and Science Study
UAE	United Arab Emirates
UKZN	University of KwaZulu-Natal

CHAPTER1: ORIENTATION TO THE STUDY

1.1 INTRODUCTION

According to the International Association for the Evaluation of Educational Achievement (IEA, 2007), the primary purpose of the Trends in International Mathematics and Science Study (TIMSS) is to measure trends in student achievement in mathematics and science; to gather information about the learning contexts of mathematics and science; to gather data about the mathematics and science curricula in each country; and to provide countries with information to improve teaching and learning (Mullis, Martin, Ruddock, O'Sullivan & Preuschoff, 2009a). The TIMSS test is administered once every four years, and thus far it was administered in 1995, 1999, 2003, 2007, 2011 and 2015. It is a criterion referenced test, based on the curriculum of a country. TIMSS allows countries to compare progress internationally in mathematics and science, to monitor the effectiveness of their teaching and learning, to understand the most ideal learning contexts, and address internal policy issues. In addition, TIMSS administers questionnaires to gather data from students, teachers, and principals regarding the various contexts for learning mathematics and science, as well as to gather data regarding the curriculum in each country (Mullis et al., 2009a). TIMSS is generally administered to students in the 4th and 8th grades, although certain countries administer assessments to 6th and 9th grade students (IEA, 2011). Almost 70 countries participate in TIMSS (IEA, 2011; Mullis et al., 2009a).

This study set out to explore if gender difference was evident in 8th grade learners' performance in the Trends in International Mathematics and Science Study (TIMSS) 2011 science test with regard to: scientific content (biology, chemistry, physics and earth sciences), and the cognitive dimension (knowing, applying and reasoning) in the United Arab Emirates (UAE). Additionally it aimed to identify the contextual factors that may account for these differences. In the UAE, different types of curricula are offered in different public and private schools. Furthermore, many of the teachers teaching in the UAE are foreigners who obtained their teaching qualification in their home countries.

1.1.1 Education in UAE

The landscape of the UAE schooling system depends on the diversity of the population living in the country (Kadbey, Dickson & McMinn, 2015). A huge diversity also exists in terms of teaching staff as many teachers are foreign nationals (Gaad, Arif & Scott, 2006). The emiratisation of teaching staff is scheduled to reach 90% by 2020 so as to ensure that the Islamic principles and traditions of the UAE are preserved. According to Gaad et al. (2006), the UAE provides the Emiratis student with an opportunity to receive free education from kindergarten up to a doctoral degree in public schools or institutions. All schools have some form of telecommunication infrastructure. Ninety-eight percentage of the educational establishments in the UAE have a computer laboratory, while 93% of schools have some form of internet connection with DSL connection being the most popular type of connection. Ninety-nine percent of public schools and 82% of private schools have an internet connection (Ministry of education, MoE, 2014).

The existing educational structure, which was established in the early 1970s, is a four-tier system covering 14 years of education:

- Kindergarten: Age level from four to five years old.
- Primary: Length of the programme is six years, spanning six years of age to 12.
- Preparatory: Length of the programme is three years, from age level 12 to 15.
- Secondary: Length of the programme is three years, from age level 15 to 18. A secondary school leaving certificate is awarded on completion of this level. With the secondary tier of education, there are also technical secondary schools. The length of the programme is six years from age level 12 to 18. On completion of this level, students are awarded a Technical Secondary Diploma.

In the UAE, there is a mix of public, private, and home schools. These different types of schools will be discussed next.

1.1.1.1 Public Primary Education

The educational priorities of the government at primary level include better preparation, accountability, and professionalism. Likewise, the learning strategies in terms of science and mathematics have also been changed. The Abu Dhabi Education Council (ADEC), the Dubai Education Council (DEC), the Sharjah Education Council and the UAE Ministry of Education are all jointly working to reform the education system of the UAE (Gaad et al., 2006). The medium of instruction in public schools is Arabic, with emphasis on English as a second language. Kindergarten and primary schools may be co-ed or segregated, while secondary public schools are segregated.

Primary education is compulsory from the age of five by the Ministry of Education in the UAE (MoE, 2014). Most schools offer both primary and secondary instruction so that students do not need to transfer to a separate school upon graduating from primary school. Primary education lasts for six years, and is divided into two three-year cycles: A basic or "junior primary stage" in which one teacher has a single class throughout the day, and the "senior primary stage," in which there are different teachers for the different school subjects. "Preparatory education" includes classes from Grades VII to IX of the first primary sequence, or from Forms I to III of the preparatory stage (MoE, 2010). The school year extends over 32 weeks for both the kindergarten and the basic junior primary stage. The core subjects in the junior primary stage include Islamic education, Arabic, English, mathematics, and science, while the activity-based subjects include art, physical education, music, and family education for girls (MoE, 2014). The same subjects are taught at the senior primary stage, but the number of periods for some of them is increased. At the senior stage, social studies join the required subjects. The same subjects are taught at the preparatory stage with an increase in content and the number of class periods. Social studies is then divided into three separate units that include history, geography and civics.

1.1.1.2 Public Secondary education

At the secondary level, the following subjects are taught in the annual sequence indicated:

- Year I: Islamic education, Arabic, English, history, geography, mathematics, physics, chemistry, biology, geology, computer science, physical education, and family education (for girls).

- Years II-III: Islamic education, Arabic, English, mathematics, physical education, and family education (for girls). These are the basic subjects. In addition, students can choose to join either the science section or the literary section, which would require them to study the following additional subjects: history, geography, sociology, and economics in the literary section; and physics, chemistry, biology, and geology in the science section.

- Year III: There is an increase in the number of subjects taught in the second year of secondary school in each of the two streams. Literary-section students are taught philosophical subjects, logic, and psychology instead of sociology and economics.

Ministerial Resolution No. 2263/2 for the year 1995 allocated the number of teaching periods for the different subjects and activity subjects for the secondary stage of general education. Exactly 34 weekly periods (boys) or 36 periods (girls) are required in the first two years; 36 weekly periods (boys and girls) are then required in the third year. Preparatory education lasts three years (age group 12-14) and qualifies students for general or technical secondary education. General secondary education lasts for three years and is for the age group 15-17 years old. After the first year of core subjects, students can choose to follow either a science or a literary stream. Technical education comprises three main streams: technical, agricultural, and commercial. It is further divided into two levels, one for technical preparatory education, and the other for technical, commercial, and agricultural secondary education, each lasting three years. In technical education courses, English is used for specialised subjects, but all other subjects are taught in Arabic. At the end of the general and technical secondary stages, students are awarded a certificate after passing the general examination held at the end of each academic year. This certificate qualifies a student to undertake higher studies at university level. From 1996, technical education programmes have been carried out jointly with German technical institutions. The priorities of the Ministry at the secondary level are to reduce the failure and dropout rates, and incidents of truancy, as well as to increase the efficiency of administrators through executive development programmes. Secondary education development studies include research on teaching strategies that take into account individual differences among learners, and directing educational resources towards improvements in individualised instruction (Alshammari, 2013). There is a further focus on educational guidance or counselling, monitoring, and directing students to areas that suit their capabilities and aptitudes. The School Activities Project seeks to help learners to develop their capabilities and interests in science and technology by adding two successive periods for programme activities. Such activities include electronics, automotive engineering, astronomy, basic electricity, and maritime sciences.

1.1.1.3 Private sector of Education

Most of the education system in Dubai is private. According to Ball (2007), the private sector of education in the UAE promotes students' proficiency in English, thereby ensuring a better level of education for the students. Approximately 80% of students attend private schools in Dubai.

1.1.1.4 Home schooling

In traditional homes, female are normally home schooled (Al-Karaki, Harous, Al-Muhairi, AlHammadi, Ayyoub, AlShabi & AlAmiri, 2016). Students who are schooled at home include young people who were removed from school by their parents, and adult women completing their education after leaving school to be married.

1.1.2 Curriculum in the UAE

According to Alshammari, (2013) the term curriculum refers to the combination of principles and educational philosophies, goals and the content developed by each teacher. It also includes the written material provided to support the educational system. The concept of a curriculum can be defined under three sub-headings, namely, intended curriculum, implemented curriculum, and attained curriculum. The intended curriculum is the document produced by the Ministry of Education and other education authorities, and helps schools and teachers with teaching (Al-Karaki et al., 2016). The implemented curriculum is the practical implementation of the intended curriculum. The implemented curriculum also includes the teaching practices, teaching resources being utilised by the teacher, and how effectively teachers present the material. The attained curriculum is the feedback derived from the implemented curriculum. It determines how much students have learned, as well as the learning outcomes of the students (Farah & Ridge, 2009). The education system of the UAE consists of different types of curricula. Parents have a choice of 13 educational curricula in the UAE. The United Kingdom (UK), United States (US), the Indian, and United Arab Emirates (UAE) Ministry of Education (MoE) curricula cater to 90% of the private school population. The "other" category, alternatively, includes Japanese, Russian, Iranian, German, Pakistani, Philippine, Australian and French curricula. According to the results of

TIMSS, different types of curricula provide different results. The schools following the UK, American, Indian, and IB curricula performed at a higher rate than the other curricula (Ball, 2014). In the section below, I focus on the features of the aforementioned curricula.

1.1.2.1 English National Curriculum

The objective of this curriculum is to develop complete understanding, knowledge and the skills of every student to enable them to meet the challenges of a highly competitive world. The curriculum is aligned with international standards, and the medium of exchange in this curriculum is English (Kharkhurin, 2015).

1.1.2.2 British Curriculum

This curriculum is based on the national curriculum for England. It is enhanced by World of Work (WOW) learning, equipping learners with the skills, attitudes and values required for the world of work (Kharkhurin, 2015). This curriculum is also known as a UK-based curriculum. This curriculum is exciting for students as it provides them an opportunity to enjoy activities outside of the classroom.

1.1.2.3 American Curriculum

There are some schools that offer an American curriculum in the UAE. The schools that use this curriculum are running a standards-based system of education. These schools are divided into Elementary (K-Grade 6), Middle School (Grades 7-8) and High School (Grades 9-12). A broad range of subjects is covered on all of these levels in the American curriculum (Kadbey et al., 2015).

1.1.2.4 International Baccalaureate (IB) curriculum

The IB curriculum was established in 1969, and is recognised by international universities as it covers the international curriculum and offers an excellent balance of subjects. The IB curriculum is a passport for the child to attain outstanding global education. The IB curriculum provides students with a wide range of culture, ethnic and socio-economic backgrounds and world class qualifications (Knight & Morshidi, 2011). It also provides school-driven assessment opportunities to students at primary, middle and diploma levels.

1.1.2.5 Indian Curriculum

The Indian curriculum focuses on culture and opportunity. This curriculum provides a passport to opportunities in life. The Indian curriculum is a highly respected national and regional system of education. This curriculum strongly focuses on academia, mainly mathematics and science, and creates a wide range of abilities among students (Kharkhurin, 2015). The Indian curriculum was recently revised and is now increasingly accepted by different universities worldwide. This curriculum was selected because it offers a highly supportive system and encourages students to reach their full potential. This curriculum offers a broad range of subjects to increase the abilities of the students (Kadbey et al., 2015).

1.1.3 Significance of TIMSS

The results of TIMSS provide baseline information about the students of Dubai (Michael, Mullis, Gonzalez & Chrostowski, 2008). This baseline information therefore assists decision makers and policy makers to understand the performance of Dubai students. TIMSS also provides information regarding the range of opportunities available to students in Dubai. This information and the results of TIMSS further reveal the factors contributing to students' learning achievement. The results of TIMSS, and the variation in the performance of the students shows that the curriculum choice offered by schools in Dubai plays a significant role in learning improvement (Kharkhurin, 2015). The students of Dubai participated in TIMSS in 2007, 2011 and 2015. The results of TIMSS 2007 demonstrate that the students of Dubai outperformed the students of other Middle East and North Africa (MENA) countries (Kharkhurin, 2015). The overall average of the Dubai students' performance in Grade 4 and 8, however, was below the international average in science and mathematics.

The average science results of TIMSS suggested that the highest achieving students in science belonged to the schools offering the IB and UK curricula. According to TIMSS 2007, the private schools in Dubai that offered an Indian curriculum were also above the international average of TIMSS (Thomson, 2008). Alternatively, the private schools in Dubai offering the Philippine curriculum had a lower average. The achievements of the schools offering the Pakistani curriculum revealed a score below the international average of TIMSS. Moreover, the science achievement of the students in public MoE schools and private MoE schools showed a huge difference. In Dubai schools offering a UK curriculum, there was an impressive improvement in science, which showed that these schools were making significant progress in improving the education system (Provasnik, Kastberg, Ferraro, Lemanski, Roey & Jenkins, 2012).

1.1.4 Gender differences in Dubai

In general, the UAE government (and politics) support female advancement and empowerment, but social barriers and a set traditional way of thinking continue to impede the Emirati female's growth academically and in business (Bitar, 2010). According to Omair (2008), the UAE operates within a cultural framework of a patriarchal, male-dominated society where much of the culture and religious beliefs are firmly embedded in Islamic law. Alternatively, Ahmed (1998) proposes that patriarchal relations are the product of cultural practices, not of the teaching of Islam.

As a result of these cultural practices, some Emirati men still see women working outside of the family home to be in direct opposition to these patriarchal relations. Although a woman's status is subject to a number of coded or unwritten social mores, there has been remarkable success in females taking a stance on modernisation and a role in the business environment (Omair, 2008; Elamin & Omair, 2010). Government is in the process of successfully putting the focus on empowering women through education, and providing leadership jobs in the government sector, which are positive trends. At an official level, the men and women in the UAE enjoy equal opportunity to advance themselves and the nation, but at a societal level, gender-based issues are not addressed (Chu & Abdulla, 2014). Males in Dubai are engaged in high state administration areas and private businesses, while women are not allowed to play a significant role in male-dominated areas such as politics and the religious life. The societal values of the UAE discourage the mixing of women with men in a professional setting. Most often, women in the UAE opt for marriage and raising children to stay within societal norms (Ibrahim & Al Marri, 2015).

Within the UAE, women are not required by society, tradition or religion to contribute financially to the family. The responsibility of financially supporting the family is relegated to men, while females are given the primary role of care takers over having a career (Sidani, 2005). Now, women are only allowed to enter professions that are construed as an extension of the home life where they play the role of a care taker, therefore, women are only acceptable as primary school teachers (Sika, 2011). This is why professions that favour women, related to the literacy and educational programmes, are especially introduced at school for female rather than male learners (Constantine, 2010; Thomson, 2008).

In spite of the small gain in primary, secondary and tertiary enrolment data, females still encounter barriers to male-dominated Science, Technology, Engineering and Mathematics (STEM) fields (Adam, 2004). Not much has been documented about females' academic achievement in STEM subjects in the UAE's context (Constantine, 2010). At all levels, educational systems across the UAE continue to have a strong emphasis on religious studies instead of mathematics or science (Raphaeli, 2005). Consequently, the UAE suffers from a serious scarcity of professional scientists, mathematics and science teachers, engineers, and technologists due to the low levels of engagement and reduced enrollment in science, technology, engineering, and mathematics (STEM) disciplines. Furthermore, the chief teaching method employed by teachers is rote memorisation, especially in Arabic and Islamic (Quranic) studies, rather than more interactive methods. In light of the above-mentioned factors, this study sought, initially, to explore whether there is a gender difference, as well as the contextual factors that contributed to 8th grade UAE learners' performance in the TIMMS science test in 2011.

The UAE government's effort to enhance access to females in the education sector raises a pertinent question: Are Emirati men/boys at risk of being overshadowed by their female counterparts in science, which is considered to be a male dominated field?

1.1.5 Science achievements and gender differences in Dubai

An extensive amount of literature shows that gender plays a significant role in the student's achievement of science and math (Miller, Eagly & Linn, 2015). Several studies indicate that the capability of females in learning and mastering scientific concepts and knowledge is equal to males (Mullis, Martin, Foy & Arora 2012). Females have strong and positive views about learning the concepts of science, and its applications in solving problems. The views of females on learning and applying science suggest that they should enroll for science-based courses. There are a lot of factors that contribute to females' learning and achievement of science, such as support from parents, teachers and other role models (Michael et al., 2008). Other factors include the climate of the school, the attitude of the teacher, and teaching strategies, amongst others. Other factors demonstrating gender difference include a difference in cognitive abilities, attitude and the stereotyping of science in society, which suggests that science is a purely male-orientated field of study. All of these factors significantly contribute to making girls less interested in studying within the field of science (Provasnik et al., 2012).

Different researchers have provided different theories to explain the gender gap in the achievement of science and mathematics. There are some biological theories that suggest that the innate difference in the spatial ability of an individual develops his or her interest in a certain field of study (Halpern, 2007). These innate abilities include higher order thinking and brain development gap. The hypothesis of gender stratification suggests that in a society with societal stratification based on gender and inequality of opportunities, girls will have a less positive attitude and will perform poorer in science and mathematics tests than boys (Bhana, 2005). Another theory based on gender similarity suggests that there are some similarities between boys and girls in terms of psychological variables (Mullis et al., 2012).

Only a few schools in Dubai participated in the TIMSS science test in 2007, however, to date, UAE learners from 156 private and 342 public schools have participated in two consecutive TIMMS sciences tests that were conducted in 2011 and 2015 respectively. This study focused on the 2011 TIMSS test scores for UAE schools in Dubai.

Based on the 2003 analysis of the TIMSS test, gender differences in science achievements in Dubai is one of the most significantly noticeable factors in the schools offering the Pakistani curriculum and the public school MoE curriculum, while in schools offering Philippine, IB, UK and US curricula, the differences are slightly more significant. (Michael et al., 2008).

1.2 RATIONALE OF THE STUDY

I am a South African trained teacher of Natural Sciences and mathematics in the UAE. I have observed, and confirmed through the literature that the UAE suffers from a serious shortage of professional scientists, mathematics and science teachers, engineers and technologists due to low levels of engagement and reduced enrollment in science, technology, engineering, and mathematics disciplines (Constantine, 2010). Consequently, the teaching work force in the UAE comprises mainly foreign qualified teachers, such as myself. In the UAE, there is a wide variety of curricula that are offered in the different types of schools. It is worth noting that the required curriculum implementation hinges on foreign qualified teachers having to acquaint themselves with these curricula in order to implement them. Moreover, the chief teaching methods employed by Emirati teachers of Arabic and Islamic (Quranic) studies is rote memorisation rather than more interactive methods (Mullis et al. 2012). The UAE's schools have performed below average in the TIMSS science test (Shabindi, 2012), therefore this study attempted to contribute to the literature on the possible factors that inhibited learners from performing well.

Additionally, on the one hand I am in awe of the modernity that Dubai has to offer and the strong emphasis on religious studies rather than science and mathematics (Raphaeli, 2005). On the other hand, I am perplexed by the most conservative arenas of life in the UAE, namely, male-female interaction. For most Emirati women, the home remains the basic sphere of activity, while only 14% of the small overall Emirati labor force is female. This study is an attempt to fill a gap in the literature regarding gender inequality in the education system in the UAE. It is the high tech modernity, differentiated curricula, together with the patriarchal system in the UAE that spurred me to explore if gender difference was evident in 8^{th} grade learners' performance in the TIMSS 2011 science test with regard to science content and the cognitive dimension in order to fill a gap in the literature regarding gender inequality in the education system in the UAE.

1.3 RESEARCH QUESTIONS

The objective of this study was to establish if gender difference is evident in 8^{th} grade learners' performance in the TIMSS 2011 science tests with regard to: the science content dimension (biology, chemistry, physics and earth sciences) and the science cognitive dimension (knowing, applying, reasoning) and ascertain contextual factors could possibly account for any the observed gender difference.

The research questions guiding this study was:

1. What gender difference is evident in 8^{th} grade learners' performance in the TIMSS 2011 science tests with regard to:

1.1. The science content dimension (biology, chemistry, physics and earth sciences)?

1.2. The science cognitive dimension (knowing, applying, reasoning)?

2. What contextual factors could possibly account for the observed gender difference, in the TIMSS 2011 science if any?

1.4 SIGNIFICANCE OF THE STUDY

This study will be beneficial to policy makers, school management, parents, and religious leaders by giving insight into the performance of 8th grade UAE learners in the TIMSS science test regarding gender. UAE policy makers will be able to understand gender difference in 8th grade learners science performance and make comparisons between UAE learners' performances and other learners worldwide (particularly in Western countries). UAE learners' performance in the TIMSS tests will also be used to identify flaws and factors in the UAE education system that perpetuate gender bias. The results of this study would be beneficial to the MoE and school management in helping them to make decisions about curriculum adoption and the elimination of gender differences in learners' achievements. Teachers will be able to engage in a more nuanced, reflective practice through which they will be able to eliminate the perpetuation of gender bias in their pedagogy and assessment strategies.

The results of this study will also be helpful to parents in shaping their children's attitude towards science. It will furthermore assist in promoting the idea that science is not a male-orientated field, but one that also welcomes female students because females should not only be restricted to house chores.

This study can be placed in the category of feminist research as it assists Emirati women and their adoption of science by providing a set of recommendations to the MoE, policy makers, and decision makers. Moreover, this study is an attempt to fill a gap in the literature regarding gender inequality in the education system in the UAE.

1.5 LIMITATIONS OF THE STUDY

A case study method was used in this study, which explored gender differences in 8th grade learners' performance in the TIMSS 2011 science test in Dubai schools in United Arab Emirates. According to Rule and John (2011) a case is a bounded system that can vary in size or scope for example an institution, a country, state or province. This means that the case is not confined to a particular size or number. In this study the case is demarcated by a geographical boundary. The schools in the Dubai State of UAE that participated in the 2011 Grade 8 science TIMSS test forms the case in the study.

The case study method may be criticised because the results cannot be generalised. For example the results ought to be confined to Dubai schools. However, it is worth noting that Flyvbjerg (2006) emphasises the value of the single case experiments carried out by Galileo, Newton, Einstein, Bohr, Darwin, Marx and Freud, which confirm that both human and natural sciences could be advanced by a single case.

A further limitation was the use of the secondary data that was analysed.

1.6 CLARIFICATION OF TERMS

1.6.1 Curriculum

The term curriculum can be defined as principles and educational philosophies, goals and the content developed by the teacher. It also includes the written material provided to support the educational system. Likewise, it can be defined as the subjects related to a particular field in which students desire to grow their career during the educational process (Farah & Ridge, 2009).

1.6.2 TIMSS

The Trends in International Mathematics and Science Study (TIMSS) is conducted every five years and provides reliable and timely data on the mathematics and science achievement of students in different countries (Mullis et al., 2012).

1.6.3 Ministry of Education (MoE)

The Ministry of Education is the department responsible for recognising, implementing and monitoring the quality of education. It also makes policies, programmes and initiatives; recognises the need for progress; and makes new educational advancement plans (Calderon, 2013).

1.6.4 Gender differences

Gender difference is defined as social discrimination between men and women. The term gender difference also includes sexual differences as well as biological differences (Majumdar & Varadarajan, 2013).

1.6.5 A benchmarking participant

An educational entity within a country (such as a city or province) that participates in TIMSS or Progress in Reading Literacy Study (PIRLS) with a sufficiently representative sample to compare itself to other countries. Examples of benchmarking participants include: Dubai in the UAE, Florida in the USA, and Ontario in Canada.

1.6.6 IEA

The International Association for the Evaluation of Educational Achievement is an organisation that monitors academic progress in countries across the world through studies like TIMSS and the PIRLS.

1.6.7 Cognitive domain

A set of skills and/or behaviours required across different content domains in TIMSS.

1.6.8 International benchmark

A scale of four levels of performance, with each level summarising achievement in relation to students' expected knowledge and skills. This is presented in detail in Table 1.1 below.

Table 0.1 Levels of students' performance

Benchmark level	**Benchmark threshold**	**Skills that students display**
Advanced international benchmark	625	Communicate an understanding of the characteristics and life processes of organisms, reproduction and development, ecosystems and organisms' interactions with the environment, as well as factors relating to human health. Show an understanding of the properties of light and relationships among the physical properties of materials. Apply and communicate their understanding of electricity and energy in practical contexts and demonstrate an understanding of magnetic and gravitational forces and motion. Communicate their understanding of the solar system and of Earth's structure, physical characteristics, resources, processes, cycles, and history. Have a beginning ability to interpret results in the context of a simple experiment, reason and draw conclusions from descriptions and diagrams, and evaluate and support an argument
High international benchmark	550	Show some understanding of plant and animal structure, life processes, life cycles and reproduction, of ecosystems and organisms' interactions with their environment, including an understanding of human responses to outside conditions and activities. Demonstrate an understanding of some properties of matter, electricity and energy, magnetic and gravitational forces, and motion.

Benchmark level	**Benchmark threshold**	**Skills that students display**
		Show some knowledge of the solar system, and of Earth's physical characteristics, processes, and resources. Demonstrate elementary knowledge and skills related to scientific inquiry. Compare, contrast, and make simple inferences, and provide brief descriptive responses combining knowledge of science concepts with information from both every day and abstract contexts
Intermediate international benchmark	475	Recognise some basic information related to characteristics of living things, their reproductive and life cycles, their interactions with the environment, and show some understanding of human biology and health. Show some knowledge of properties of matter and light, electricity and energy, and forces and motion. Know some basic facts about the solar system and show an initial understanding of Earth's physical characteristics and resources. Demonstrate an ability to interpret information in pictorial diagrams and apply factual knowledge to practical situations.
Low international benchmark	400	Demonstrate knowledge of some simple facts related to human health and the behavioural and physical characteristics of animals. Demonstrate some basic knowledge of energy and the physical properties of matter. Interpret simple diagrams, complete simple tables, and provide short, written responses requiring factual information.

(Adapted from Martin et al., 2012)

1.6.9 Measuring trends

The process of measuring progress over the years. In large scale assessments such as TIMSS and PIRLS, student achievement is measured over cycles, which enables countries to measure the progress of students over the years.

1.6.9.1 Reading literacy

Defined by PIRLS as the ability to understand and use those written language forms required by society and/or valued by individuals. Young readers can construct meaning from a variety of texts. They read to learn, to participate in communities of readers in school and everyday life, and read for enjoyment.

1.6.9.2 Scale centre point

A scale centre point refers to a mean of 500 at each grade level. Set by the IEA, it remains constant from one assessment cycle to another to ensure comparability.

1.6.9.3 Standard deviation

A measure representing variation within data, it is also set by the IEA to a constant of 100 in both TIMSS and PIRLS.

1.7 OVERVIEW OF THE CHAPTERS

This dissertation is organised into five chapters. The present chapter set the stage and provided the motivation for the study. It acquainted the reader with the objectives and research questions, significance, and limitations of the study.

The next chapter, Chapter 2, will focus on a review of the literature. It further elucidates the conceptual framework used in this study. The literature reviewed was guided by the research questions.

Chapter 3 presents the research methodology used to answer the research questions. This chapter provides the reasons for the choice of research method and case study design, as well as methods of data analysis. The development of materials, and the processes undertaken to improve the different data collection tools, and hence the reliability of the results, are discussed in depth. The ethical aspects of the research are then also given in detail.

The fourth chapter covers the data analysis. The field data that was collected according to the research methodology was analysed against the theoretical framework to answer the research questions posed in this study.

Chapter 5, the final chapter, comprises a critical discussion of the main findings of the research. This chapter also includes recommendations for future research and researchers, and comes to a close with some concluding thoughts.

CHAPTER 2: LITERATURE REVIEW

2.1. INTRODUCTION

The Trends in International Mathematics and Science Study (TIMSS) is an international assessment study of educational achievement designed to test the knowledge of students in science and mathematics all over the world. TIMSS tests students at three points in their schooling: primary school (3rd and 4th grades in most countries), middle school (7th and 8th grades in most countries), and the final year of secondary school. The target population of TIMSS is diverse and represents a variety in race, language, ethnicity, socio-economic status (SES), gender, and geographical locations (Forawi, Almekhlafi & Al-Mekhlafy, 2012). Countries participating in TIMSS for more than one cycle (TIMSS is conducted every four years) can analyse the assessment for educational development purposes, such as the improvement of textbooks, in order to enhance the successful acquisition of scientific habits of minds, learning skills and scientific knowledge (Dagher & BouJaoude, 2011). So, the main purpose of TIMSS is to provide educational policy makers and educators with a base to better understand the performance of their educational systems (Mullis, et al., 2003).

This study focused on the gender differences in 8th grade learners' performance in the science content and cognitive dimensions of the TIMSS test, as well as the contextual factors that could account for the observed gender differences. The literature reviewed in response to the research questions is arranged around the following issues: TIMSS, the TIMSS science assessment, and factors that could contribute to differences in gender performance. The theoretical framework underpinning this study is also explained in this chapter, and finally the chapter ends with a conclusion.

2.2. LITERATURE REVIEW

2.2.1. The Trends in International Mathematics and Science Study (TIMSS)

TIMSS is a large scale comparative study in mathematics and science. Through TIMSS, data on the knowledge and skills of students in mathematics and science have been collected since 1995 (Wu, 2010). Data are collected from the students in the 4th grade and then four years later in the 8th grade. The students undertaking the TIMSS tests are in the age groups of nine to ten and 13 to 14 years. TIMSS is an ongoing international study that is designed with the intention of comparing mathematics and science achievements across international education systems over time. Cross-sectional data on science and mathematics achievement are collected through a standardised assessment from the representative samples of students. The TIMSS assessment is designed with the objective of aligning the curriculum of science and mathematics and education systems in participating countries. The results of the 2011 TIMSS study are also used to suggest the extent to which students have learned the concepts and skills of science and mathematics (Bray & Kobakhidze, 2014).

TIMSS was first performed in 1995 as the largest international student assessment study of its time, and evaluated students in the 5th grade. In the second cycle of TIMSS, only students in 8th grade were evaluated. In 2003, 2007 and 2011, students in the 4th and 8th grade were tested. The latest cycle of TIMSS was conducted in 2015 and offered a comprehensive assessment in mathematics and science. The results of the study were analysed for technology use, and teacher preparation and training.

The data and results of TIMSS are published in publicly accessible reports with the objective of informing the general public, policymakers and educators about the variability in the science and mathematics achievements of students (Guhn, Gadermann & Wu, 2014).

2.2.2. The TIMSS science assessment

Science is directly applied to all aspects of life and society. It is related to maintaining and improving human health, and to understanding and solving local regional and global environmental issues. The early development of scientific knowledge and thinking among students is necessary to make them thoughtful citizens, and capable of engaging in public discussions on important social issues involving science. Knowledge of science is important for students as it enables them to participate in a wide range of careers in science-related fields, such as medicine and technology. Therefore, the study of science in primary and secondary grades provides a critical foundation that is a gateway to the future career development of students (Pellegrino, 2013).

Inquiry-based learning is central in science education and it should underpin all learning and teaching in science (Al-Nabqi, 2010; Bryant, 2006; Lord & Orkwisezeski, 2006; Marx, Blumenfeld, Krajcik, Fishman, Soloway & Geier, 2004). Inquiry practice is the main focus of science education reform, as it allows students to construct their knowledge and accommodate these new experiences in a suitable way (NRC, 1996b). Furthermore, it supports the acquisition of modern learning skills such as critical thinking and problem solving in real-life situations. These are considered as major benefits in applying the inquiry process in schools (Gupta, 2012). In addition, many researchers find that guided inquiry as a student-centred active method is an effective approach in science in general, and in chemistry in particular, as it enhances students' conceptual understanding (Hofstein, 2004; Hofstein, Navon, Kipnis & Mamlok- Namaan, 2005; Tobin, 1990; Weaver, 1998).

The TIMSS science assessment is based on a comprehensive framework developed collaboratively with the participating countries. The TIMSS science assessment in each tested grade is organised on the basis of two dimensions, namely:

- **The content dimension:** This dimension specifies the domain or subject matter to be assessed. This content dimension can be subdivided into three domains for 4th grade science assessment. These three domains are Life Sciences, Earth Science and Physical Science. This dimension for 8th grade science assessment can be subdivided into four content domains, namely, biology, chemistry, physics and Earth Sciences. This is illustrated in Figure2.1 below.

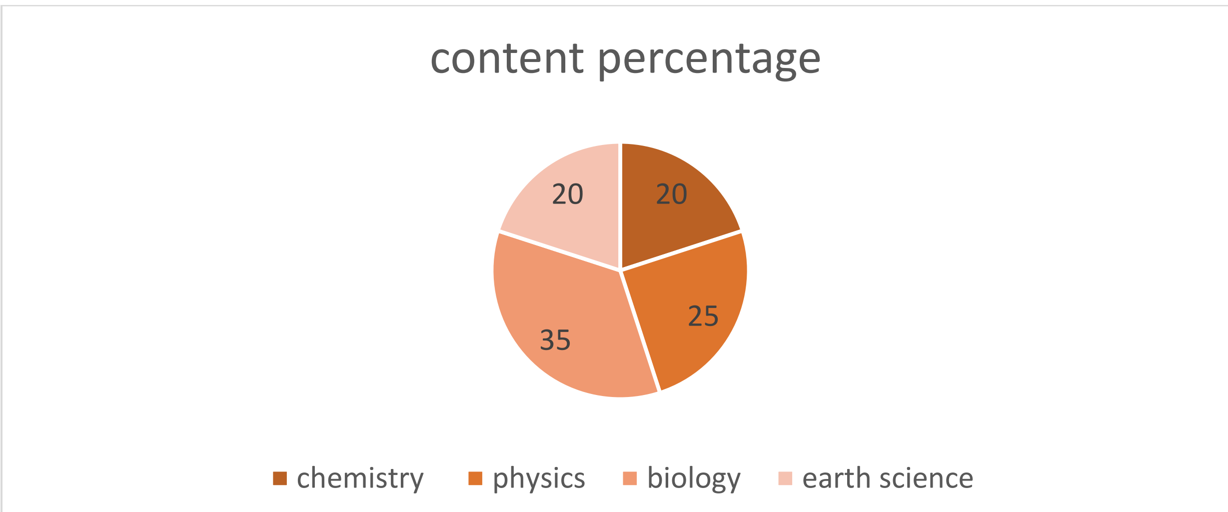

Figure 0.1: Content percentage of the four subjects within the science domain

The biology dimension comprises the following topics: Characteristics classification and life processes of organisms; cells and their functions; life cycles, reproduction and heredity; diversity, adaptation, and natural selection; ecosystems and human health. The chemisrty dimension comprises: The classification and composition of matter; properties of matter; and chemical change. The physics dimension consists of : Physical states and changes in matter; energy transformations; heat, light and sound; electricity and magnetism; and forces and motion. Earth science topics include: Earth's structure and physical features; earth's processes, cycles and history; earth's resources, their use and conservation; and earth in the solar system and the universe.

- **The cognitive dimension:** This dimension covers the assessment within the domain and its thinking processes.

  Cognitive domains are the same for the students in the 4^{th} and 8^{th} grades. The cognitive dimension encompasses a range of cognitive processes involved in working scientifically and solving problems throughout the primary and middle school years.

Table 0.1: Percentage weighting per cognitive dimension

Cognitive dimension	Percentage weighting
Knowing	35
Reasoning	30
Applying	35

The Knowing domain refers to the students' knowledge base of scientific facts, concepts, tools, and procedures. The Reasoning domain goes beyond the solution of routine problems to encompass unfamiliar situations, complex contexts, and multi-step problems. The Applying domain focuses on the students' ability to apply knowledge and conceptual understanding in a problem situation (IEA, 2012).

The items of the science assessment are associated with one content domain and one cognitive domain. In other words, it is the combination of content and cognitive domains. These items provide both content and cognitively orientated perspectives in order to allow students to apply knowledge and conceptual understanding to solve the problems. The knowledge of science includes the knowledge of facts, procedures, and different concepts. In science, reasoning (30%) together with application (35%) are measured more than knowing or simple recall (IEA, 2012). The science assessment has broad coverage goals, so the items' pools are also large, 172 and 217 assessment items in the 4th and 8th grade item pool respectively, with approximately half of the items being multiple-choice questions and half constructed response format in which students had to write their answers. According to the IEA (2012), multiple-choice questions have four possible response options, only one of which is correct. Constructed response questions require a written response, which can range in length from a single word or number to a paragraph. Each constructed response item has an accompanying scoring guide that details how to score pupils' responses.

Some constructed response items have full credit (i.e., the response is either right or wrong) while others are partial credit items (e.g., a fully correct answer gets two points, a partially correct answer gets 1 point, and an incorrect answer gets 0). When scoring, emphasis is placed on the quality of the answer with respect to the topic in question (IEA, 2012).

The TIMSS 2011 assessment development was a cooperative venture. It involved the cooperation of the National Research Coordinators (NRCs) from the participating countries throughout the entire process. The TIMSS science assessment carefully selects a well-documented probability sample of students in the 4th and 8th grades. TIMSS 2011 ensures the quality and comparability of the data through careful planning and documentation, cooperation among participating countries, standardised procedures, and rigorous attention to quality control throughout the assessment (Mullis et al., 2009). The quality of the assessment is assured through an extensive series of verification checks. It also ensures the comparability of the translations of the assessment items and questionnaires. To satisfy the sampling standards, a detailed description or documentation is required. Moreover, quality assurance programmes were also implemented to monitor the process of data collection (Michael et al., 2011).

TIMSS provides information about the contexts of learning and their impact on student performance (IEA, 2012). As part of the study, participating countries additionally provide important information about their national education context, curriculum, and classroom instruction for mathematics, science, and reading. In addition to this institutional data, background questionnaires provide data from school leaders, teachers, students and parents (Mullis et al., 2009). The background factors measured by TIMSS allow a uniquely comprehensive view of the learning process. The school questionnaire provides information about school resources, leadership, management, and background data on the student population as a whole (Mullis et al., 2009). The teacher questionnaire provides information about teaching practices and teachers' attitudes, as well as other classroom context details. Student questionnaires provide invaluable background information about students and their learning attitudes (Mullis et al., 2009). A parent questionnaire is used only in the Progress in International Reading Literacy Study (PIRLS), and provides information about early learning opportunities, home support for learning, and parents' attitudes towards learning (Mullis et al., 2009).

The results of the TIMSS science studies suggest that students with the best science achievement typically attend a school that places emphasis on academic success. This academic success is related to curricular goal achievements, effective teachers, students' desire to do well, and parental support. The TIMSS assessments have also shown that there is a strong relationship between students' attitude towards science and their science achievement. The TIMSS 2011 science assessment framework indicates that the process of scientific inquiry and the contemporary science curricula encourage students to build on their knowledge and understanding of science. In the 2011 round of international assessments, Dubai was a benchmarking participant in mathematics and science in the 4th and 8th grades in TIMSS. In this regard, TIMSS is helping countries to make informed decisions for the improvement of the teaching and learning of science and mathematics. TIMSS provides participating countries with a wealth of information about trends in science knowledge and the skills of their students. TIMSS consists of a wide-ranging state-of-the-art assessment of how well students master the essential scientific content, concepts, and procedures.

2.2.3. Student achievement in science globally

Keeves and Dryden (1984) indicate that science learners' achievement differs across societies, for instance, Japanese and Thai science learners achieve the best results through an emphasis on practical work, enquiry-based methods of teaching, and the investigation of scientific problems based on their society. TIMMS (1999) results in terms of the performance of United States students in mathematics and science showed that 80% of 8th grade learners performed higher in mathematics and science because of their access to computers and the internet as compared to their peers in other nations. TIMMS (1999) further shows that countries like Japan, Singapore and Chinese Taipei are on top of the list in science and mathematics, with Chinese Taipei as the leading country amongst less industrialised countries. South Africa, however, came last out of 46 countries assessed by TIMMS.

Thomas, Sammons, Mortimore and Mees (1997) remind us that socio-economic status has long been offered as a primary factor that contributes to differences in student academic achievement. Similarly, a study conducted by the Council of Educational Ministers in Canada agrees with Thomas et al. (1997), who specify that gaps in science achievement are more pronounced in learners with low socio-economic status. This Canadian study reflects what Bourdieu refers to as legitimated educational failure of the underprivileged. A wide spread socio-economic gap, as Ishda, Muller and Ridge (1995) emphasise, exists not only in industrialised countries, but also in developing countries, where it impacts negatively on learners' achievement.

A study conducted in the Philippines analysing the outcomes in mathematics and science of 13 year olds showed that the educational background of their parents is an indicator of students' achievement in mathematics and science. Students whose parents have college degrees do better in science and mathematics than those whose parents are illiterate. Akbuiro and Joshua (2004), investigating the self-concept, attitude and achievement of students in mathematics and science in Nigeria, conclude that the attitudes of learners in science are linked to their underperformance. They argue that society must play a role in developing a positive attitude in learners of science in order to improve their level of achievement.

A study conducted by Cuttance (1992) reveals that achievement in science is significantly greater for students from a more affluent home background when compared with students from poorer homes. The study also highlights the notion that power and wealth are prerequisites and contributors to learners' achievements. Learners from middle class backgrounds have a higher success rate than those from underprivileged backgrounds.

The United Nations Economic Commission for Africa (2003) argues that science and technology are the readiest means of empowering the poor that live below the threshold in sub-Saharan Africa, a statistic which is still growing in the 21st century. This commission mentions the level of achievements in science and technology, which is by far the lowest compared to other developing countries.

The percentage of learners passing science in South African schools fluctuates, but is generally declining. It has been observed that learners' interest in science is dwindling, with an increasing dropout rate (Teppo & Rannikmae, 2004 as cited in Stears & Malcolm, 2005). Secondly, South African pupils performed the worst in science in an international study conducted amongst Grade 5 and 6 classes in 41 countries (Human Science Research Council (HSRC), 1996; Beaton, Martin, Mullis, Gonzalez, Smith & Kelly, 1996). This poor performance was attributed, amongst others, to inadequate problem solving skills and science curricula that were not in line with other participating countries, since only about 18% of the questions asked were covered (HSRC, 1996).

A study carried out by South African Institute of Race Relations (SAIRC) on the achievement of South African learners in science and mathematics disclosed that a drop from 19% to 17% in the science pass rate was noticed in 1998 (Fast Facts, SAIRR, No 3, 1999), with the majority of those failing being Black (Abdi, Hofstetter, Baker & Lord, 2001, p.237). According to McRae (1994, cited in Abdi et al., 2001), this drop in science is the "brilliantly harvested" Verwoerdian apartheid end result, in which the mathematical sciences were the exclusive domains of White South Africans in terms of achievement and subsequent advancement. The performance in science and mathematics of South African learners is in a poor state.

2.2.4. Factors that impact learners' achievement in science

A country's ability to create, apply and diffuse scientific and technological knowledge is now a major determinant of its socio-economic development and national competitiveness (Masanja & Huye, 2010). This cannot be accomplished without including girls and women. Moreover, the exclusion of women and girls from participation and possible high achievement in science education means that they have limited access to jobs in these fields, which are among the fastest growing and highest paying (Atwater, 2000). Studies have shown that a student's performance in science and mathematics is a strong indicator of later earnings. It is also in science and mathematics that many of the cognitive and non-cognitive skills necessary for individual and national development, such as higher order thinking and problem solving, are expected to be learned. For science to largely remain the domain of men is a sure means to perpetuate existing inequalities in society on the basis of gender (Belal, 2014). Women should not be limited to being passive users of science and technology, but instead should be active participants in scientific development, application and decision making, ensuring that science and technology initiatives are implemented to address the needs and preferences of both sexes (Johnson, 2011).

Various factors have been identified as contributing to women's and girls' continued low rate of participation and, in some contexts, underperformance in science. Some of these factors will be discussed next.

2.2.4.1. Brain development

Many of the arguments can be classified under the nature versus nurture debate. One argument, for example, is that because girls' brains develop differently from boys', biological differences explain the gender gap in science (O'Conner & Joffe, 2014). Some have posited that the developments in boys' brains result in better developed visual and spatial ability, and that this could explain differences in abilities and interest in mathematics and some science subjects.

2.2.4.2. Motivation

Motivation and interest arouse a student's curiosity to learn, respond and attend to subject matter (Tella et al., 2007). Students' ability to learn is affected by both extrinsic motivation (their engagement with a subject or activity in order to receive reward or avoid punishment) and intrinsic motivation (engagement because it is personally satisfying and unrelated to the external reward or punishment they might receive) (Lia, 2011). The vast amount of research that has been done on the relationship between these two types of motivation and learning indicates that intrinsic motivation is of particular significance to sustained student learning. Intrinsic motivation is enhanced when practices promote the students' sense of personal autonomy, when they feel supported and safe, when their school work is challenging, but also when it is relevant to their lives and when it builds on their experiences (Lia, 2011). A student's experience in the classroom such as interactions with the curriculum, teachers and peers has a strong effect on their engagement with, and learning in a subject (Lia, 2011). In some science classes, the interest, motivation and achievement of boys is enhanced, while females experience discouragement due to factors related to curriculum, instruction and assessment.

According to Maltese and Tai (2011), students' choices are influenced by students' motivation and interests in science and mathematics. At the same time, students' motivation and interest is affected by many factors ranging from internal classroom factors, such as the teaching and learning environment, instructional methods and strategies, and the nature of the science curriculum, to more external factors such as students' social-economic status, gender and ethnic groups (Ryan & Deci, 2000, 2009; Lavigne, Vallerand & Miquelon, 2007; Maltese & Tai, 2011; Msegeya, 2009). It is well known that interest can be developed among students by manipulating these factors. Teachers' intervention in the classroom is frequently cited as the most important for sparking and maintaining students' interests (Alfayo, 1993; Hulleman & Harackiwiez, 2009; Jones, 2009; Sandoval & Harven, 2011). Other studies on student interests have found a relationship between age and gender. According to Maltese and Tai (2010), students develop an interest in science before and during early middle school age.

2.2.4.3. Textbooks

Science textbooks in many countries have been noted for their male bias and frequent use of gender stereotypes, for example, men are often depicted as scientists (Badri, Mazroui & Al Rashedi, 2016). This bias is reflected in the narrative structure, images, examples and topics used in the texts and their related classroom activities. A commonly noted bias is the portrayal of men as "active" in the generation and application of science, while females are portrayed as "passive" and occupying subordinate positions (Biklen &Pollard, 2001). Contemporary and historical examples of the contributions of women to modern science and local scientific knowledge are often excluded from the textbooks used in African countries. Examples of local scientific practice and indigenous knowledge production in which females are directly involved are even more likely to be absent (Sinnes, 2004). Girls' dissatisfaction with the way in which science is presented in the classroom has a negative impact on their interest in the subject. Curricular materials often fail to show the link between biology and other subjects, or to emphasise the social and societal connections with science. Studies have shown such connections are of interest to both boys and girls, with girls particularly drawn to topics that involve helping others. Yet, despite efforts in some countries to address these biases, they persist. The problem is further aggravated in schools that rely on old textbooks and countries that lack the publishing capacity or resources to develop curricular materials that are more appealing to both girls and boys in a social context.

2.2.4.4. Teachers

Teachers play an influential role in schools and act as a primary source of gendered messages received by students (Chartschlaa, 2004). The majority of time at school is spent with teachers, who are responsible for curricular and organisation decisions, and hold a position of authority over their students. Furthermore, the lack of texts in schools means that the role of the teacher is all the more important. However, in many countries, teachers have a tendency to give boys more feedback than girls, call on boys more often, give them longer times to answer, and more frequently ask them higher order questions than they do girls (Stevens, 2015). Praise, encouragement and feedback are more often directed to boys. Interactions with girls tend toward social, non-academic topics, and girls are less frequently called on to help with demonstrations or experiments. Science has also traditionally been taught in a more competitive and teacher-centered manner, which has tended to dampen girls' interest in STEM subjects (Tanner, Chatman & Allen, 2003).

Similar to findings elsewhere, studies in Nigeria reveal that girls are given less time than boys for a task in science classrooms, and boys are generally given more opportunities to ask and answer questions, to use equipment and learning materials, and to lead groups (Igbo, Onu, & Obiyo, 2015). Studies of African classrooms reveal entrenched gender inequities from very early grades, for instance, an ethnographic study in Liberia showed differences in girls' and boys' confidence (a pattern observed around the world), with boys believing that they were smarter and receiving better grades than girls. The same study revealed that girls were less verbal in the 4th grade than they were in the 1st grade. By the 4th grade, they were also called upon less often, volunteered less frequently and preferred to write responses on the board. A Guinean study similarly showed reduced teacher–student interaction from the 1st to the 5th grade and a related decline in girls' confidence (Stromquist 2007). A more recent study of primary school teachers in Benin revealed that the majority of teachers surveyed believed that science was less important for girls, given their future roles, and classified subjects according to the gendered divisions in society. Also, the belief that girls had weaker academic abilities when it came to science influenced how primary school teachers taught (Ekine, 2013).

Teachers' own experiences with science education can have an effect on their students (Ali, 2012). Female teachers, who are often concentrated at the primary school level, may have negative attitudes toward science acquired from their own school experiences (Vaz, Wilson, Falkmer, Sim, Scott & Cordier, 2015). Such attitudes are easily transmitted to their students from an early age, making it difficult to foster interest or provide a strong foundation of learning in science for girls. At the post-primary level, fewer women than men select science and mathematics as their teaching subjects, a phenomenon that both perpetuates the belief that science is not for girls, and that fails to provide positive role models for female students.

Kinga (2010) studied the impact of teachers' attitudes on girls' achievement in mathematics. The study found that a teacher's opinion of mathematics, or how mathematics is taught, greatly influences girls' attitude and beliefs, which in turn, impact achievement in the subject. Kinga further states that learning mathematics depends on the way it is presented to the learner, the way the learner interacts with the learning experiences presented, and the environment within which the learning takes place. The study showed that 82% of the teachers in the study strongly believed that boys have a natural talent for mathematics. This attitude influenced their teaching and reaction to the way girls performed in mathematics. This kind of attitude does not serve girls well, since the belief that boys can naturally do mathematics implies that regardless of effort, girls cannot outperform boys. Eccles and Jacobs (2006) find that girls' self-perceptions reflect their parents' expectations. When parents had low expectations of their daughters, the girls increasingly lost confidence in their mathematics skills and lowered their opinion of the future usefulness of mathematics.

Ireson, Hallam and Hurley (2005) found that teachers can hold gender-stereotyped perceptions of learners' success and failure, and relay gendered expectations and encouragement to students, just like parents can. Ireson et al. (2005) find that teachers pay more attention to boys, call on them more, give them more complex questions, expect boys to be assertive, and girls are expected to be cooperative and expressive. This difference in treatment can inadvertently lead to differences in cognitive development, as a boy who is given more attention and harder questions in a mathematics class may receive more cognitive stimulation, while a girl would gravitate toward less competitive, more socially orientated domains (Brunner & Kim, 2010). Brunner suggests that girls and boys have gender-based learning preferences, where boys are more inclined to like the theoretical and competitive learning environments, while girls prefer creativity and cooperative learning environments. Brunner et al. conclude that these learning preferences may lend themselves to particular subjects, as girls adjust well to the creativity associated with reading and writing, but may not perform as well in mathematics and science, which are traditionally taught in a competitive manner. Therefore, learning preferences may inhibit girls' interest and performance in mathematics.

The UAE depends on foreign labour in its education sector and the majority of teachers in boys' schools are foreign teachers (teachers qualified in other countries). There are different requirements for national and foreign qualified teachers (Mohamed, 2008). In the UAE, lower secondary science teachers are not required to hold a degree from a teacher education programme (Mohamed, 2008). Holding a degree from a teacher education programme may be an indicator that the teacher received content and pedagogical training to teach secondary science. The connection between teachers' subject area and education training is known as Pedagogical Content Knowledge (PCK) (Shulman, 1986). PCK is part of a larger pre-service education framework, which includes content knowledge and general pedagogical knowledge (Blömeke, Kaiser& Lehmann, 2008). In a PCK-science training framework, pre-service teachers learn how to integrate various science disciplines and instructional strategies to support student learning in that content area (Nezalová, 2011).

If a teacher is trained in these three elements, namely, content knowledge, pedagogical content knowledge, and general content knowledge, they may be more able to support student learning in science. According to Ridge (2010) many foreign trained teachers in boy's schools are poorly trained. In this regard, 80% of teachers employed in boys' government schools are non-Emirati (Ridge, 2010; Kirk & Napier, 2009; Al Nayadi, 1994).

2.2.4.5. Assessment

The style and kind of assessments used by teachers can also be a source of gender bias (Birch, Batten & Batey, 2016). Some evidence suggests that boys perform better than girls in competitive, high-stakes tests (Azmat & Calsamiglia, 2015), for example, in some contexts, risk taking is not encouraged in girls, making it more likely that they will leave blank those multiple-choice questions where they are not sure of the answer. Contributing to this is the tendency for boys, on average, to have greater confidence in their abilities and science knowledge than girls (Reilly, 2012). However, when tests include a diversity of question types, such as short answers, problem solving, and multiple-choice, the difference between girls' and boys' achievement is narrow. How assessments exacerbate gender disparities in performance in science is an area requiring greater research.

A recent review of the gendered dimensions of teaching and learning recommends that equitable learning outcomes for girls can be promoted through the use of continuous assessment, and that the value of international assessments for informing national policy on learning outcomes can be enhanced if a specific gender focus is included (Moeller, 2013). From this review of factors contributing to the science gender gap, it is evident that access to basic education is crucial, but not enough to ensure girls' participation in and learning of science. Due to the gendered processes of socialization that occur in the home and wider society, there is a tendency for boys to have an environmentally induced head start in science (Monkman, 2011). The gendered biases, expectations and stereotypes that children confront at an early age can either be powerfully reinforced or challenged in school. Moreover, how science is taught can either serve to engage girls —as well as boys— and foster their interest, or can worsen both negative attitudes toward science and a lack of self-confidence. In this regard, high quality and equity in science education are complementary and need to be established from the start. Interventions to support girls' learning in science must begin at an early age, when the skills and knowledge fundamental for future learning are being acquired, and before gender disparities are cemented.

2.2.4.6. Language

Language is a form of human capital that impacts academic achievement. Lewis and Aiken (1971, 1972) examined the relationship between the acquisition of a language and students' academic achievement. Earlier studies have recognised the effects of language on mathematics and science performance (Lewis & Aiken, 1971, 1972). Later, Cuevas (1984) argued that language fluency influences mathematics achievement positively. Herbert, Hau, and Kong (2002) show that students who received their instruction in a second language (English instead of Chinese) experienced lower achievements than native language students. Papanastasiou (2000) and Nxumalo (2015) highlighted the fact that students who took TIMSS evaluations in a second language were the most disadvantaged. Moreover, it has been recognised that students with a good mastery of their first language are efficient acquirers of a second language (Collier 1989). For most students, the acquisition of language does not appear to be an effortless process. It is interesting to note that students in Muslim countries who took the tests in their native languages performed better than the major Arab countries, and on the whole, they were better ranked than Arab countries in TIMSS.

2.2.4.7. Homework

Homework is defined as all oral and written assignments that are determined by the teachers, are bound to temporal deadlines, and must be completed at home by students (Wagner, Schober &

Spiel, 2008). Intuitively, homework appears to be a valuable support for learning: it aims to consolidate what has been learnt in class, it prepares students for the exams, and it allows them to rely on themselves. So it seems that the more learners do extra work at home, the greater the achievement gains. However, the empirical evidence in the literature does not usually support this claim. Ulrich and Baeriswy (2007) identified three homework dimensions: Time, frequency and effort. Using the German national extension to the Programme for International Student Assessment 2000 (PISA), and the third TIMSS, they found that homework time was inversely proportional to achievement. The longer the time devoted to homework, the more plausible it is that the student faces problems in understanding and motivation. Secondly, homework frequency is a significant predictor of achievement at the class level, and thirdly, homework effort is the most prominent dimension of performance. In summary, this study underlines the fact that homework time is not a suitable indicator of effort. Furthermore, neither homework time nor homework frequency explain students' performance. What counts, then, is the student's effort. The findings of Levin and Tsang (1987), and Mason, Steagall, and Fabritius (2003) confirm the evidence that reduced efforts are responsible for the declining test scores of high school students.

2.2.4.8. Parental and socio-cultural influences

Parental influence has been identified as an important factor affecting female students' academic achievement; parents' education and encouragement are strongly related to improved student achievement (Wang, Wildman & Calhoun, 1996). Parents have different attitudes towards their sons and daughters. Daughters are brought up for female roles such as child rearing, while sons have a whole working life to devote to career-building. Parents believe that females do not have the qualities of independence, initiative and assertiveness (Mampele, 1994). Eshiwani (1986) notes that girls have not been encouraged to enter those academic disciplines that are historically dominated by men, since cultural influence is still strong in many parts of the world. Girls' education is seen as a mere waste of time since girls will leave home and go to another family.

Demola (1989) notes that among the Sisala tribe of Ghana, girls are taught high level skills for being housewives, yet are denied that part of education that would allow them to compete favourably in other sectors. As a result, girls may develop some dependent attitudes. Alternatively, Kihumba (1997) found that in Lesotho, girls who would otherwise remain at home to learn duties of good housewifery are now taken to schools, rather than boys who go to look after cattle. This is a totally different trend compared to what happens in most cultures where girls are left behind to take care of the children as nannies, while boys are sent to school. Some tribes in Kenya believe that boys' education should be developed, since they are going to be the heads of families. Kihumba rightly concludes that the gender of a child should not be a fundamental issue when dealing with the provision of education. Karugu (1987) says that whether in school or not, girls of primary school age spend significantly more time on household chores than boys. Culturally prescribed roles for girls and women, especially in the domestic sphere, socialize girls to take the roles of deputy mothers. Owing to the cultural division of labour and allocation of duties between sexes, which in many societies start early, the cost of sending girls to primary school tends to be higher than that of boys. Psacharopoulos and Woodhall (1985) note that parents, particularly mothers, favored boys' education because they depend on their sons for old age insurance. Investment in a son's education is seen as security in old age. They also rely on the daughters' labour before marriage. Bernard (2002) observes that a lack of positive policy environment and structure for girls' education, including a lack of co-ordination between the education sector and other social sectors, inhibit girls' achievement in education.

Chege and Sifuna (2006) note that parents tend to discourage too much education for their daughters. There is always the fear that if a girl is highly educated, she may find it difficult to get a husband or be a good wife. They argue that women should stay away from too much education in order to remain manageable and to avoid entering fields that would make it difficult to follow their husbands in case of transfer of residence. Patriarchal societies are affected by patriarchal systems, which prefer investment in schooling for boys who are supposed to be responsible for their parents when they grow older, compared to girls, who are incorporated into their husbands' families (Eshiwani, 1993). This is why boys are expected to receive maximum training in order be successful heads of their respective families. Boys are also expected to inherit their parents' property and hence maintain their family's status quo. Girls, alternatively, believe that their success and future depend on the success of their husbands and therefore it is an excuse for girls not to be taken to school (Maritim, 1990). A lack of vision and prospects for future life reduce girls' interest in participating, achieving and performing in education. Special efforts therefore need to be employed to cultivate girls' interest in education and provide an environment that will ensure their full participation and achievement in education. Abdulahi (2005) reported cases affecting girls amongst the Masai. He noted that fathers do not wish to pay fees for their daughters; instead they would rather have them married.

Socio-cultural influences and gender-role stereotyping with regard to participation in mathematics are well documented by Byrne (2008) and Kelly (2008), but the focus is on a Western culture and not on an African culture. Byrne (2008) found that "the poor performance of girls in mathematics may in part be due to anxiety that girls experience in test taking situations. When taking a test in mathematics, female students enter the test situation concerned that a poor performance on their part will confirm a culturally held stereotype about mathematical inferiority of females" (p. 9). As a result, they experience stereotyping, which saps mental energy, attention, and effort and thereby disrupts their performance in mathematics tests. Some researchers indicate that girls' beliefs and attitudes contribute most to their mathematics interests and experience (Hanson, 1996, p. 56; Kahle, Parker, Rennie, & Riley, 1993, p. 379; Mayer & Khoehler, 1990, p. 60). Nevertheless, Van Lauven (2004) argues that girls often underestimate their mathematics competence, feel less adequate, and have lower expectations for success in mathematics when compared to boys.

2.2.4.9. Students' learning preferences

A good match between students' learning preferences and instructors' teaching style has been demonstrated to have a positive effect on students' performance (Harb & El-Shaarawi, 2006). According to Reid (1995), learning preference refers to a person's "natural, habitual and preferred way" (p. 12) of assimilating new information. This implies that individuals differ with regard to what mode of instruction or study is most effective for them. Scholars who promote the learning preferences approach to learning agree that effective instruction can only be undertaken if the learner's learning preferences are identified and the instruction is tailored accordingly (Pashler, McDaniel, Rohrer & Bjork, 2009). "I hear and I forget. I see and I remember. I do and I understand" (Confucius, 551-479 BC) – a quote that provides evidence that, even in early times, there was a recognition of the existence of different learning preferences among people. Indeed, Ormrod (2008) reports that some students seem to learn better when information is presented through words (verbal learners), whereas others seem to learn better when it is presented in the form of pictures (visual learners). Clearly in a class where only one instructional method is employed, there is a strong possibility that a number of students will find the learning environment less optimal and this could affect their academic performance. Felder and Solomon (1993) establish that alignment between students' learning preferences and an instructor's teaching style leads to better recall and understanding.

The learning preferences approach has gained significant mileage despite the lack of experimental evidence to support the utility of this approach. There are a number of methods used to ascertain the learning preferences/styles of students, but they all typically ask students to evaluate the kind of information presentation they are most at ease with. One of these approaches being used widely is the Visual/Aural/Read and Write/Kinaesthetic (VARK) questionnaire, pioneered by Neil Fleming in 1987, which categorises learners into at least four major learning preferences classes. Neil Fleming (2001-2011) described these four major learning preferences as follows:

- Visual learners: Students who prefer information to be presented on the whiteboard, flip charts, walls, graphics, pictures, and colour. They are probably creative and may use different colours and diagrams in their notebooks.
- Aural (or oral)/auditory learners: Students who prefer to sit back and listen. They do not make a lot of notes. They may find it useful to record lectures for later playback and reference.
- Read/write learners: Students who prefer to read the information for themselves and take a lot of notes. These learners benefit from being given access to additional relevant information through handouts and guided readings.
- Kinesthetic (or tactile) learners: These learners cannot sit still for long and like to fiddle with things. They prefer to be actively involved in their learning and thus would benefit from active learning strategies in class.

A number of learners are multi-modal, with more than one preferred style of learning in addition to using different learning styles for different components of the same subject. There is a strong possibility that learning preferences would depend on the subject matter being taught. The question that arises is whether a particular learning preference is favoured in certain subjects/courses.

2.2.4.10. Class attendance and academic performance

Romer (1993) is one of the first authors to explore the relationship between student attendance and exam performance. A number of factors have contributed to declining class attendances around the world in the last 15 years. The major reasons given by students for non-attendance include assessment pressures, poor delivery of teaching/lectures, the timing of teaching/lectures, and work commitments (Newman-Ford, Lloyd & Thomas, 2009). In recent times, students have found a need to seek employment while studying on a part-time basis due to financial constraints. The number of part-time and mature students has also risen sharply. The use of information technology also means that information that used to be obtained from sitting through lectures can be obtained at the click of a mouse. Indeed, web-based learning approaches have become the order of the day. Given all these developments that either make it impossible or unnecessary for students to attend classes, the question that needs to be asked is whether absenteeism affects students' academic performance. Research in this subject seems to result in a consensus that students who miss classes perform poorly compared to those who attend classes (Devadoss & Foltz, 1996; Romer, 1993; Park & Kerr, 1990; Schmidt, 1983). Based on these findings, a number of stakeholders have called for mandatory class attendance.

Learning is a cumulative process, thus a student recruited with higher entry requirements will be well prepared for the course material compared to a student admitted based on the bare minimum qualifications. It is important for educators to have an idea of how well- or ill-prepared students are based on their admission qualifications. It is important to identify students who might need extra attention based on their level of competencies upon admission.

Other determinants of academic performance not discussed above include self-motivation, family income, and parents' level of education. While a positive relationship between self-motivation and academic performance has been established (Zimmerman, Bandura, & Martinez-Pons, 1992), the effect of family income and parents' level of education on academic performance is far from being unraveled without equivocation. The socio-economic status of students and their families show a moderate to strong relationship to academic performance (Sirin, 2005), but these relationships are contingent upon a number of factors such that it is nearly impossible to predict academic performance using socio-economic status.

The factors that impact learners' performance in science bring to the fore the intrinsically intertwined relationship between gender, socio-cultural reproduction and cultural capital.

2.3. THEORETICAL FRAMEWORK

I contend that a strong relationship exists between gender, class, cultural capital and social reproduction. If we acknowledge that gender is molded by a specific historicity, then it (gender) should be conceived as a structuring principle of social space. Therefore, I have selected Bourdieu's (1977) Theory of Cultural Capital and Social Reproduction to frame this study as it accommodates social (gender), economic, and educational issues, which have a direct link to my research focus. Bourdieu (1977, p.488) argues that the major role of the education system is the preservation (reproduction) of the culture of dominant stereotyping from one generation to the next, and this he calls *cultural reproduction*. However, social reproduction, he argues, means the conservation or maintenance of unequal social structures, privilege and power relations in successive generations, whose fundamental cause is centred on the education system that legitimates the cultural heritage of the dominant class. Bourdieu (1977) reminds us that the major role of educational systems is the reproduction of power relationships and privilege between social classes or groups, where social inequality is reproduced and legitimated.

According to Bourdieu (1984), symbolic dichotomy is used as grounds for the hegemonic relationships of differences inscribed within a social structure. The stereotypes relating to gender constitute cultural expressions of social traditions. These cultural expressions (men are bread winners, while the primary role of women is that of care giver) would operate as classifying schemes or cognitive structures in the individuals' perception and construction of the social world. From a feminist perspective, the second key concept of interest is that of capital, which, according to Bourdieu, refers to the different forms of power that determine the position of individuals in the social hierarchy and their relative distribution in the space of social relations. With regard to the aforementioned point, it is worth noting that Bourdieu (1985a) posits that:

> The social world can be represented as a space (with several dimensions) constructed on the basis of principles of differentiation or distribution constituted by the set of properties active within the social universe in question, i.e., capable of conferring strength, power within that universe, on their holder. Agents and groups of agents are thus defined by their relative positions within that space

> […] The active properties which are selected as principles of construction of the social space are the different kinds of power or capital which are current in the different fields […] The kinds of capital, like the aces in a game of cards, are powers that define the chances of profit in a given field (pp. 723-724).

The concept of capital thus proves crucial to the system developed by Bourdieu because it refers to the forms of power held by social agents or individuals, and because these forms of power are structuring principles of the social space. According to Bourdieu's conceptual system, the distinctive positions in the social space (as well as the particular conditions of existence and relational properties that are associated with them) produce a specific habitus. The concept of habitus, also central in his theoretical model, refers to the set of acquired dispositions and schemes of perception and appreciation inculcated by the social environment in a given time at a given place, practice or action. In short, the given social positions produce given cultural dispositions.

Using Bourdieu’s Theory of Cultural Capital and Social Reproduction will assist me to expose how real principles of selection and exclusion are hidden behind nominal constructions of categories, such as occupation and educational qualification. Although forms of capital correspond with occupational fields (e.g., literary capital, and scientific capital), they have gendered meanings because they are given form by *gendered dispositions.* Gendered dispositions pertain precisely to those body and mind dispositions acquired over time through the process of socialization. Hence, gendered dispositions are embodied states of cultural capital. As such, gendered dispositions have the same properties as the other states of cultural capital; that is, gendered dispositions work also as sources of power (as is the case with educational credentials and possession of cultural goods).

2.4. CONCLUSION

This chapter paid attention to the components of the TIMSS science test, students’ achievement in science globally, as well as factors that impact learners’ performance. The chapter also provided an insight into Bourdieu’s (1977) Theory of Cultural Capital and Social Reproduction, which framed this study. The next chapter, Chapter 3, focuses on the methodology of this study.

CHAPTER 3: METHODOLOGY

3.1. INTRODUCTION

The purpose of this chapter is to describe and justify the methodology that was adopted during this study. Research methodology, as defined by Henning, van Rensburg and Smit (2004), is a group of techniques that complement each other to achieve the requirements of the study. This is done by generating data that will produce answers to the research questions asked in the study. The selection of methodology is very important since this allows the researcher to attain proper and valid research results if deployed properly. The purpose of the research, its aims, objectives and research questions were the factors upon which the selection of the appropriate research methodology rested. Research design and methodology entails all of the activities and planning that leads to the main study, which include the preparations and procedures that a researcher follows to carry out the research (Koshy, 2005). As mentioned previously, this study sought to explore gender differences in 8th grade learners' performance in the TIMSS 2011 science test in terms of the science content and cognitive dimensions in United Arab Emirates schools. This chapter discusses the procedures undertaken in carrying out this research. The chapter further explains the research design, methodology, research methods used for data collection, the instruments, sampling and sampling techniques, credibility, and the data analysis. Finally, the chapter concludes by discussing the ethical issues underlying the research and the delineation of the study.

3.2. RESEARCH PARADIGM

The term paradigm originates from the Greek word *paradeigma,* which means pattern. It was first used by Kuhn (1962) to represent a conceptual framework shared by a community of scientists. This framework provided them with a convenient model for examining problems and finding solutions. According to Kuhn (1977), the term paradigm refers to a research culture with a set of beliefs, values, and assumptions that a community of researchers has in common regarding the nature and conduct of research (Kuhn, 1977). A paradigm hence implies a pattern, structure and framework, or system of scientific and academic ideas, values and assumptions (Olsen, Lodwick, & Dunlop, 1992). Cohen, Manion and Morrison (2011) maintain that a paradigm is a worldview or a set of assumptions about how things work, while Rossman and Rallis (2003) define a paradigm as shared understandings of reality. The paradigm therefore deals with the philosophy of the research. It allows the views of the researcher to be made known to the world and also supports the research strategy. There are four different kinds of research philosophy, namely, interpretivism, positivism, transformativism, and pragmatism (Cohen et al., 2011). Each of the four research paradigms will be briefly explored in the section that follows.

3.2.1. Interpretivism

The interpretivist or constructivist approaches to research seek to understand "the world of human experience" (Cohen et al, 2011, p.36), suggesting that "reality is socially constructed" (Mertens, 2005, p.12). Unlike the positivist researcher, the interpretivist/constructivist researcher relies on the "participants' views of the situation being studied" (Creswell, 2012, p.8). This approach therefore recognises the impact on the research of the researcher's own background and experiences. Constructivists do not generally begin with a theory (as do positivists), rather they "generate or inductively develop a theory or pattern of meanings" (Creswell, 2012, p.9) throughout the research process. The constructivist researcher is most likely to rely on qualitative data collection methods and analysis, or a combination of both qualitative and quantitative methods (mixed methods). Quantitative data may be used in a way that supports or expands on the qualitative data, and effectively deepens the description thereof. Interpretivists believe that only through the subjective interpretation of and intervention in reality can that the truth be completely arrived at (Scotland, 2012). They admit that there might be numerous interpretations of reality, and regard these translations as in themselves a part of the scientific knowledge that they are pursuing.

3.2.2. Positivism

The positivist paradigm of exploring social reality is based on the philosophical ideas of the French Philosopher August Comte (Cohen et al., 2011). According to Comte, observation and reason are the most appropriate means of understanding human behaviour. He further suggested that true knowledge is based on the experience of the senses, and can be only be obtained by observation and experiment. Positivists favour scientific methods that quantitatively measure independent facts about a single reality (Mertens, 2005). Put simply, this means that positivists assume that reality is objectively given and is measurable using properties that are independent of the researcher and his or her instruments. Knowledge is therefore seen as objective and quantifiable. Positivism is concerned with uncovering the truth and presenting it by empirical means (Henning, Van Rensburg & Smit, 2004, p. 17).

3.2.3. Transformative paradigm

The transformative paradigm arose during the 1980s and 1990s as a result of the research community's dissatisfaction with the existing and dominant research paradigms and practices, as well as a realisation that much of the theory that lay behind the dominant paradigms "had been developed from the white, able-bodied male perspective and was based on the study of male subjects" (Mertens, 2005 p.17). Put simply, this means that transformative researchers felt that the interpretivist/constructivist approach to research did not adequately address issues of social justice and marginalised peoples (Creswell, 2003). According to Creswell, transformative researchers "believe that inquiry needs to be intertwined with politics and a political agenda" (Creswell, 2003, p.9), and contain an action agenda for reform "that may change the lives of the participants, the institutions in which individuals work or live, and the researcher's life" (Creswell, 2003, pp.9-10). To be able to engage in their research, transformative researchers may use qualitative and quantitative data collection and analysis methods in much the same way as the interpretivist/constructivists. However, a mixed methods approach provides the transformative researcher the structure necessary for the development of "more complete and full portraits of our social world through the use of multiple perspectives and lenses" (Somekh & Lewin, 2005, p.275), allowing for an understanding of "greater diversity of values, stances and positions" (Somekh & Lewin, 2005, p.275).

3.2.4. Pragmatism

Pragmatism is not committed to any one system of philosophy or reality. Pragmatic researchers focus on the 'what' and 'how' of the research problem (Creswell, 2003, p.11). Early pragmatists "rejected the scientific notion that social inquiry was able to access the 'truth' about the real world solely by virtue of a single scientific method" (Mertens, 2005, p.26). While pragmatism is seen as a paradigm that provides the underlying philosophical framework for mixed methods research (Tashakkori & Teddlie, 2003; Somekh & Lewin, 2005), some mixed methods researchers align themselves philosophically with the transformative paradigm (Mertens, 2005). It may be said, however, that mixed methods could be used with any paradigm. The pragmatic paradigm views "the research problem" as central and applies all approaches to understanding the problem (Creswell, 2003, p.11). With the research question 'central', data collection and analysis methods are chosen as those most likely to provide insight into the question with no philosophical loyalty to any alternative paradigm.

As mentioned earlier, this study sought to explore gender differences in 8th grade learners' performance in the TIMSS 2011 science test in terms of the science content and cognitive dimensions in United Arab Emirates schools. The pragmatic paradigm and its underpinning philosophy were deemed most suitable for this study in order to uncover the contextual realities' within the UAE in terms of gender differences in education. TIMSS itself was a highly variable aspect, as it could be perceived differently by different individuals. The perceptions regarding Grade 8 science tests were so different that without a proper philosophy for research on such a topic, especially in the context of learners in the UAE, the data obtained and methodology could be highly skewed.

The philosophy of pragmatism allowed this study to embrace a mixed methods approach to gather or access both quantitative as well as qualitative data.

3.3. RESEARCH METHODOLOGY

According to Myers (2009), the research method is a strategy of enquiry, which moves from the underlying assumptions of the study to the research design and data collection (Myers, 2009). There are two common classifications of research methods, namely, qualitative and quantitative. On the one hand, qualitative and quantitative refer to distinctions in the nature of knowledge, that is, how one understands the world, and eventually the purpose of the research. On the other hand, at discourse level, the terms refer to research methods, or rather the way in which the data is collected and analysed, and the type of generalisations and representations derived from the data. Quantitative research methods were originally developed in the Natural Sciences to study natural phenomena (Cohen et al., 2011), while qualitative research methods were developed in the social sciences to enable researchers to study social and cultural phenomena (Meyers, 2009). Both quantitative and qualitative research studies are conducted extensively in education. Neither of these methods is better or superior than the other. Some researchers prefer to use a mixed methods approach by combining these two methods for use in a single research project, depending on the kind of study and its methodological foundation (Bryman & Burgess, 1999, p. 45). Each of the three research methods will be unpacked in the section below.

3.3.1. Qualitative methods

Qualitative methods of research are related to the detailed interpretation of data, as these methods are associated with the provision of a complete understanding regarding the particular conditions of the study. Qualitative methods provide the researcher with the facility to explain the data by collecting the relevant information. They also allow an understanding of the relationship between the different factors. Moreover, qualitative methods are related to the development of understanding about intangible factors that include norms, gender and the culture of a society (Csikszentmihalyi, 1991). The use of qualitative methods is usually recommended in the earlier stages of research as they are more subjective and the information that is attained cannot be analysed numerically. So, such data are related to investigations regarding the attitudes, opinions and fears of individuals that could not be studied quantitatively. There is also less probability of the generalisation of this kind of data.

3.3.2. Quantitative methods

Quantitative methods are related to the analysis of data by considering numbers and figures. Quantitative research is dependent on different strategies that are seen to be creative, and the results are easy to interpret. Quantitative methods are associated with a number of different methods for the determination of answers to the research questions. According to Kawecki, Lenski, Ebert Hollis and Olivieri, (2012), quantitative research is related to the epistemological methodology, which provides the facility to determine the exact values of the different relations, and allows the researcher to treat the data in a convenient way using an analysis that is mostly comparative. These methods are also related to the validity and reliability of the data. Moreover, quantitative methods are more objective than qualitative methods. Different kinds of quantitative research methods that are accessible for researchers include experimental and quasi-experimental research, review research, longitudinal research, cross sectional research, time sequence research, and meta-analysis.

3.3.3. Mixed methods

The paradigmatic stance adopted, and the research questions of this study guided me to embrace a mixed methods approach. According to Creswell (2013), mixed methods research is an "approach to research in which the investigator gathers both quantitative and qualitative data , integrates the two and then draws interpretation based on the combination strengths of both sets of data to understand the research problem" (p2) .

From the aforementioned definition of mixed methods, it can be extrapolated what the core characteristics of mixed methods are, and what such research does not entail. Mixed methods research is not simply the gathering of both quantitative and qualitative data, nor is it the addition of qualitative data to a quantitative design. This means that there is a rigorous use of scientific techniques associated with mixed methods methodology. Furthermore, the collection of quantitative and qualitative data is in response to the research questions posed, while the integration of quantitative and qualitative data involves using a specific type of mixed methods design and the interpretation of this integration.

From the preceding discussion, it is clear that mixed methods are used when quantitative research does not adequately investigate meanings or personal factors, or deeply probe the perspectives of individuals, for example, issues of social justice.

According to Creswell (2013), there are three basic mixed methods designs, namely, convergent design, explanatory sequential design, and exploratory sequential design.

3.4. RESEARCH DESIGN

Research design comprises the overall plan for connecting the conceptual research problems to the empirical research. In other words, the research design articulates what data is required, what methods are going to be used to collect and analyse this data, and how all of this is going to answer the research question posed (Creswell, 2013). The description of the research process and its completion is referred to as the research design. As mentioned earlier, three basic mixed methods designs, namely, convergent design, explanatory sequential design, and exploratory sequential designs exist. Each design may have additional advanced features, such as an intervention, social justice framework, or multi-stage evaluation. The key characteristics of each design will be explicated next.

3.4.1. A convergent design

In a convergent design, the aim is to collect both quantitative and qualitative data, and to merge the results of the data analyses to provide a quantitative and qualitative picture of the problem (Creswell, 2013). The advantage of using a convergent design is that the researcher can advance multiple perspectives, as well as compare and validate the results.

3.4.2. An exploratory sequential design

According to Creswell (2013), the aim of this design is to study a problem by exploring it first through qualitative data collection and analysis. Thereafter, the results are used to develop the instrument/s for an experiment, which is then followed by a third quantitative phase.

3.4.3. An explanatory sequential design

This study embraced an explanatory sequential design, but viewed the data through a gendered lens. In this design, the aim was to firstly explore a problem using quantitative methods, and then using qualitative methods, to help explain the quantitative results in greater detail (Creswell, 2013). Whilst the quantitative results in Phase 1 of data collection provide simply frequencies and comparative analysis, it does not, however, provide information on the contextual factors, as in the case of this study, that could contribute to gender differences in the performance of Grade 8 learners in the 2011 TIMSS science test in the UAE. Therefore, in Phase 2, qualitative data was accessed to explain the quantitative results.

According to Creswell (2013), the strength of this design lies in the fact that the two phases build on each other.

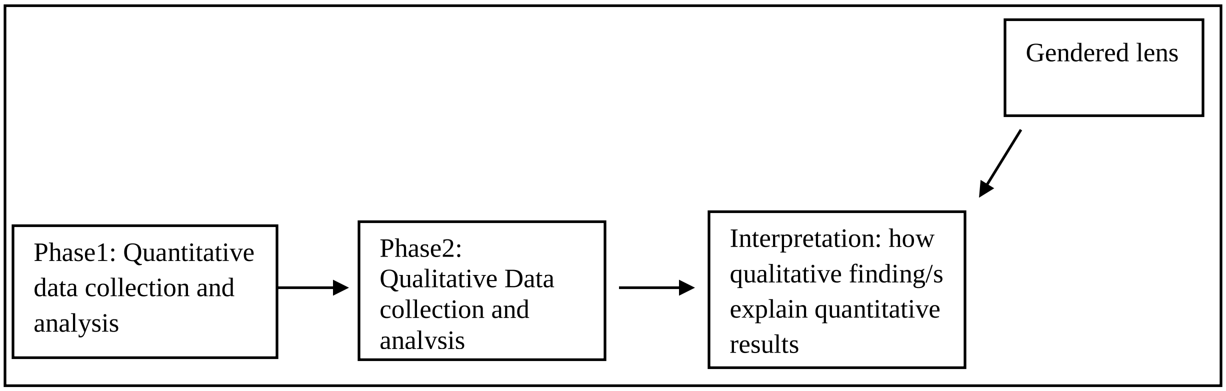

Figure 0.1: Explanatory sequential design

3.5. LOCATION OF THE STUDY

This study was located in the UAE, a small, oil-rich country on the Persian Gulf neighbouring Oman, the Kingdom of Saudi Arabia, Kuwait, and Qatar. The UAE is found across the Gulf from the Islamic Republic of Iran. The United Arab Emirates is composed of seven states: Abu Dhabi, Dubai, Sharjah, Ajman, Umm al-Quwain, Ras al-Khaimah, and Fujairah. Each of the seven states is ruled by an Emir. This federation of states joined together to become the United Arab Emirates (UAE) in 1971-72.

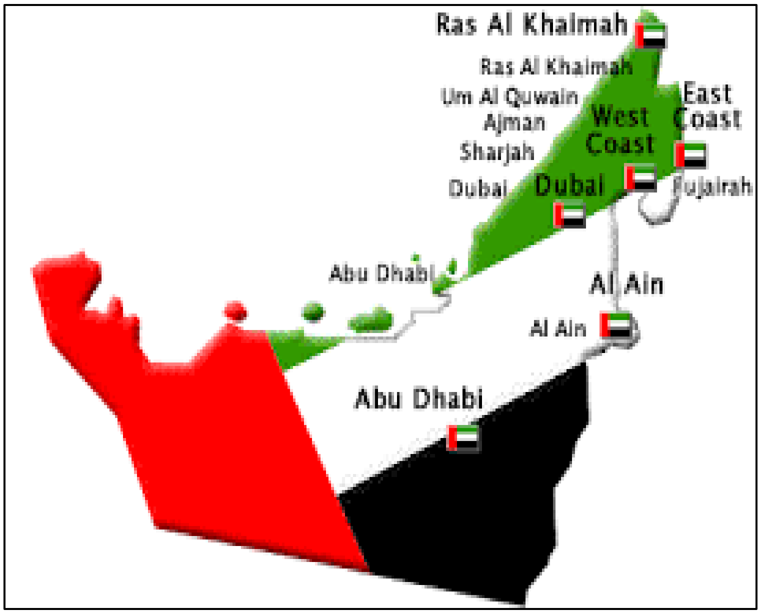

Figure 0.2: Map of the seven States of the UAE

The UAE has a population of 3.754 million people (MoP, 2004), with UAE citizens numbering less than a quarter of the total population. Rapid expansion and development in the UAE after the discovery of oil resulted in the influx of predominantly male expatriate labour into the country. The labour force comprised 90.9% migrant workers in 1995 (MoP, 1997). Given the small size of the national population, and the pace of economic development, the UAE labour market will probably further increase its demand for foreign labour unless the national labour force acquires the skills and expertise needed to become more competitive (Al-Nayadi, 1994). Therefore, one of the long-term development strategies of the UAE is the allocation of resources to both the diversification of the UAE economy, and the education of its citizens so that they may be equipped with the appropriate skills, knowledge and expertise to actively participate in a post-oil UAE economy.

3.6. GAINING ACCESS

Gaining access involves convincing the people that the researcher has decided who should be informants to provide information in conducting the research (Henning et al., 2004). In other words, gaining access means dealing with the various gatekeepers at each stage of the research.

Since this study made use of secondary data that is available in the public domain, and there were no live participants involved in the study, formal permission to conduct the research was only obtained from the University of KwaZulu-Natal's (UKZN) research office (see appendix A1 for the ethical clearance certificate).

3.7. DATA COLLECTION METHODS

The data was collected in two phases, as outlined in Table 3.1 below.

Table 0.1 Phases of data collection

Phase	Research question	Data source	Analysis
1	What gender difference is evident in 8th grade learners' performance in the TIMSS 2011 science tests with regard to: The science content dimension (biology, chemistry, physics and earth sciences), and The science cognitive dimension (knowing, applying, reasoning)?	Quantitative data: TIMSS 2011 science test results for the UAE. UNESCO data base/TIMSS website. PISA 2009 results.	Comparative analysis of 8th grade learners' performance in the TIMSS science test in 2011.
2	What contextual factors examined in the TIMSS 2011 science test could possibly	TIMSS 2011 – data from the learners' background questionnaire;	Comparative analysis of data from the learners' background questionnaire and then finding a correlation

Phase	Research question	Data source	Analysis
	account for the observed gender difference, if any?	Literature.	between the different reported background factors for learners and their achievement in the TIMSS test. Use the theoretical framework as a lens to interrogate the literature.

Stage 1: This phase of data collection entailed the use of quantitative secondary data. According to Kumar (2005), secondary data is the data that has already been collected by someone else and only the required information is extracted for the purpose of pursuing one's study. Data from the 2011 TIMSS science test that was obtained from the TIMSS website was used to answer Research Question 1 and 2. An additional data source was consulted in phase 1 once I began with data generation, which was not part of my original data generation plan. I consulted the Programme for International Student Assessment (PISA), which measures 15 year old students' literacy, mathematics and science learning in 65 countries (PISA, 2012). PISA 2009 is included in this discussion because it assesses students' science skills and knowledge (OECD, 2011), and provides comparative evidence to supplement this study's analysis of students' science achievement in TIMSS. Furthermore, Dubai participated in the PISA study in 2009.

Stage 2: In this phase, the qualitative data was accessed through a survey of existing literature on gender issues pertaining to education in the UAE.

3.8. SAMPLING

According to Cohen et al. (2011), a sample can be a finite part of a statistical population whose properties are studied to gain information about the whole, or it can pertain to respondents (people) selected from a larger population for the purpose of a survey. This study used purposive sampling. Maxwell (1997) defines purposive sampling as a type of sampling in which, "particular settings, persons, or events are deliberately selected for the important information they can provide that cannot be gotten as well from other choices" (p. 87). In this study, the location (UAE), and the secondary data (2011 TIMSS science test results), which were used as the sample, were purposively selected. All schools in Dubai that participated in the 2011 TIMSS science test formed the sample of this study.

3.9. DATA ANALYSIS METHOD

As mentioned previously, this study used secondary data collected via the 2011 TIMSS science test for 8th grade students in the UAE, Dubai schools. Secondary data analysis entails an analysis of data collated by someone else, or an organisation or association (Boslaugh, 2007). The advantages of using secondary data is that it saves time and money that would be used to generate data. The following steps were undertaken during the analysis of the data.

- All potential data pertaining to the 2011 TIMSS science test from the TIMSS website was transferred to an electronic folder.
- The data was read several times in order to separate data pertaining to 8th grade science students from the UAE, Dubai from data pertaining to other countries.
- The data for 8th grade UAE science students was read many times to note their achievement in the content and cognitive dimensions.
- Male and female science students' achievement in both the content and cognitive dimensions were compared, contrasted, and traced across different cohorts of students to note patterns, similarities, and differences in the statistical variables available.
- The achievement scores of 8th grade girls were juxtaposed with that of 8th grade boys.
- The differences between these achievements were calculated and noted.
- Graphs and tables were then constructed.
- Lastly, the literature was surveyed to account for the gender differences observed.

3.10. RESEARCH RIGOUR

The validity of any data refers to the appropriateness, correctness and relatedness of the data according to the research questions that are set by the researcher. In order to achieve the validity of the data, it is important that it should be associated with the research objectives and research questions. In order to ensure the validity of this research, I made sure that the information used would be gathered according to the research questions, and the data would be collected step by step to ensure that they were valid.

Reliability is the degree to which the researcher can rely upon the data and the source of the data (Patton, 2012). Data that are reliable may be trusted and are genuine, authentic, consistent and reputable. In the next section, I unpack the steps taken for international consensus by the National Research Coordinators (NRCs), their national committees, mathematics and science experts, and measurement specialists to ensure that the items used in the survey were appropriate for their students. This is furthermore analysed to confirm that the items reflected each participating countries' curriculum, enabling students to give a good account of their knowledge and ability, and ensuring that international comparisons of student achievement could be based on a "level playing field" as far as possible. I will then focus on the item types, and developing the pool items and item pilots.

3.10.1. Item types

The item types were not limited to multiple-choice questions (Mullis, Martin, Ruddock, O'Sullivan, Arora & Eberber, 2005). Constructing proof in mathematics or communicating findings in science or mathematics, or even making a case for action based on scientific principles all require skills that are not adequately measured by multiple-choice items (Mullis et al., 2005). It is also believed that tasks requiring complex, multi-step reasoning are measured with greater validity by constructed- or free-response items, which demand written responses from students. Such items, especially those that demand an extended response, also convey to the students that the ability to present a lucid written account of their reasoning is an important component of learning. It was therefore decided by the NRCs at the outset that the TIMSS test should employ a variety of item types for the best coverage of the outcomes of school mathematics and science education. Three types of achievement items were included in the item pools for TIMSS: Multiple-choice items; free-response items (both short-answer and extended-response items); and performance tasks.

3.10.2. Developing item pools

To ensure the comparability of the items, personnel in the national centres were also asked to submit multiple-choice and free-response items considered suitable to the International Coordinating Center (ICC) (Mullis et al., 2005). Items submitted by national centers were then classified according to the content and performance expectation codes of the TIMSS curriculum frameworks (Robitaille, Schmidt, Raizen, McKnight, Britton & Nicol, 1993). Thereafter, a detailed test blueprint for content-by-performance category was developed by an iterative process, and an interim item specification framework developed in 1991 was used for the initial selection of items to be piloted. This draft blueprint was in lieu of a more refined version that was to evolve later from the data collected in the curriculum analysis component of TIMSS. The draft blueprint indicated the approximate numbers of items needed for each sub-topic and for each performance expectation category. Items were distributed across content areas with a weighting reflecting the emphasis that the national committees placed on individual topics (Mullis et al., 2005). For the purposes of assigning the blueprint to categories, items with multiple codes were classified according to the code judged to relate to the primary content and performance categories being assessed. Inevitably, key stages of test development revealed shortages of items with particular specifications, and new items had to be written or gathered. Although large pools of items had been assembled, a disproportionate number were found to assess computation, recall, or simple application in limited content areas. For some content areas, an adequate number of potentially good items were available, but for others, there were too few items of good quality. Also, because most items had been written for use within particular countries, the panel had to reject many for use in TIMSS because of cultural bias, or because the translation was likely to lead to ambiguity or misunderstanding (Mullis et al., 2005). However, items that were not too culture-bound, or specific to the curricula of too few countries, or were not too time consuming were considered for the TIMSS item pool. At the national centers, committees that included people with subject-matter, evaluation, and teaching expertise reviewed each item for its appropriateness to the national curriculum and its overall quality. Items considered to be biased were targeted, and national review committees identified those that they believed should not be included in TIMSS. This information was used in conjunction with item statistics to determine which items would be retained and which would be discarded.

3.10.3. Item pilot

Items selected by the NRC were piloted with at least 100 students per item, and in most countries that target was exceeded. Once again, at the national centers, committees that included people with subject-matter, evaluation, and teaching expertise reviewed each item for its appropriateness to the national curriculum and its overall quality. Items considered to be biased were targeted, and national review committees identified those that they believed should not be included in TIMSS. This information was used in conjunction with item statistics to determine which items would be retained and which discarded. To be retained for further consideration, an item had to meet the following criteria: Be appropriate for the curricula of more than 70% of countries, be recommended for deletion by less than 30% of countries, have p-values of greater than .20 (for five-choice items) or .25 (for four-choice items), have positive point-biserial correlations for correct responses, and negative point-biserial correlations for all distracters. These steps ensured the comparative reliability of the TIMSS test items.

3.11. LIMITATIONS OF THE STUDY

In spite of the data available for each participating country, TIMSS does not account for unique cultural effects and conditions in each school in participating countries (Chen, Clark & Schaffer, 1988). Furthermore, the TIMSS data does not report teachers' nationality or country where they received their teaching training. This is a limitation in the UAE as Dubai schools have a large number of foreign qualified teachers (Ridge, 2010). Additionally, TIMSS does not indicate if the schools sampled for each county are government, independent or private school. This information is only accessible through the country's TIMSS coordinator or MoE.

3.12. CONCLUSION

This chapter presented the research methodology adopted in this study. A mixed methods approach was used to access secondary quantitative data and qualitative data. The location of the study, gaining access, and the sampling techniques used were discussed. Furthermore, the steps taken to ensure the reliability of the TIMSS tests were also highlighted. The next chapter attempts to answer the research questions posed earlier in this dissertation.

CHAPTER 4: PRESENTATION AND DISCUSSION OF THE FINDINGS

4.1. INTRODUCTION

Empirical studies internationally indicate that girls are more likely to outperform boys in literacy and the humanities (Sadowski, 2010). In many instances, boys outperform girls in mathematics and science in secondary school (Husain & Miller, 2007). Globally, there has been education policy reform to increase girls' access to and achievement in STEM (Ramirez & Wotipka, 2001). As mentioned previously, this study explored whether gender differences is evident in 8th grade science learners performance in the 2011 TIMSS science test. This chapter presents the data so as to answer the two research questions posed, namely:

1. What gender difference is evident in 8th grade learners' performance in the TIMSS 2011 science tests with regard to:

    1.1. The science content dimension (biology, chemistry, physics and earth sciences)?

    1.2. The science cognitive dimension (knowing, applying, reasoning)?

2. What contextual factors in the TIMSS 2011 science test could possibly account for the observed gender difference, if any?

As alluded to in Chapter 3, the data was collected through the use of secondary data. This chapter is divided into two parts, Part A and B. Part A focuses on Research Question 1, while Part B aims to answer Research Question 2.

4.2. PART A: RESEARCH QUESTION 1

In this section, I attempt to answer the first research question, namely: What gender difference is evident in 8th grade learners' performance in the TIMSS 2011 science tests with regard to:

1.1. The science content dimension (biology, chemistry, physics and earth sciences)?

1.2. The science cognitive dimension (knowing, applying, reasoning)? Using secondary data.

In order to answer the above questions, I examined the general performance of 8th grade learners in schools offering different curricula, where after I analysed any gender differences that were present. At the outset, it is worth noting that the the average score of 8th grade science students in Dubai is 465 (2.4). Dubai is one of the 24 countries that had an average score that lay below the TIMSS scale center point of 500. Additionally, it should be noted that the performance of 8th grade science students in Dubai decreased from a score of 489 in TIMSS 2007 to a score of 465 in 2011 (Martin et al., 2012), as reflected in the Figure 4.1 below. The comparison of learners' performance in the 2007 and 2011 TIMSS helps create a clear picture of 8th grade learners performance in science.

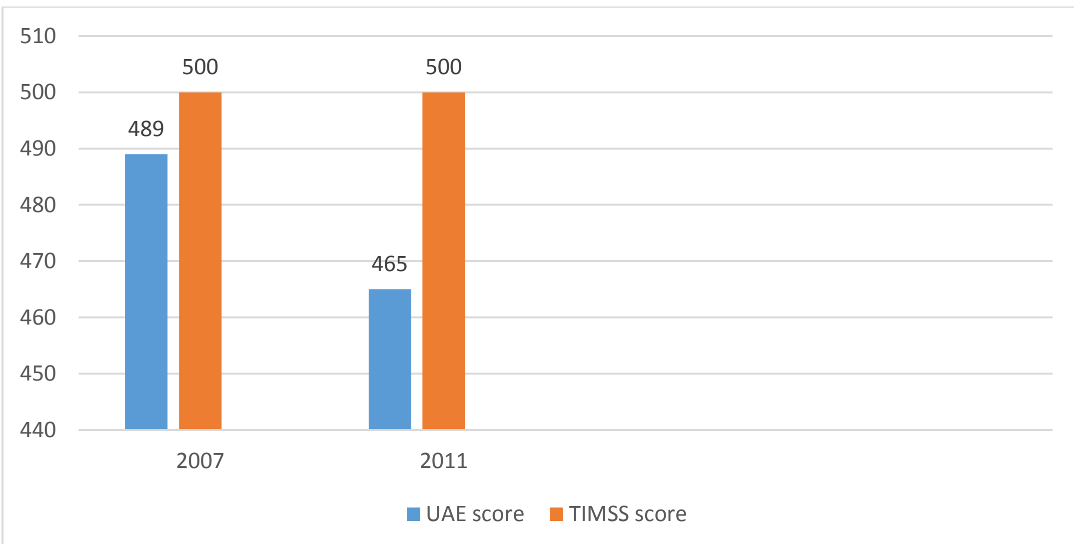

Figure 0.1: Trends in 8th grade science students' performance in Dubai

Coincidently, the 2011 cohort of 8th grade students also performed below the scale centre point (500) in their 4th grade in 2007 (460). The regression in 8th grade science students' performance raises questions about factors that could have negatively impacted learners' performance. A closer examination of the achievement of 8th grade science students at schools offering different curricula is represented in Figure 4.2 below.

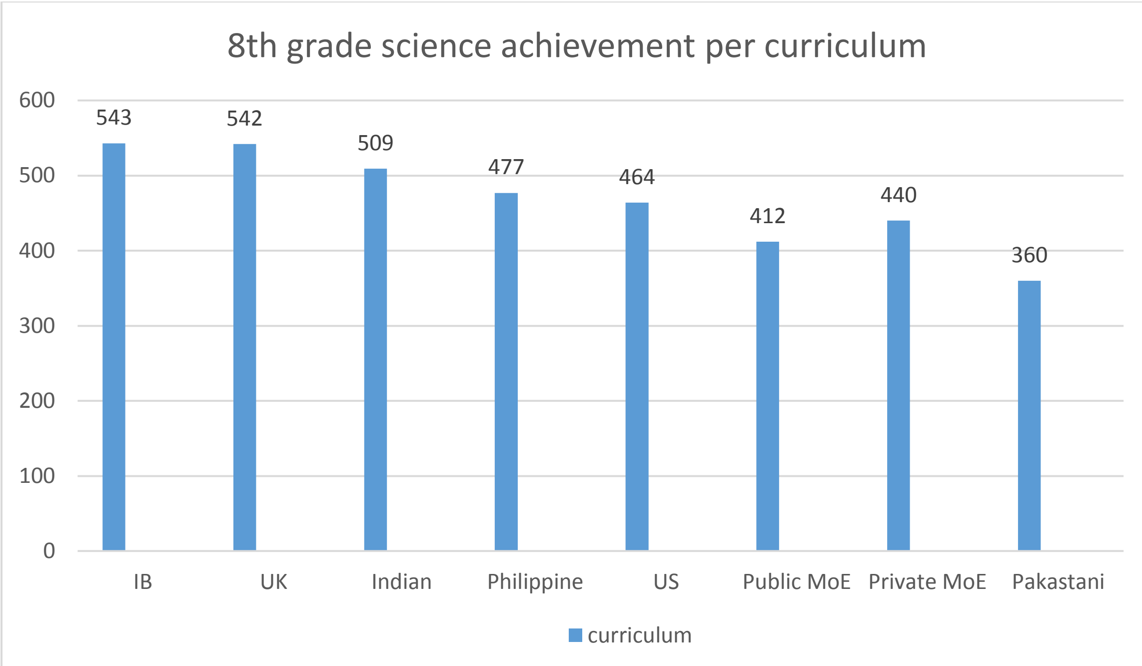

Figure 0.2: Eighth grade science learners' overall achievement results in different school curricula

It is evident from Figure 4.2 that only three curricula exceeded the TIMSS scale centre point of 500, namely the IB, UK, and Indian curricula. In schools offering the Philippine curriculum, 8th grade science students achieved above Dubai's average score of 465, but their performance was still below that of the TIMSS center point of 500. In schools offering the Public MoE, Private MoE and Pakistani curriculum, 8th grade science students achieved below Dubai's average score of 465. Whilst the achievement of science students' per curricula is important, it is equally important to inspect the benchmark level at which the students achieved as these levels could point to the various types of social, cultural, and intellectual capitals in operation in these school environments. Figure 4.3 below reflects the 8th grade science international benchmark per school curriculum type.

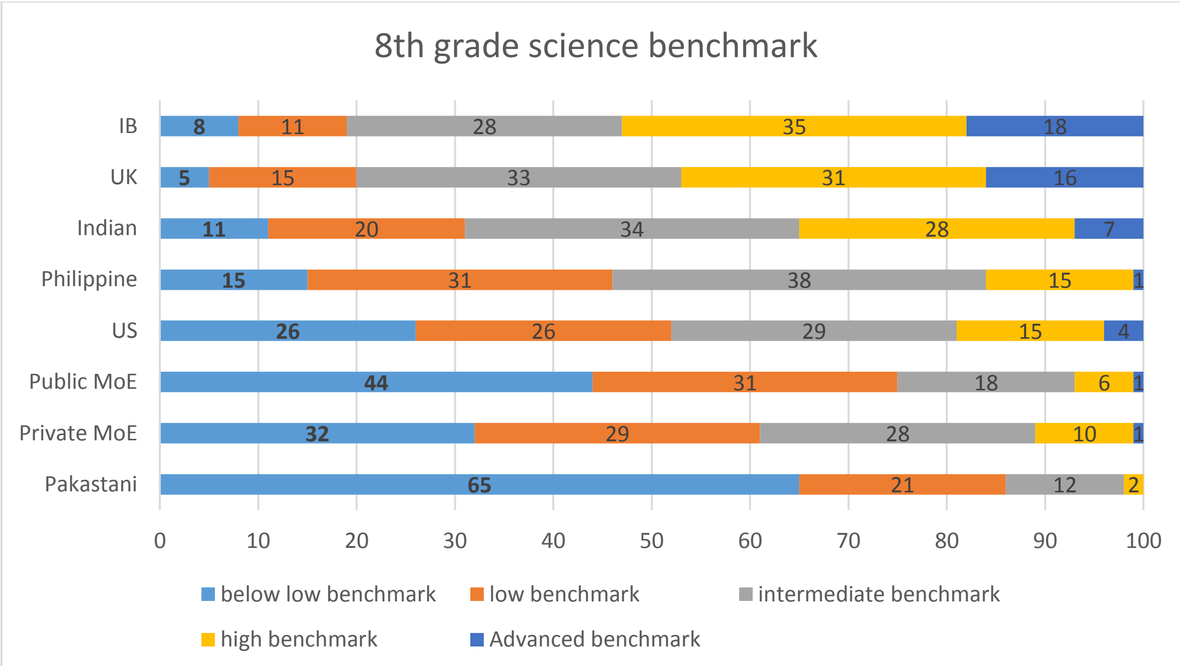

Figure 0.3: 8th grade science – international benchmarks by school curriculum type

This figure reveals that the highest proportion of 8th grade science students achieving below the lowest TIMSS benchmark were attending schools offering the Pakistani and Public MoE curriculum. Sixty-five percent of the 8th grade science students at Pakistani curriculum schools, and 44% at Public MoE curriculum schools did not reach the lowest TIMSS benchmark. This means that 86% of the 8th grade science students in Pakistani curriculum schools and 75% of students in Public-MoE curriculum schools' achievement placed them in the low international benchmark or below it. The 8th grade science students at schools offering the Pakistani curriculum did not reach the advanced benchmark scores.

In terms of the schools offering the US curriculum, 51% of students scored at or below the TIMSS Low benchmark. Schools offering the UK, IB, and Indian curricula had a higher proportion of 8th grade science students performing at the advanced benchmark, high benchmark and intermediate benchmark levels as compared to schools offering other curricula. The above data raises questions regarding the kind of teaching and learning capital that prevails at the schools offering the IB, UK and Indian curricula and how these teaching and learning capitals differ from that which is present in the Pakistani and Public MoE schools.

4.2.1. Gender differences in 8th grade learners' performance

Girls in Dubai performed better than boys, and the same cohort of girls who were in the 4th grade in 2007 and the 8th grade in 2011 performed better than boys by a large margin, as reflected in Table 4.1 and Figure 4.4 below. The reason for focusing on the 2007 performance is for comparison and to trace gender differences and find possible factors that could attribute for this difference in the literature.

Table 0.1: Average achievement by gender

Cohort	Girls	Boys	Difference (Absolute value)
2007 4th grade (these students will form the 2011 8th grade cohort).	462	461	1(7.3)
2007 8th grade cohort.	495	483	12
2011 8th grade cohort.	500	472	28 (9.3)

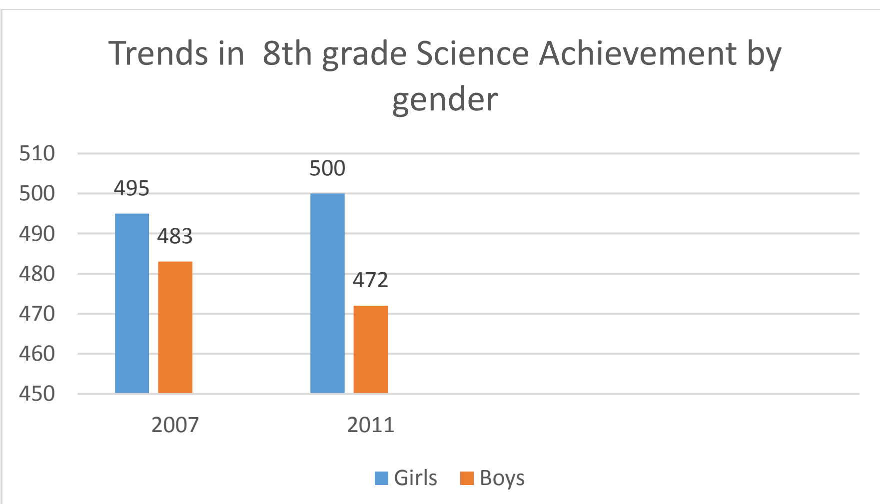

Figure 0.4: Trends in 8th grade science achievement by gender

From the above table and figure, it is clear that a significant gender difference does exist amongst 8th grade students' performance in science.

As alluded to in Chapter 1, the TIMSS achievement scale summarises student performance on test items designed to measure the breadth of knowledge in science content domains, as well as a range of cognitive processes within the knowing, applying, and reasoning domains. TIMSS reports on learners' achievement at four points along the scale as international benchmarks: The Advanced International Benchmark (625), High International Benchmark (550), Intermediate International Benchmark (475), and Low International Benchmark (400). Table 4.2 below reflects the performance in terms of international benchmarks for science achievement of the 8th grade science students in 2011 in Dubai, the UAE.

Table 0.2 Performance per international benchmark for science achievement of the 8th grade science students in 2011 in Dubai

	Advanced benchmark 625	High benchmark 550	Intermediate bench mark level 475	Low benchmark level 400
Dubai, UAE	7	28	57	79

From Table 4.2, it can be deduced that a very small proportion of the 8th grade science student performed at an advanced level. According to Martin et al. (2012), students performing at the Advanced International Benchmark are capable of communicating an understanding of complex and abstract concepts in biology, chemistry, physics, and earth science. They also combine information from several sources to solve problems and draw conclusions, and provide written explanations to communicate scientific knowledge. Students performing at a high benchmark level demonstrate an understanding of concepts related to science cycles, systems, and principles. They further demonstrate some scientific inquiry skills, and combine and interpret information from various types of diagrams, contour maps, graphs, and tables. They select relevant information, analyse and draw conclusions, and provide short explanations conveying scientific knowledge (Martin et al., 2012). A higher proportion of students performed at the intermediate bench mark level. Martin et al. (2012) maintain that at the Intermediate International Benchmark level, students recognise and apply their understanding of basic scientific knowledge in various contexts. They interpret information from tables, graphs, and pictorial diagrams, draw conclusions, and communicate their understanding through brief descriptive responses. The majority of the students performed at a low benchmark level. The students at the Low International Benchmark recognise some basic facts from Life and Physical Sciences, and can interpret simple pictorial diagrams, complete simple tables, and apply their basic knowledge to practical situations (Martin et al., 2012).

The exact extent of gender difference in the content and cognitive dimension will be presented next.

4.2.1.1. Content dimension

As mentioned previously in Chapter 2, the content dimension comprises four parts, namely: biology, chemistry, physics and earth sciences. Table 4.3 highlights the achievement of 8^{th} grade science students in the 2011 TIMSS science content domains.

Table 0.3: Achievement of 8th grade students in the 2011 science content domains

	Biology		Chemistry		Physics		Earth science	
	Girls Achievement scores	Boys Achievement scores	Girls Achievement scores	Boys Achievement scores	Girls Achievement scores	Boys Achievement scores	Girls Achievement scores	Boys Achievement scores
Dubai	504	468	502	474	492	472	498	477

From Table 4.3 above, it is clear that 8th grade female learners outperform male learners in all four science content domains, thereby shattering the belief that boys are better than girls in physics. The above finding resonates with Belal's (2014) assertion that if science remains the domain of men, it is sure to perpetuate existing gender bias in Islamic societies. The lower performance of boys across all four science content dimensions alerted the researcher to a possible crisis that boys may be encountering in a patriarchal society, and at school where they are unable to seek help from the teacher regarding their poor academic performance. Addis and Mahalik (2003) confirm that men have poor help-seeking instincts and behaviour, which may result in reverse gender isolation and bias.

4.2.1.2. Cognitive dimension

As noted in Chapter 1, the cognitive dimension describes a set of thinking processes that students are likely to use as and when they engage with scientific content. This dimension can be subdivided into three domains, i.e. knowing, applying, and reasoning. Cvencek, Meltzoff and Greenwald (2011) assert that mathematics and science are masculine domains, while Furnham, Reeves and Budhani, (2000), and Beilock, Gunderson, Ramirez and Levine (2010) suggest that parents and teachers expect boys to be more intelligent when it comes to reasoning, application, logical and spatial skills. Other studies show that girls whose mothers believed that mathematics and science is a masculine domain performed worse in mathematics and science, especially in situations when gender stereotypes were activated (Tomasetto, Alparone & Cadinu, 2011). Data from the 2011 TIMSS 8th grade students' achievement in the cognitive domain is captured in Table 4.4 below.

Table 0.4: Achievement of 8th grade students in 2011 science cognitive domains

	Knowing		Applying		Reasoning	
	Girls	Boys	Girls	Boys	Girls	Boys
Dubai	507	478	500	475	496	464

For the cognitive domain, 8th grade female learners outperformed male learners across all domains. This finding indicates that the efforts made by the UAE MoE to empower girls has been successful. The above finding exemplifies the fact that, in spite of gender stereotyping, and exposure to cultural patriarchal laws, 8th grade female science students outperformed male students in both the content and cognitive domains. The above findings debunk the myth that boys are better at science (Atwater, 2000). Furthermore, the above findings signal the direction of the reform journey that needs to be undertaken by policy makers and the MoE to enhance science performance amongst boys, which would help to develop their "knowing" into "application and reasoning," and bridge the gaping gender gap in students' science achievement. If measures are not put into place, boys in the UAE could be in crises and become isolated from careers in the STEM disciplines.

According to Ridge (2010), girls' and boys' experiences in school may also explain their different levels of achievement and their schooling outcomes (the factors that impact students' experiences at school will be discussed in Part B).

While 8th grade female science students outperformed boys, it is essential to establish gender differences in science achievement as per school curriculum type. Figure 4.5 below elucidates which school curriculum types enabled girls' high achievement in science.

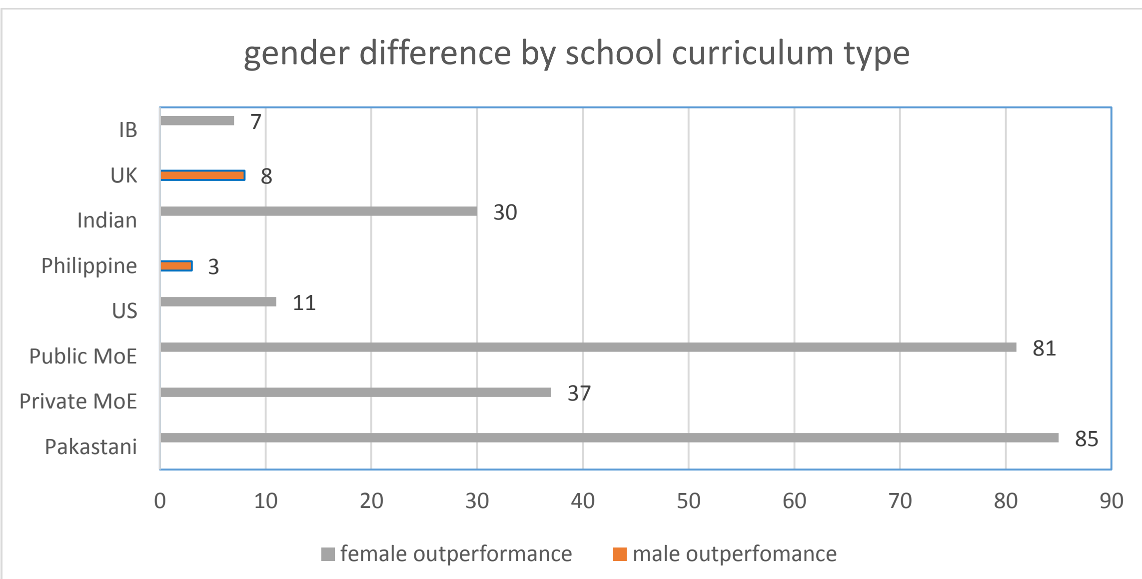

Figure 0.5: Gender difference in science achievement by school curriculum type

From the figure above, it is visible that boys outperformed girls only in schools that offered the UK and Philippine curricula, while in schools offering other curricula, girls continued to outperform boys in science achievement. This particular finding requires further research in order to establish the possible or probable factors within the schools offering the Philippine and UK curricula. In other words, further research is needed to establish the factors that perpetuate male dominance in science.

4.3. PART B: RESEARCH QUESTION 2

In Part B, I present the factors from the literature that could account for the observed gender differences in the content and cognitive dimensions. These factors were grouped into three categories:

- Home resources;
- Spoken language; and
- School learning environment.

In the next section, I examine the factors that impacted the students' achievement in science, which could be attributed to their observed content and cognitive gender difference.

4.3.1. Home resources

Research consistently shows a strong positive relationship between achievement and indicators of socio-economic status, such as parents' or caregivers' level of education, and the availability of books.

Okpala, Okpala and Smith (2001), and Sirin (2005) affirm that socio-economic status in the home is associated with achievement. According to Sirin (2005), and Yang (2003), the term 'socio-economic status' is a complex and multi-dimensional concept that is linked to the term 'cultural capital' (Bourdieu, 1977). Bourdieu's theory basically argues that social origins and resources have a strong influence on students' cultural resources, skills, attitudes, and use of language. Gendered dispositions are an embodied state of cultural capital, and have the same properties as other states of cultural capital. Put simply, this means that gendered dispositions work as sources of power. The data from the 2011 TIMSS science student questionnaire on the home and educational resources available to the students is depicted in Table 4.5 below.

Table 0.5: Home educational resources of 8th grade science students

	Many resources - books, computers, internet, educated parent(s)		Some resources		Few resources		Average scale score
	% students	Average achievement	% students	Average achievement	% students	Average achievement	
Dubai	15	546	76	482	9	415	10,6

The above table indicates that 8th grade science students who had access to many home resources had higher achievement scores as compared to students who had access to fewer resources. The above finding confirms that the availability of resources to students has a direct bearing on their study environment and study habits. From the above tables it can further be inferred that students with access to more resources have greater opportunities to excel. This finding concurs with that of Okpala et al. (2001) and Sirin (2005), whose studies confirm the relationship between achievement and home resources. Additionally, the above finding concurs with the theoretical framing of this study that social capital enhances cognitive capital.

4.3.2. Spoken language

Students bring to the learning process their own ways of interpreting the natural and social worlds assimilated from their cultural environments. Sometimes the cultural knowledge acquired at home is incongruent with the expectations and assumptions of school science (Moll, 1992). The language of science that is the norm for scientific argument, explanation and the evaluation of evidence differs from that of everyday life or home language. Therefore, science students need to be familiar with the language of instruction in their science classes in order to be able to access, participate and engage with science content and assessments. According to Howie (2003), Aikenhead and Jegede (1999), Atwater, (1994), Lee (1998), and Moje, Collazo, Carillo and Marx (2001), students perform better in science if the Language of Learning and Teaching (LoLT) is the same as the language spoken at home. Table 4.6 below represents the 8th grade science students' spoken language and their achievement in the 2011 TIMSS science test.

Table 0.6: Students' spoken home language compared to that of the test

	Always or almost always		Sometimes		Never	
	% students	Average achievement	% students	Average achievement	% students	Average achievement
Dubai	62	492	34	476	4	466

From the above table, it is noticeable that students who spoke the language of the test had mastery of the language of instruction, and could thus deconstruct the language of the test and answer appropriately. These students had higher average science achievement than students who did not speak the language of the test more often. Language is a form of cultural and social capital that empowers certain students to have advanced cognitive capital.

The above table points to the kind of reform that teachers of science and designers of benchmark tests need to undertake in order to ensure that instruction and assessments considers students' prior knowledge and make learning more accessible to them (Cobern, 1998; Cobern & Aikenhead, 1998; Lee, 2003, 2002; Lee & Fradd, 1998; Warren, Ballenger, Ogonowski, Rosebery & Hudicourt-Barnes, 2001).

In Chapter 3, I alluded to the use of data from PISA 2009 as it assessed students' science skills and knowledge (OECD, 2011), and provided comparative evidence to support this study's analysis of students' science achievement in TIMSS. The UAE's MoE had commissioned the Australian Council for Educational Research to analyse the students' performance in PISA 2009. It was found that girls outperformed boys in all sections, and the greatest difference in students' achievement was in the scientific literacy scale, in which girls outscored boys by 31 points. Girls outperformed boys in identifying science issues and knowledge about science (OECD. 2011).

4.3.3. School learning environment

According to Spaull, (2013) and Van der Berg (2008), the socio-economic status of a school's learning environment has a significant impact on learners' performance. The learning environment of the school can be a positive influence, encouraging a positive attitude toward academic excellence and facilitating classroom instruction (Abulibdeh & Abdelsamad, 2008). Furthermore, Mullis et al. (2005) argue in the Assessment Frameworks for the 2007 TIMSS study that internationally, students from well-resourced schools generally have higher achievement than students from schools that report resource shortages. In view of the aforementioned studies, I now examine the data pertaining to school resources.

Table 0.7 Resources that teachers use to teach science

Textbook		Workbook/worksheet		Science equipment		Computers and internet	
As a basic instruction	As a supplement	As a basic instruction	As a supplement	As a basic instruction	As a supplement	As a basic instruction	As a supplement
74 %	21%	35%	63%	53%	47%	34%	61%

The table above reveals that 74% of science teachers rely on the textbook as a basic source of instruction to direct their teaching, while only 53% use practical work as an activity to instruct students, and 63 % depend on computers and the internet to provide instruction to students during their teaching. The above modality of teaching that relies on the textbook as a major resource is a dominant strategy. According to Mullis et al. (2012), textbook content is presented in a way to measure students' basic knowledge. This means that they do not measure students' skills or capabilities, nor do they contribute to developing skills of critical thinking and problem solving. If the above resources are used for basic instruction, then the guiding principles of the curriculum/ policy documents of the school and the MoE, in terms of science pedagogical content knowledge, seem to be sidelined.

Table 0.8: School resources for conducting science experiments

School has a science laboratory				Teacher has an assistance available to conduct science experiments			
Yes		No		Yes		No	
% students	Academic achievement	% students	Academic achievement	% students	Academic achievement	% students	Academic achievement
97	485	3	502	93	483	7	512

From the table above, it can be inferred that the availability of school resources for conducting experiments does not correlate with 8th grade science students' achievement scores in the 2011 TIMSS test. The data reveals that in schools lacking science laboratories and assistance to conduct investigations, 8th grade science students performed better than their counterparts in well-resourced schools. The above finding reminds us of the 8th grade science students' performance in the cognitive domains of the test, where science students do not perform well in the application and reasoning aspects, but excel in the knowledge aspect. The above finding requires us to question the effectiveness of the practical work undertaken in these schools with resources in promoting critical thinking, application, inquiry-based learning, and problem solving.

Getting students to engage in scientific investigations and inquiry is a way in which students can be encouraged to build on their knowledge and understanding of science. Teachers ought to devote time to involving students in process-based inquiry that encourages critical thinking and problem solving. Table 4.9 shows the emphasis placed by teachers on scientific investigation.

Table 0.9: Teachers' emphasis on scientific investigations

About ½ the lessons or more		**Less than ½ the lessons**	
% students	Average achievement	%students	Average achievement
60	474	40	490

The data in Table 4.9 once again raises questions about the quality and effectiveness of the science investigation undertaken by teachers. Are these teacher-led demonstrations or are they "cook book recipe" type investigations that promote basic science process skills? Furthermore, do they promote inquiry-based learning, application and problem solving? In other words, are investigations both "hand on and minds on"? Reports by Mullis et al. (2012) indicate that students do not take practical sessions seriously as there are no significant marks counted for practicals. This finding confirms that having laboratories in schools does not necessarily ensure that higher order process skills are developed in students during scientific investigations. Furthermore, the above findings also raise the following questions: Firstly, why do the curriculum standards not recommend practicals/investigations to become compulsory and testable? Secondly, why is teachers' confidence in conducting practical work not bolstered, and thirdly, why are there not various kinds of professional development offered or available to teachers for engaging in practical work (considering that many foreign qualified teachers teach science in UAE schools)?

Table 0.10 Science teachers' formal education

Majored in science and science education.		Majored in science education but not science.		Majored in science but not in science education.		All other majors.		No formal education beyond upper secondary level.	
%	Average achievement	%	Average achievement	%	Average achievement	%	Average achievement	%	Average achievement
34	507	7	413	54	475	5	443	0	0

According to Darling-Hammond (2000), there is growing evidence that teacher preparation is a powerful predictor of students' achievement. This means that teachers should have solid mastery of the content in the subject to be taught. They should be confident in their content knowledge and its accompanying relevant content specific teaching strategies (Appleton, 2008). Rice (2003) has found a positive relationship between subject-specific advanced degrees and student achievement in mathematics and science. A teacher's content knowledge, pedagogical practice and assessment procedures are invariably linked to his/her social, cultural and cognitive capital. It is these forms of capital that determine his/her occupational success and the success of his/her students.

The data represented in Table 4.10 indicates that teachers' formal qualification does seem to have an impact on science students' achievement in the 2011 TIMSS test. Teachers who have majored in both science and science education seem to be equipped with both the content knowledge, as well as the pedagogical knowledge to engage students meaningfully in science. Therefore, they appear to have the ability to organise and execute their teaching with confidence. Hence their students have the highest average achievement scores (Bandura, 1997; Henson, 2002).

Moreover, boys' underachievement in Dubai schools in the UAE could be related to the training characteristics of foreign qualified male teachers in boys' schools.

4.4. CONCLUSION

This chapter attempted to answer the two research questions posed using the secondary data from the 2011 TIMSS science test. The findings illuminated that gender differences do exist amongst 8th grade science students in the content and cognitive dimensions. In both dimension 8th grade female science students in the UAE outperform their male counterparts. Nationally, the structural barriers that impacted females' participation in education have been removed through the innovative policy reform, therefore 8th grade girls' achievement levels in science have increased. Additional factors that possibly contribute to the observed gender differences are home resources, spoken language, and school environment resources. The findings show that 8th grade boys' achievement in science has stagnated or decreased. These differences in students' achievement could also be linked to their schooling experience. There are a high number of foreign qualified teachers teaching in boys' schools. According to Ridge (2009, 2010), girls are more likely to have a positive experience in school as they are taught by Emirati female teachers, so they have a more supportive school environment as compared to boys. It seems that boys are in crisis and have "lost ground" to girls in science in Dubai schools in the UAE. The findings raise questions about boys being disadvantaged or marginalised by a biased curriculum, instruction and assessment. Another question that needs to be asked is whether they struggling to cope with changes in a masculine society, or rather shifts in gender roles at work and at home.

In the next chapter, I present my recommendations, avenues for further research, and conclusions.

CHAPTER 5: CONCLUSION

5.1. INTRODUCTION

This chapter provides a summary of the findings, makes recommendations, and signals areas for future research. The findings confirm that gender differences do exist amongst 8th grade science students' achievement in the content and cognitive domains of TIMSS 2011 in Dubai schools in the UAE. Eighth grade female science students outperformed boys in the four content areas and in all three cognitive domains. The findings further show that 74% of teachers are heavily reliant on the textbook as a basic source of instruction. In this regard, it is worth noting that textbook content is presented in a way that does not measure the students' skills or capabilities, nor does it contribute to developing the skills of critical thinking and problem solving (Mullis et al., 2012). It is interesting to note that only 53% of science teachers used practical work (science equipment) as an activity to instruct students. According to Furirwai (2015) and Pillay (2004), investigations and practical work are an integral part of the science curriculum as they underpin the development of basic science process skills (observe, draw, identify), as well as integrated science process skills (problem solving, critical thinking, hypothesis formation, application). Interestingly, the findings highlight that students in schools with a science laboratory and teaching assistants had lower achievement scores in TIMSS 2011 compared to students in schools with no laboratories and no teaching assistants. This particular finding brings to the fore the nature of investigation or practical work undertaken in schools with laboratories and teaching assistants. Furthermore, the results signal that 8th grade boys in the UAE could be disadvantaged or may even be marginalised by biased curriculum reform, instructions, and assessments, as well as their school experiences in terms of being taught by foreign qualified male teachers. Based on the findings of this study, the relevant recommendations will be discussed in the next section.

5.2. Recommendations

The findings of this study have led to the following recommendations.

5.2.1. Quality Teacher Preparation

The Trends in International Mathematics and Science Study (TIMSS) report indicates the relevance and importance of a well prepared teaching force in any educational system (Mullis et al., 2012). Resonating with this statement, Darling-Hammond (2000), Darling-Hammond, Berry and Thoreson (2001), and Goldhaber and Anthony (2003) assert that there is a positive and strong correlation between teacher preparation and students' achievement. In a similar vein, the National Research Council (1996, p. 28) in the United States has put forward its National Science Education Standards with the following assumptions about science teaching, namely:

- Students' learning is influenced by how they are taught;
- There must be a pedagogical shift from a teacher-centred to a student-centred instructional paradigm.
- A more student-centred approach to learning engages students in socially interactive scientific inquiry and facilitates lifelong learning.

Put simply, this means that students cannot achieve high levels of performance in the absence of a student-centred learning environment with qualified, skilled, talented, and dedicated teachers. This means that improving teacher quality should be a major focus of the UAE's educational reforms as curriculum reform hinges on teachers (Singh-Pillay, 2010).

The research findings confirm that teacher quality is seemingly the most essential factor influencing student achievement (Darling-Hammond, 2000). The academic preparation of teachers, the type of certificate, and years of teaching experience serve as indicators of teacher quality. Teachers who have acquired sufficient academic preparation are seen to be competent in subject matter content and pedagogical skills, enabling them to be effective in the classroom. Certain characteristics of teachers that are harder to measure, but which are crucial to student learning, include the ability to convey ideas in clear and convincing ways; to create effective learning environments for different types of students; to foster productive teacher-student relationships; to be enthusiastic and creative; and to work effectively with colleagues and parents

(Akiba et al., 2007). However difficult it may be, the constant evaluation of teachers' competencies and qualifications is required to ensure the excellent delivery of instruction, especially in the sciences.

5.2.2. Teachers' Professional Development

The main findings of this study therefore suggest the need for continuous teacher professional development in terms of learner-centred teaching and practical work, given that the UAE is dependent on foreign qualified teachers. There seems to be a lack of consensus on how practical work or investigations can be used as a leverage to promote critical thinking and problem-based learning. Teachers and their teaching assistants need to be trained in how to use the different types of practical work/investigations so as to develop their reasoning skills and ability to apply this in the cognitive domains.

5.3. AVENUES FOR FURTHER CONSIDERATION, AND CONCLUDING THOUGHTS

The IEA should consider including a biographical data section in their teacher questionnaires in order to acquire more information regarding the nationality of the teacher. Furthermore, the UAE should consider carrying out their own tests amongst local schools in order to further compare curricula, and to compare gender differences, specifically in the sciences.

This study has demonstrated the importance of gender equality in education in the UAE, especially in terms of the sciences, but has also illustrated the following points:

- The importance of the curriculum chosen to educate learners;
- The importance of teachers' qualifications and biographical information; and
- A shift from teacher-centred to learner-centred teaching, and thus from passive to active learning.

In highlighting these factors, this study has filled a gap in the literature on factors that contribute to gender differences in 8th grade learners performance in the TIMSS science test in UAE, Dubai schools, and has created a foundation based on which further research can be undertaken.

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Appendix A1: ethical clearance

Appendix A2: Editing certificate

Exclamation Translations

To whom it may concern

The dissertation entitled, "A case study of gender differences in 8th grade students' performance in TIMSS 2011 science test in United Arab Emirates, Dubai schools" has been edited and proofread as of 01 December 2016.

As a language practitioner, I have a Basic degree in Languages, an Honours degree in French and a Master's degree in Assessment and Quality Assurance. I have been editing, proofreading and technically formatting documents for the past six years.

Please take note that Exclamation Translations takes no responsibility for any content changes made to the document after the issuing of this certificate. Furthermore, Exclamation Translations takes no responsibility for the reversal or rejection of the changes made to this document.

Kind regards

Melissa Labuschagne

Melissa Labuschagne trading as Exclamation Translations
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Appendix A3: Turnitin report

Document Viewer

Turnitin Originality Report

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Appendix A4: TIMSS School Questionnaire

Identification Label

School ID: School Name:

TIMSS 2011

School Questionnaire

<Grade 8>
<TIMSS National Research Center Name>
<Address>

School *Questionnaire*

Your school has agreed to participate in TIMSS 2011 (Trends in International Mathematics and Science Study), an educational research project sponsored by the International Association for the Evaluation of Educational Achievement (IEA). TIMSS measures trends in student achievement in mathematics and science, and studies differences in national education systems in more than 60 countries in order to help improve teaching and learning worldwide.

This questionnaire is addressed to school principals and department heads who are asked to supply information about their schools. Since your school has been selected as part of a nationwide sample, your responses are very important in helping to describe secondary education in <country>.

It is important that you answer each question carefully so that the information provided reflects the situation in your school as accurately as possible. Some of the questions will require that you look up school records, so you may wish to arrange for the assistance of another staff member to help provide this information.

Since TIMSS is an international study and all countries are using the same questionnaire, you may find that some of the questions seem unusual or are not entirely relevant to you or schools in <country>. Nevertheless, it is important that you do your best to answer all of the questions so comparisons can be made across countries in the study.

It is estimated that you will need approximately 30 minutes to complete this questionnaire. We appreciate the time and effort that this takes and thank you for your cooperation and contribution.

When you have completed the questionnaire, please place it in the accompanying envelope and return it to:

<Insert country-specific information here>.

Thank you.

TIMSS 2011

<Grade 8> School *Questionnaire*

School Enrollment and Characteristics

1

What is the total enrollment of students in your school as of <first day of month TIMSS testing begins, 2010/2011>?

_____________ students
Write in a number.

2

What is the total enrollment of <eighth-grade> students in your school as of <first day of month TIMSS testing begins, 2010/2011>?

_____________ students
Write in a number.

5

A. How many people live in the city, town, or area where your school is located?

*Check **one** circle only.*

More than 500,000 people --- A

100,001 to 500,000 people --- A

50,001 to 100,000 people --- A

15,001 to 50,000 people --- A

3,001 to 15,000 people --- A

3,000 people or fewer --- A

B. Which best describes the immediate area in which your school is located?

*Check **one** circle only.*

Urban–Densely populated --- A

Suburban–On fringe or outskirts of urban area --- A

Medium size city or large town --- A

Small town or village --- A

Remote rural --- A

C. Which best characterizes the average income level of the school's immediate area?

*Check **one** circle only.*

High --- A

Medium --- A

Low --- A

3

Approximately what percentage of students in your school have the following backgrounds?

*Check **one** circle for each line.*

0 to 10%

11 to 25%

26 to 50%

More than 50%

a) Come from economically disadvantaged homes ---------- A A A A

b) Come from economically affluent homes ----------------- A A A A

4

Approximately what percentage of students in your school have <language of test> as their native language?

*Check **one** circle only.*

More than 90% --- A

76 to 90% --- A

51 to 75% --- A

26 to 50% --- A

25% or less --- A

3

<Grade 8> School *Questionnaire*

Instructional Time

Resources and Technology

6

For the <eighth-grade> students in your school:

A. How many days per year is your school open for instruction?

__________days
Write in the number.

B. What is the total instructional time, excluding breaks, in a typical day?

_________hours and __________minutes
Write in the number of hours and minutes.

C. In one calendar week, how many days is the school open for instruction?

*Check **one** circle only.*

6 days---- A

5 1/2 days---- A

5 days---- A

4 1/2 days---- A

4 days---- A

Other---- A

7

What is the total number of computers that can be used for instructional purposes by <eighth-grade> students?

___________computers
Write in the number.

8

A. Does your school have a science laboratory that can be used by <eighth-grade> students?

*Check **one** circle only.*

Yes---- A

No---- A

B. Do teachers usually have assistance available when students are conducting science experiments?

*Check **one** circle only.*

Yes---- A

No---- A

9

How much is your school's capacity to provide instruction affected by a shortage or inadequacy of the following?

Check ***one*** *circle for each line.*

Not at all

A little

Some

A lot

A. General School Resources

a) Instructional materials (e.g., textbooks)----------------------- A A A A

b) Supplies (e.g., papers, pencils)-------------------------- A A A A

c) School buildings and grounds------------------------- A A A A

d) Heating/cooling and lighting systems-------------------------- A A A A

e) Instructional space (e.g., classrooms)---------------------- A A A A

f) Technologically competent staff------------------------------ A A A A

B. Resources for Mathematics Instruction

a) Teachers with a specialization in mathematics----------------- A A A A

b) Computers for mathematics instruction----------------------- A A A A

c) Computer software for mathematics instruction-------- A A A A

d) Library materials relevant to mathematics instruction----- A A A A

e) Audio-visual resources for mathematics instruction-------- A A A A

f) Calculators for mathematics instruction----------------------- A A A A

Check ***one*** *circle for each line.*

Not at all

A little

Some

A lot

C. Resources for Science Instruction

a) Teachers with a specialization in science-------- A A A A

b) Computers for science instruction----------------------- A A A A

c) Computer software for science instruction-------------- A A A A

d) Library materials relevant to science instruction----------- A A A A

e) Audio-visual resources for science instruction-------------- A A A A

f) Calculators for science instruction---------------------- A A A A

g) Science equipment and materials------------------------ A A A A 5 **<Grade 8> School *Questionnaire***

Involving Parents in Your School

10

C. How often does your school do the following for parents in general?

*Check **one** circle for each line.*

Never

Once a year

2–3 times a year

More than 3 times a year

a) Inform parents about the overall academic achievement of the school (e.g., results of national tests, results of inspections of learning)--------- A A A A

b) Inform parents about school accomplishments (e.g., tournament results, facility improvements)------------------ A A A A

c) Inform parents about the educational goals and pedagogic principles of the school----------------------- A A A A

d) Inform parents about the rules of the school -------------- A A A A

e) Discuss parents’ concerns or wishes about the school’s organization (e.g., rules and regulations, time tables, safety measures) --------------- A A A A

f) Provide parents with additional learning materials (e.g., books, computer software) for their child to use at home -------------------- A A A A

g) Organize workshops or seminars for parents on learning or pedagogical issues---------------------------- A A A A

A. How often does your school do the following for parents concerning individual students?

*Check **one** circle for each line.*

Never

Once a year

2–3 times a year

More than 3 times a year

a) Inform parents about their child’s learning progress-------- A A A A

b) Inform parents about the behavior and well-being of their child at school------------- A A A A

c) Discuss parents’ concerns or wishes about their child’s learning------------------------- A A A A

d) Support individual parents in helping their child with schoolwork---------------------- A A A A

B. How often does your school ask parents to do the following?

*Check **one** circle for each line.*

Never

Once a year

2–3 times a year

More than 3 times a year

a) Volunteer for school projects, programs, and trips------------------------- A A A A

b) Serve on school committees--------------------- A A A A **<Grade 8> School *Questionnaire*** 6

School Climate

11

How would you characterize each of the following within your school?

*Check **one** circle for each line.*

Very high

High

Medium

Low

Very low

a) Teachers' job satisfaction---------------------- A A A A A

b) Teachers' understanding of the school's curricular goals----------------------------- A A A A A

c) Teachers' degree of success in implementing the school's curriculum--------- A A A A A

d) Teachers' expectations for student achievement-------------------- A A A A A

e) Parental support for student achievement----------- A A A A A

f) Parental involvement in school activities-------------- A A A A A

g) Students' regard for school property----------------- A A A A A

h) Students' desire to do well in school-------------------- A A A A A

12

A. To what degree is each of the following a problem among <eighth-grade> students in your school?

*Check **one** circle for each line.*

Not a problem

Minor problem

Moderate problem

Serious problem

a) Arriving late at school----------- A A A A

b) Absenteeism (i.e., unjustified absences)----------- A A A A

c) Classroom disturbance---------- A A A A

d) Cheating------------------------- A A A A

e) Profanity------------------------ A A A A

f) Vandalism----------------------- A A A A

g) Theft---------------------------- A A A A

h) Intimidation or verbal abuse among students (including texting, emailing, etc.) --------- A A A A

i) Physical injury to other students------------------------- A A A A

j) Intimidation or verbal abuse of teachers or staff (including texting, emailing, etc.)---------- A A A A

k) Physical injury to teachers or staff--------------------------- A A A A

B. To what degree is each of the following a problem among teachers in your school?

*Check **one** circle for each line.*

Not a problem

Minor problem

Moderate problem

Serious problem

a) Arriving late or leaving early---- A A A A

b) Absenteeism-------------------- A A A A 7 **<Grade 8> School *Questionnaire***

Teachers in Your School

15

How difficult was it to fill <eighth-grade> teaching vacancies for this school year for the following subjects?

*Check **one** circle for each line.*

Were no vacancies in this subject

Easy to fill vacancies

Somewhat difficult

Very difficult

a) Mathematics -------------------- A A A A

b) Science -------------------------- A A A A

13

In your school, are any of the following used to evaluate the practice of <eighth-grade> mathematics teachers?

*Check **one** circle for each line.*

Yes

No

a) Observations by the principal or senior staff--------------------------- A A

b) Observations by inspectors or other persons external to the school-- A A

c) Student achievement----------------------------- A A

d) Teacher peer review------------------------------- A A

16

Does your school currently use any incentives (e.g., pay, housing, signing bonus, smaller classes) to recruit or retain <eighth-grade> teachers in the following fields?

*Check **one** circle for each line.*

Yes

No

a) Mathematics ------------------------------------- A A

b) Science --- A A

c) Other -- A A

14

In your school, are any of the following used to evaluate the practice of <eighth-grade> science teachers?

Check ***one*** *circle for each line.*

Yes

No

a) Observations by the principal or senior staff--------------------------- A A

b) Observations by inspectors or other persons external to the school---------------------------- ---------- A A

c) Student achievement----------------------------- A A

d) Teacher peer review------------------------------- A A **<Grade 8> School *Questionnaire*** 8

Leadership Activities

17

During the past year, approximately how much time have you spent on the following school leadership activities in your role as a school principal?

*Check **one** circle for each line.*

No time

Some time

A lot of time

a) Promoting the school's educational vision or goals ----- A A A

b) Developing the school's curricular and educational goals ---------------------------- A A A

c) Monitoring teachers' implementation of the school's educational goals in their teaching ---------------- A A A

d) Monitoring students' learning progress to ensure that the school's educational goals are reached --------------- A A A

e) Keeping an orderly atmosphere in the school ------ A A A

f) Ensuring that there are clear rules for student behavior ------ A A A

g) Addressing disruptive student behavior --------------- A A A

h) Creating a climate of trust among teachers ---------------- A A A

i) Initiating a discussion to help teachers who have problems in the classroom ---------------- A A A

j) Advising teachers who have questions or problems with their teaching ------------------- A A A

*Check **one** circle for each line.*

No time

Some time

A lot of time

k) Visiting other schools or attending educational conferences for new ideas ------ A A A

l) Initiating educational projects or improvements ----- A A A

m) Participating in professional development activities specifically for school principals ---------------------- A A A

Appendix A5: 2011 TIMSS student school questionnaire

Identification Label

School ID: School Name:

TIMSS 2011

Student Questionnaire

<Grade 8>
<TIMSS National Research Center Name>
<Address>

<Grade 8> Student *Questionnaire*

1

Directions

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

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

Example 1

Do you go to school?

*Fill **one** circle only.*

Yes---A

No---A

Example 2

How often do you do these things?

*Fill **one** circle for each line.*

Every day Once or Once or Never or or almost twice a twice a almost every day week month never

a) I talk with my friends ------------------ A A A A

b) I play sports -------------------------------- A A A A

c) I ride a skateboard ---------------------- A A A A

Example 3

What do you think? Tell how much you agree with these statements.

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) Watching movies is fun ---------------- A A A A

b) I like eating ice cream ------------------ A A A A

c) I do not like waking up early --------- A A A A

d) I enjoy doing chores --------------------- A A A A

- Read each question carefully, and pick the answer you think is best.
- Fill in the circle next to or under your answer.
- If you decide to change your answer, draw an through your first answer, like this: A. Then, fill in the circle next to or under your new answer.
- Ask for help if you do not understand something or are not sure how to answer.

About you

1

Are you a girl or a boy?

*Fill **one** circle only.*

Girl---A

Boy---A

2

When were you born?

Fill the circles next to the month and year you were born.

a) Month b) Year

January--- A 1993--- A

February--- A 1994--- A

March--- A 1995--- A

April--- A 1996--- A

May--- A 1997--- A

June--- A 1998--- A

July--- A 1999--- A

August--- A 2000--- A

September--- A 2001--- A

October--- A Other--- A

November--- A

December--- A **<Grade 8> Student *Questionnaire* 4**

3

How often do you speak <language of test> at home?

*Fill **one** circle only.*

Always---A

Almost always---A

Sometimes---A

Never---A

4

About how many books are there in your home? (Do not count magazines, newspapers, or your school books.)

*Fill **one** circle only.*

None or very few (0–10 books)---A

Enough to fill one shelf (11–25 books)---A

Enough to fill one bookcase (26–100 books)---A

Enough to fill two bookcases (101–200 books)---A

Enough to fill three or more bookcases (more than 200)---A

5

Do you have any of these things at your home?

*Fill **one** circle for each line.*

Yes No

a) Computer ----------------------------------- A A

b) Study desk/table for your use -------- A A

c) Books of your very own (do not count your school books) --------------- A A

d) Your own room ---------------------------- A A

e) Internet connection ---------------------- A A

f) <country-specific indicator of wealth> -------------------------------------- A A

g) <country-specific indicator of wealth> -------------------------------------- A A

h) <country-specific indicator of wealth> -------------------------------------- A A

i) <country-specific indicator of wealth> -------------------------------------- A A

j) <country-specific indicator of wealth> -------------------------------------- A A

k) <country-specific indicator of wealth> -------------------------------------- A
A

6

A. What is the highest level of education completed by your mother <or stepmother or female guardian>?

*Fill **one** circle only.*

Some <ISCED Level 1 or 2 > or did not go to school--------------------A

<ISCED Level 2>--------------------A

<ISCED Level 3>--------------------A

<ISCED Level 4>--------------------A

<ISCED Level 5B>--------------------A

<ISCED Level 5A, first degree>--------------------A

Beyond <ISCED Level 5A, first degree>--------------------A

I don’t know--------------------A

B. What is the highest level of education completed by your father <or stepfather or male guardian>?

*Fill **one** circle only.*

Some <ISCED Level 1 or 2 > or did not go to school--------------------A

<ISCED Level 2>--------------------A

<ISCED Level 3>--------------------A

<ISCED Level 4>--------------------A

<ISCED Level 5B>--------------------A

<ISCED Level 5A, first degree>--------------------A

Beyond <ISCED Level 5A, first degree>--------------------A

I don’t know--------------------A

7

How far in your education do you expect to go?

*Fill **one** circle only.*

Finish <ISCED Level 2>--------------------A

Finish <ISCED Level 3>--------------------A

Finish <ISCED Level 4>--------------------A

Finish <ISCED Level 5B>--------------------A

Finish <ISCED Level 5A, first degree>--------------------A

Beyond <ISCED Level 5A, first degree>--------------------A

I don't know--------------------A

8

A. Was your mother <or stepmother or female guardian> born in <country>?

*Fill **one** circle only.*

Yes---A

No---A

B. Was your father <or stepfather or male guardian> born in <country>?

*Fill **one** circle only.*

Yes---A

No---A**<Grade 8> Student *Questionnaire* 8**

9

A. Were you born in <country>?

*Fill **one** circle only.*

Yes---A

(If Yes, go to question 10)

No---A

B. If you were not born in <country>, how old were you when you came to <country>?

*Fill **one** circle only.*

Older than 10 years old---A

5 to 10 years old---A

Younger than 5 years old---A

10

How often do you use a computer in each of these places?

*Fill **one** circle for each line.*

Every day Once or Once or Never or or almost twice a twice a almost every day week month never

a) At home ------------------------------------- A A A A

b) At school ------------------------------------ A A A A

c) Some other place ------------------------- A A A A

11

How often do the following things happen at home?

*Fill **one** circle for each line.*

Every day Once Once Never or almost or twice or twice or almost every day a week a month never

a) My parents ask me what I am learning in school ------------------------ A A A A

b) I talk about my schoolwork with my parents----------------------------------A A A A

c) My parents make sure that I set aside time for my homework --------- A A A A

d) My parents check if I do my homework----------------------------------- A A A A**<Grade 8> Student *Questionnaire* 10**

Your School

12

What do you think about your school? Tell how much you agree with these statements.

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I like being in school -------------------- A A A A

b) I feel safe when I am at school ------- A A A A

c) I feel like I belong at this school ----- A A A A

13

During this year, how often have any of the following things happened to you <u>at school?</u>

*Fill **one** circle for each line.*

At least Once or A few once a twice times week a month a year Never

a) I was made fun of or called names -- A A A A

b) I was left out of games or activities by other students ------------------------- A A A A

c) Someone spread lies about me ------- A A A A

d) Something was stolen from me ------ A A A A

e) I was hit or hurt by other student(s) (*e.g., shoving, hitting, kicking*) ------- A A A A

f) I was made to do things I didn't want to do by other students --------- A A A A **<Grade 8> Student *Questionnaire* 11**

Mathematics in School

14

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

Fill ***one*** *circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I enjoy learning mathematics -------- A A A A

b) I wish I did not have to study mathematics ---------------------- A A A A

c) Mathematics is boring ------------------ A A A A

d) I learn many interesting things in mathematics ------------------ A A A A

e) I like mathematics ----------------------- A A A A

f) It is important to do well in mathematics --------------------------- A A A A **<Grade 8> Student *Questionnaire* 12**

15

How much do you agree with these statements about your <u>mathematics lessons</u>?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I know what my teacher expects me to do -------------------------- A A A A

b) I think of things not related to the lesson ------------------------------------ A A A A

c) My teacher is easy to understand --- A A A A

d) I am interested in what my teacher says -------------------------------- A A A A

e) My teacher gives me interesting things to do --------------------------------- A A A A**<Grade 8> Student *Questionnaire* 13**

16

How much do you agree with these statements about mathematics?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I usually do well in mathematics ---- A A A A

b) Mathematics is more difficult for me than for many of my classmates ----------------------------- A A A A

c) Mathematics is not one of my strengths ------------------------------- A A A A

d) I learn things quickly in mathematics --------------------------- A A A A

e) Mathematics makes me confused and nervous -------------------------------- A A A A

f) I am good at working out difficult mathematics problems ------ A A A A

g) My teacher thinks I can do well in mathematics <programs/classes/ lessons> with difficult materials ---- A A A A

h) My teacher tells me I am good at mathematics ------------------------------- A A A A

i) Mathematics is harder for me than any other subject ------------------ A A A A

16 (continued)

How much do you agree with these statements about mathematics?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

j) I think learning mathematics will help me in my daily life ---------------- A A A A

k) I need mathematics to learn other school subjects ---------------------------- A A A A

l) I need to do well in mathematics to get into the <university> of my choice ----------------------------------- A A A A

m) I need to do well in mathematics to get the job I want --------------------- A A A A

n) I would like a job that involves using mathematics ---------------------- A A A A**<Grade 8> Student *Questionnaire* 15**

Science in School

17

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

Fill ***one*** *circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I enjoy learning science ---------------- A A A A

b) I wish I did not have to study science --------------------------------------- A A A A

c) I read about science in my spare time ---------------------------------- A A A A

d) Science is boring -------------------------- A A A A

e) I learn many interesting things in science -------------------------- A A A A

f) I like science ------------------------------- A A A A

g) It is important to do well in science ----------------------------------- A A A A

18

How much do you agree with these statements about your science lessons?

Fill ***one*** *circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I know what my teacher expects me to do -------------------------- A A A A

b) I think of things not related to the lesson ------------------------------------ A A A A

c) My teacher is easy to understand --- A A A A

d) I am interested in what my teacher says -------------------------------- A A A A

e) My teacher gives me interesting things to do --------------------------------- A A A A**<Grade 8> Student *Questionnaire* 17**

19

How much do you agree with these statements about science?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I usually do well in science ------------ A A A A

b) Science is more difficult for me than for many of my classmates ----- A A A A

c) Science is not one of my strengths ------------------------------- A A A A

d) I learn things quickly in science ----------------------------------- A A A A

e) Science makes me confused and nervous -------------------------------- A A A A

f) I am good at working out difficult science problems -------------- A A A A

g) My teacher thinks I can do well in science <programs/classes/ lessons> with difficult materials ---- A A A A

h) My teacher tells me I am good at science ----------------------------------- A A A A

i) Science is harder for me than any other subject ------------------------- A A A A

19 (continued)

How much do you agree with these statements about science?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

j) I think learning science will help me in my daily life ----------------------- A A A A

k) I need science to learn other school subjects ---------------------------- A A A A

l) I need to do well in science to get into the <university> of my choice -- A A A A

m) I need to do well in science to get the job I want ------------------------------ A A A A

n) I would like a job that involves using science ------------------------------- A A A A

Homework

20

A. How often does your teacher give you homework in mathematics?

*Fill **one** circle only.*

Every day---A

3 or 4 times a week---A

1 or 2 times a week---A

Less than once a week---A

Never---A

B. When your teacher gives you mathematics homework, about how many minutes do you usually spend on your homework?

*Fill **one** circle only.*

My teacher never gives me homework in mathematics---A

1–15 minutes --A

16–30 minutes---A

31–60 minutes---A

61–90 minutes---A

More than 90 minutes---A **<Grade 8> Student *Questionnaire* 20**

21

A. How often does your teacher give you homework in science?

*Fill **one** circle only.*

Every day---A

3 or 4 times a week---A

1 or 2 times a week---A

Less than once a week---A

Never---A

B. When your teacher gives you science homework, about how many minutes do you usually spend on your homework?

*Fill **one** circle only.*

My teacher never gives me homework in science---A

1–15 minutes --A

16–30 minutes---A

31–60 minutes---A

61–90 minutes---A

More than 90 minutes---A

Appendix A6: Student science questionnaire

Identification Label

TIMSS 2011

School Questionnaire

Student

Separate Science Subjects

Field Test Version

<Grade 8>
<TIMSS National Research Center Name>
<Address>

<Grade 8> Student *Questionnaire*

1

Directions

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

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

Example 1

Do you go to school?

*Fill **one** circle only.*

Yes---A

No---A

Example 2

How often do you do these things?

*Fill **one** circle for each line.*

Every day Once or Once or Never or or almost twice a twice a almost every day week month never

a) I talk with my friends ------------------ A A A A

b) I play sports -------------------------------- A A A A

c) I ride a skateboard ---------------------- A A A A

Example 3

What do you think? Tell how much you agree with these statements.

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) Watching movies is fun ---------------- A A A A

b) I like eating ice cream ------------------ A A A A

c) I do not like waking up early --------- A A A A

d) I enjoy doing chores --------------------- A A A A

• Read each question carefully, and pick the answer you think is best.

• Fill in the circle next to or under your answer.

• If you decide to change your answer, draw an through your first answer, like this: A. Then, fill in the circle next to or under your new answer.

• Ask for help if you do not understand something or are not sure how to answer.

About you

1

Are you a girl or a boy?

*Fill **one** circle only.*

Girl---A

Boy---A

2

When were you born?

Fill the circles next to the month and year you were born.

a) Month b) Year

January--- A 1993--- A

February--- A 1994--- A

March--- A 1995--- A

April--- A 1996--- A

May--- A 1997--- A

June--- A 1998--- A

July--- A 1999--- A

August--- A 2000--- A

September--- A 2001--- A

October--- A Other--- A

November--- A

December--- A **<Grade 8> Student *Questionnaire* 4**

3

How often do you speak <language of test> at home?

*Fill **one** circle only.*

Always---A

Almost always---A

Sometimes---A

Never---A

4

About how many books are there in your home? (Do not count magazines, newspapers, or your school books.)

*Fill **one** circle only.*

None or very few (0–10 books)---A

Enough to fill one shelf (11–25 books)---A

Enough to fill one bookcase (26–100 books)---A

Enough to fill two bookcases (101–200 books)---A

Enough to fill three or more bookcases (more than 200)---A

5

Do you have any of these things at your home?

*Fill **one** circle for each line.*

Yes No

a) Computer ----------------------------------- A A

b) Study desk/table for your use -------- A A

c) Books of your very own (do not count your school books) --------------- A A

d) Your own room ---------------------------- A A

e) Internet connection ---------------------- A A

f) <country-specific indicator of wealth> -------------------------------------- A A

g) <country-specific indicator of wealth> -------------------------------------- A A

h) <country-specific indicator of wealth> -------------------------------------- A A

i) <country-specific indicator of wealth> -------------------------------------- A A

j) <country-specific indicator of wealth> -------------------------------------- A A

k) <country-specific indicator of wealth> -------------------------------------- A
A

6

A. What is the highest level of education completed by your mother <or stepmother or female guardian>?

*Fill **one** circle only.*

Some <ISCED Level 1 or 2> or did not go to school--------------------A

<ISCED Level 2>--------------------A

<ISCED Level 3>--------------------A

<ISCED Level 4>--------------------A

<ISCED Level 5B>--------------------A

<ISCED Level 5A, first degree>--------------------A

Beyond <ISCED Level 5A, first degree>------------------A

I don't know--------------------A

B. What is the highest level of education completed by your father <or stepfather or male guardian>?

*Fill **one** circle only.*

Some <ISCED Level Level 1 or 2> or did not go to school--------------------A

<ISCED Level 2>--------------------A

<ISCED Level 3>--------------------A

<ISCED Level 4>--------------------A

<ISCED Level 5B>--------------------A

<ISCED Level 5A, first degree>--------------------A

Beyond <ISCED Level 5A, first degree>------------------A

I don't know--------------------A

7

How far in your education do you expect to go?

*Fill **one** circle only.*

Finish <ISCED Level 2>--------------------A

Finish <ISCED Level 3>--------------------A

Finish <ISCED Level 4>--------------------A

Finish <ISCED Level 5B>--------------------A

Finish <ISCED Level 5A, first degree>-------------------A

Beyond <ISCED Level 5A, first degree>------------------A

I don't know--------------------A

8

A. Was your mother <or stepmother or female guardian> born in <country>?

*Fill **one** circle only.*

Yes---A

No---A

B. Was your father <or stepfather or male guardian> born in <country>?

*Fill **one** circle only.*

Yes---A

No---A**<Grade 8> Student *Questionnaire* 8**

9

A. Were you born in <country>?

*Fill **one** circle only.*

Yes---A

(If Yes, go to question 10)

No---A

B. If you were not born in <country>, how old were you when you came to <country>?

*Fill **one** circle only.*

Older than 10 years old---A

5 to 10 years old---A

Younger than 5 years old---A

10

How often do you use a computer in each of these places?

*Fill **one** circle for each line.*

Every day Once or Once or Never or or almost twice a twice a almost every day week month never

a) At home ------------------------------------- A A A A

b) At school ------------------------------------ A A A A

c) Some other place ------------------------- A A A A

11

How often do the following things happen at home?

*Fill **one** circle for each line.*

Every day Once Once Never or almost or twice or twice or almost every day a week a month never

a) My parents ask me what I am learning in school ------------------------ A A A A

b) I talk about my schoolwork with my parents ---------------------------------- A A A A

c) My parents make sure that I set aside time for my homework --------- A A A A

d) My parents check if I do my homework ---------------------------------- A A A A

Your School

12

What do you think about your school? Tell how much you agree with these statements.

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I like being in school -------------------- A A A A

b) I feel safe when I am at school ------- A A A A

c) I feel like I belong at this school ----- A A A A

13

During this year, how often have any of the following things happened to you <u>at school</u>?

*Fill **one** circle for each line.*

At least Once A few once a or twice times week a month a year Never

a) I was made fun of or called names -- A A A A

b) I was left out of games or activities by other students ------------------------- A A A A

c) Someone spread lies about me ------- A A A A

d) Something was stolen from me ------ A A A A

e) I was hit or hurt by other student(s) (*e.g., shoving, hitting, kicking*) ------- A A A A

f) I was made to do things I didn't want to do by other students --------- A A A A

Mathematics in School

14

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

Fill ***one*** *circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I enjoy learning mathematics -------- A A A A

b) I wish I did not have to study mathematics ---------------------- A A A A

c) Mathematics is boring ------------------ A A A A

d) I learn many interesting things in mathematics ------------------ A A A A

e) I like mathematics ----------------------- A A A A

f) It is important to do well in mathematics -------------------------- A A A A

15

How much do you agree with these statements about your mathematics lessons?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I know what my teacher expects me to do ------------------------------------- A A A A

b) I think of things not related to the lesson ----------------------------------- A A A A

c) My teacher is easy to understand --- A A A A

d) I am interested in what my teacher says -------------------------------- A A A A

e) My teacher gives me interesting things to do --------------------------------- A A A A

16

How much do you agree with these statements about mathematics?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I usually do well in mathematics ---- A A A A

b) Mathematics is more difficult for me than for many of my classmates ----------------------------- A A A A

c) Mathematics is not one of my strengths ------------------------------- A A A A

d) I learn things quickly in mathematics --------------------------- A A A A

e) Mathematics makes me confused and nervous -------------------------------- A A A A

f) I am good at working out difficult mathematics problems ------ A A A A

g) My teacher thinks I can do well in mathematics <programs/classes/ lessons> with difficult materials ---- A A A A

h) My teacher tells me I am good at mathematics --------------------------- A A A A

i) Mathematics is harder for me than any other subject ----------------- A A A A

16 (continued)

How much do you agree with these statements about mathematics?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

j) I think learning mathematics will help me in my daily life ---------------- A A A A

k) I need mathematics to learn other school subjects ---------------------------- A A A A

l) I need to do well in mathematics to get into the <university> of my choice ----------------------------------- A A A A

m) I need to do well in mathematics to get the job I want --------------------- A A A A

n) I would like a job that involves using mathematics ---------------------- A A A A**<Grade 8> Student *Questionnaire* 15**

Biology in School

17

Are you studying biology in school this year?

*Fill **one** circle only.*

Yes---A

No---A

(If No, go to question 21)

18

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

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I enjoy learning biology ---------------- A A A A

b) I wish I did not have to study biology --------------------------------------- A A A A

c) I read about biology in my spare time ---------------------------------- A A A A

d) Biology is boring -------------------------- A A A A

e) I learn many interesting things in biology -------------------------- A A A A

f) I like biology ------------------------------- A A A A

g) It is important to do well in biology ----------------------------------- A A A A

19

How much do you agree with these statements about your biology lessons?

Fill ***one*** *circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I know what my teacher expects me to do ------------------------------------- A A A A

b) I think of things not related to the lesson ----------------------------------- A A A A

c) My teacher is easy to understand --- A A A A

d) I am interested in what my teacher says -------------------------------- A A A A

e) My teacher gives me interesting things to do --------------------------------- A A A A

20

How much do you agree with these statements about biology?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I usually do well in biology ------------ A A A A

b) Biology is more difficult for me than for many of my classmates ----- A A A A

c) Biology is not one of my strengths ------------------------------- A A A A

d) I learn things quickly in biology ----------------------------------- A A A A

e) Biology makes me confused and nervous -------------------------------- A A A A

f) I am good at working out difficult biology problems -------------- A A A A

g) My teacher thinks I can do well in biology <programs/classes/ lessons> with difficult materials ---- A A A A

h) My teacher tells me I am good at biology ----------------------------------- A A A A

i) Biology is harder for me than any other subject ------------------------- A A A A**<Grade 8> Student *Questionnaire* 18**

20 (continued)

How much do you agree with these statements about biology?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

j) I think learning biology will help me in my daily life --------------- A A A A

k) I need biology to learn other school subjects ---------------------------- A A A A

l) I need to do well in biology to get into the <university> of my choice ----------------------------------- A A A A

m) I need to do well in biology to get the job I want --------------------- A A A A

n) I would like a job that involves using biology ------------------------------ A A A A

Earth Science in School

21

Are you studying earth science in school this year?

*Fill **one** circle only.*

Yes---A

No---A

(If No, go to question 25)

22

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

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I enjoy learning earth science -------- A A A A

b) I wish I did not have to study earth science ------------------------------- A A A A

c) I read about earth science in my spare time ---------------------------------- A A A A

d) Earth science is boring ----------------- A A A A

e) I learn many interesting things in earth science ----------------- A A A A

f) I like earth science ---------------------- A A A A

g) It is important to do well in earth science ------------------------------ A A A A**<Grade 8> Student *Questionnaire* 20**

23

How much do you agree with these statements about your earth science lessons?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I know what my teacher expects me to do ------------------------------------ A A A A

b) I think of things not related to the lesson ----------------------------------- A A A A

c) My teacher is easy to understand --- A A A A

d) I am interested in what my teacher says -------------------------------- A A A A

e) My teacher gives me interesting things to do -------------------------------- A A A A

24

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

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I usually do well in earth science --- A A A A

b) Earth science is more difficult for me than for many of my classmates ----------------------------- A A A A

c) Earth science is not one of my strengths ------------------------------- A A A A

d) I learn things quickly in earth science --------------------------- A A A A

e) Earth science makes me confused and nervous -------------------------------- A A A A

f) I am good at working out difficult earth science problems ------ A A A A

g) My teacher thinks I can do well in earth science <programs/classes/ lessons> with difficult materials ---- A A A A

h) My teacher tells me I am good at earth science -------------------------- A A A A

i) Earth science is harder for me than any other subject ----------------- A A A A**<Grade 8> Student *Questionnaire* 22**

24 (continued)

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

Fill ***one*** *circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

j) I think learning earth science will help me in my daily life ---------- A A A A

k) I need earth science to learn other school subjects ---------------------------- A A A A

l) I need to do well in earth science to get into the <university> of my choice -------------------------------- A A A A

m) I need to do well in earth science to get the job I want --------------------- A A A A

n) I would like a job that involves using earth science ---------------------- A A A A

Chemistry in School

25

Are you studying chemistry in school this year?

*Fill **one** circle only.*

Yes---A

No---A

(If No, go to question 29)

26

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

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I enjoy learning chemistry ------------ A A A A

b) I wish I did not have to study chemistry ----------------------------------- A A A A

c) I read about chemistry in my spare time --------------------------------- A A A A

d) Chemistry is boring --------------------- A A A A

e) I learn many interesting things in chemistry ---------------------- A A A A

f) I like chemistry --------------------------- A A A A

g) It is important to do well in chemistry ------------------------------- A A A A

27

How much do you agree with these statements about your <u>chemistry lessons</u>?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I know what my teacher expects me to do ------------------------------------- A A A A

b) I think of things not related to the lesson ------------------------------------ A A A A

c) My teacher is easy to understand --- A A A A

d) I am interested in what my teacher says -------------------------------- A A A A

e) My teacher gives me interesting things to do --------------------------------- A A A A

28

How much do you agree with these statements about chemistry?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I usually do well in chemistry -------- A A A A

b) Chemistry is more difficult for me than for many of my classmates ----- A A A A

c) Chemistry is not one of my strengths ------------------------------- A A A A

d) I learn things quickly in chemistry ------------------------------- A A A A

e) Chemistry makes me confused and nervous -------------------------------- A A A A

f) I am good at working out difficult chemistry problems ---------- A A A A

g) My teacher thinks I can do well in chemistry <programs/classes/ lessons> with difficult materials ---- A A A A

h) My teacher tells me I am good at chemistry ------------------------------- A A A A

i) Chemistry is harder for me than any other subject ----------------- A A A A**<Grade 8> Student *Questionnaire* 26**

28 (continued)

How much do you agree with these statements about chemistry?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

j) I think learning chemistry will help me in my daily life --------------- A A A A

k) I need chemistry to learn other school subjects ---------------------------- A A A A

l) I need to do well in chemistry to get into the <university> of my choice ----------------------------------- A A A A

m) I need to do well in chemistry to get the job I want --------------------- A A A A

n) I would like a job that involves using chemistry --------------------------- A A A A

Physics in School

29

Are you studying physics in school this year?

*Fill **one** circle only.*

Yes---A

No---A

(If No, go to question 33)

30

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

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I enjoy learning physics ---------------- A A A A

b) I wish I did not have to study physics --------------------------------------- A A A A

c) I read about physics in my spare time ---------------------------------- A A A A

d) Physics is boring ------------------------- A A A A

e) I learn many interesting things in physics ------------------------- A A A A

f) I like physics ------------------------------- A A A A

g) It is important to do well in physics ----------------------------------- A A A A**<Grade 8> Student *Questionnaire* 28**

31

How much do you agree with these statements about your <u>physics lessons</u>?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I know what my teacher expects me to do ------------------------------------- A A A A

b) I think of things not related to the lesson ----------------------------------- A A A A

c) My teacher is easy to understand --- A A A A

d) I am interested in what my teacher says -------------------------------- A A A A

e) My teacher gives me interesting things to do --------------------------------- A A A A

32

How much do you agree with these statements about physics?

Fill ***one*** *circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

a) I usually do well in physics ----------- A A A A

b) Physics is more difficult for me than for many of my classmates ----- A A A A

c) Physics is not one of my strengths ------------------------------- A A A A

d) I learn things quickly in physics ----------------------------------- A A A A

e) Physics makes me confused and nervous ------------------------------- A A A A

f) I am good at working out difficult physics problems ------------- A A A A

g) My teacher thinks I can do well in physics <programs/classes/ lessons> with difficult materials ---- A A A A

h) My teacher tells me I am good at physics ---------------------------------- A A A A

i) Physics is harder for me than any other subject ------------------ A A A A

32 (continued)

How much do you agree with these statements about physics?

*Fill **one** circle for each line.*

Agree Agree Disagree Disagree a lot a little a little a lot

j) I think learning physics will help me in my daily life ---------------------- A A A A

k) I need physics to learn other school subjects ---------------------------- A A A A

l) I need to do well in physics to get into the <university> of my choice -- A A A A

m) I need to do well in physics to get the job I want ------------------------------ A A A A

n) I would like a job that involves using physics ------------------------------ A A A A**<Grade 8> Student *Questionnaire* 31**

Homework

33

A. How often does your teacher give you homework in each of the following subjects?

*Fill **one** circle for each line.*

Less 3 or 4 1 or 2 than Every times times once day a week a week a week Never

a) Mathematics ------------------------ A A A A A

b) Biology -------------------------------- A A A A A

c) Earth science ----------------------- A A A A A

d) Chemistry --------------------------- A A A A A

e) Physics ------------------------------- A A A A A

B. When your teacher gives you homework in each of the following subjects, about how many minutes do you usually spend on your homework?

*Fill **one** circle for each line.*

My teacher never gives More me home- 1–15 16–30 31–60 61–90 than 90 work in... minutes minutes minutes minutes minutes

a) Mathematics ------------------------ A A A A A A

b) Biology -------------------------------- A A A A A A

c) Earth science ----------------------- A A A A A A

d) Chemistry --------------------------- A A A A A A

e) Physics ------------------------------- A A A A A A

AppendixA7: TIMSS Teacher questionnaire

Identification Label

TIMSS 2011

TeacherQuestionnaire

Science

<Grade 8>
<TIMSS National Research Center Name>
<Address>

Teacher *Questionnaire*

Your school has agreed to participate in TIMSS 2011 (Trends in International Mathematics and Science Study), an educational research project sponsored by the International Association for the Evaluation of Educational Achievement (IEA). TIMSS measures trends in student achievement in mathematics and science and studies differences in national education systems in more than 60 countries in order to help improve teaching and learning worldwide.

This questionnaire is addressed to teachers of <eighth-grade> students, and seeks information about teachers' academic and professional backgrounds, classroom resources, instructional practices, and attitudes toward teaching. Since your class has been selected as part of a nationwide sample, your responses are very important in helping to describe secondary education in <country>.

Some of the questions in the questionnaire refer to the **"TIMSS class"** or **"this class"**. This is the class that is identified on the front of this booklet, and which will be tested as part of TIMSS in your school. If you teach some but not all of the students in the TIMSS class, please think only of the students that you teach when answering these class-specific questions. It is important that you answer each question carefully so that the information that you provide reflects your situation as accurately as possible.

Since TIMSS is an international study and all countries are using the same questionnaire, you may find that some of the questions seem unusual or are not entirely relevant to you or schools in <country>. Nevertheless, it is important that you do your best to answer all of the questions so comparisons can be made across countries in the studies.

It is estimated that you will need approximately 45 minutes to complete this questionnaire. We appreciate the time and effort that this takes and thank you for your cooperation and contribution.

When you have completed the questionnaire, please place it in the accompanying envelope and return it to:

<Insert country-specific information here>.

Thank you.

<Grade 8> Teacher *Questionnaire – Science*

About You

1

By the end of this school year, how many years will you have been teaching altogether?

_____________ years

*Please **round** to the nearest whole number.*

2

Are you female or male?

*Check **one** circle only.*

Female---- A

Male---- A

3

How old are you?

*Check **one** circle only.*

Under 25---- A

25–29---- A

30–39---- A

40–49---- A

50–59---- A

60 or more---- A

4

What is the highest level of formal education you have completed?

*Check **one** circle only.*

Did not complete <ISCED Level 3>---- A

Finished <ISCED Level 3>---- A

Finished <ISCED Level 4>---- A

Finished <ISCED Level 5B>---- A

Finished <ISCED Level 5A, first degree>---- A

Finished <ISCED Level 5A, second degree> or higher---- A

5

During your <post-secondary> education, what was your <u>major or main</u> area(s) of study?

*Check **one** circle for each line.*

Yes

No

a) Mathematics --------------------------------------- A A

b) Biology -- A A

c) Physics -- A A

d) Chemistry --- A A

e) <Earth Science> --------------------------------- A A

f) Education–Mathematics ------------------------- A A

g) Education–Science ------------------------------- A A

h) Education–General ------------------------------- A A

i) Other -- A A

About Your School

7

Thinking about your current school, indicate the extent to which you agree or disagree with each of the following statements.

*Check **one** circle for each line.*

Agree a lot

Agree a little

Disagree a little

Disagree a lot

a) This school is located in a safe neighborhood ----------- A A A A

b) I feel safe at this school --------- A A A A

c) This school's security policies and practices are sufficient ----- A A A A

d) The students behave in an orderly manner ----------------- A A A A

e) The students are respectful of the teachers ------------------ A A A A

6

How would you characterize each of the following within your school?

*Check **one** circle for each line.*

Very high

High

Medium

Low

Very low

a) Teachers' job satisfaction --------------------- A A A A A

b) Teachers' understanding of the school's curricular goals ---------------------------- A A A A A

c) Teachers' degree of success in implementing the school's curriculum --------- A A A A A

d) Teachers' expectations for student achievement -------------------- A A A A A

e) Parental support for student achievement ----------- A A A A A

f) Parental involvement in school activities -------------- A A A A A

g) Students' regard for school property ----------------- A A A A A

h) Students' desire to do well in school ------------------- A A A A A

8

In your current school, how severe is each problem?

*Check **one** circle for each line.*

Not a problem

Minor problem

Moderate problem

Serious problem

a) The school building needs significant repair --------------- A A A A

b) Classrooms are overcrowded --- A A A A

c) Teachers have too many teaching hours ------------------ A A A A

d) Teachers do not have adequate workspace for preparation, collaboration, or meeting with students ------ A A A A

e) Teachers do not have adequate instructional materials and supplies --------- A A A A

About Being a Teacher

9

A. Do you use computers in your teaching in any of the following ways?

*Check **one** circle for each line.*

Yes

No

a) For preparation ---------------------------------- A A

b) For administration -------------------------------- A A

c) In your classroom instruction -------------------- A A

If Yes to "classroom instruction"

B. How much do you agree with the following statements about using computers in your classroom instruction?

*Check **one** circle for each line.*

Agree a lot

Agree a little

Disagree a little

Disagree a lot

a) I feel comfortable using computers in my teaching ----- A A A A

b) When I have technical problems, I have ready access to computer support staff in my school ------ A A A A

c) I receive adequate support for integrating computers in my teaching activities -------------- A A A A

10

How often do you have the following types of interactions with other teachers?

*Check **one** circle for each line.*

Never or almost never

2 or 3 times per month

1–3 times per week

Daily or almost daily

a) Discuss how to teach a particular topic --------------- A A A A

b) Collaborate in planning and preparing instructional materials ------------------------ A A A A

c) Share what I have learned about my teaching experiences ----------- A A A A

d) Visit another classroom to learn more about teaching -- A A A A

e) Work together to try out new ideas --------------- A A A A

About Teaching the <TIMSS Class/ Class with the TIMSS Students>

11

How much do you agree with the following statements?

*Check **one** circle for each line.*

Agree a lot
Agree a little
Disagree a little
Disagree a lot

a) I am content with my profession as a teacher --------- A A A A

b) I am satisfied with being a teacher at this school ----------- A A A A

c) I had more enthusiasm when I began teaching than I have now ----------------------- A A A A

d) I do important work as a teacher ------------------------ A A A A

e) I plan to continue as a teacher for as long as I can ----- A A A A

f) I am frustrated as a teacher ---- A A A A

12

How many students are in this class?

_____________ students
Write in a number.

13

How many <eighth-grade> students experience difficulties understanding spoken <language of test>?

_____________ students in this class
Write in a number.

14

How often do you do the following in teaching this class?

*Check **one** circle for each line.*

Every or almost every lesson
About half the lessons
Some lessons
Never

a) Summarize what students should have learned from the lesson ---------------------- A A A A

b) Relate the lesson to students' daily lives ------------ A A A A

c) Use questioning to elicit reasons and explanations ------ A A A A

d) Encourage all students to improve their performance ---- A A A A

e) Praise students for good effort --------------------- A A A A

f) Bring interesting materials to class -------------------------- A A A A**<Grade 8> Teacher *Questionnaire* – *Science*** 6

15

In your view, to what extent do the following limit how you teach this class?

*Check **one** circle for each line.*

Not applicable

Not at all

Some

A lot

a) Students lacking prerequisite knowledge or skills ------------------------- A A A A

b) Students suffering from lack of basic nutrition ---------- A A A A

c) Students suffering from not enough sleep -------------- A A A A

d) Students with special needs (e.g., physical disabilities, mental or emotional/ psychological impairment) ---- A A A A

e) Disruptive students ------------- A A A A

f) Uninterested students ---------- A A A A

16

For the typical student in this class, how often do you do these things?

*Check **one** circle for each line.*

At least once a week

Once or twice a month

4–6 times a year

1–3 times a year

Never

a) Meet or talk individually with the student's parents to discuss his/her learning progress --------------- A A A A A

b) Send home a progress report on the student's learning ------------------------ A A A A A7 **<Grade 8> Teacher *Questionnaire – Science***

Teaching Science to the <TIMSS Class/Class with the TIMSS students>

Questions 17–19 ask about science instruction for the <eighth-grade> students in the <TIMSS class/class with the TIMSS students>.

17

In a typical week, how much time do you spend teaching science to the students in this class?

___________hours and ___________minutes per week
Write in the hours and minutes.

18

In teaching science to this class, how confident do you feel to do the following?

*Check **one** circle for each line.*

Very confident

Somewhat confident

Not confident

a) Answer students' questions about science ------------------- A A A

b) Explain science concepts or principles by doing science experiments ------------ A A A

c) Provide challenging tasks for capable students ------------ A A A

d) Adapt my teaching to engage students' interest ------ A A A

e) Help students appreciate the value of learning science -------------------------- A A A

19

In teaching science to the students in this class, how often do you usually ask them to do the following?

*Check **one** circle for each line.*

Every or almost every lesson

About half the lessons

Some lessons

Never

a) Observe natural phenomena and describe what they see ---- A A A A

b) Watch me demonstrate an experiment or investigation -------------------- A A A A

c) Design or plan experiments or investigations ---------------- A A A A

d) Conduct experiments or investigations ------------------- A A A A

e) Read their textbooks or other resource materials ------- A A A A

f) Have students memorize facts and principles ------------- A A A A

g) Use scientific formulas and laws to solve routine problems ------------------------ A A A A

h) Give explanations about something they are studying ------------------------ A A A A

i) Relate what they are learning in science to their daily lives ----------------- A A A A

j) Do field work outside of class -- A A A A

k) Take a written test or quiz ------ A A A A**<Grade 8> Teacher *Questionnaire* – *Science*** 8

Resources for Teaching Science

21

A. Do the students in this class have computer(s) available to use during their science lessons?

*Check **one** circle only.*

Yes---- A

No---- A

(If No, go to #22)

If Yes,

B. Do any of the computer(s) have access to the Internet?

*Check **one** circle only.*

Yes---- A

No---- A

C. How often do you have the students do the following computer activities during science lessons?

*Check **one** circle for each line.*

Every or almost every day

Once or twice a week

Once or twice a month

Never or almost never

a) Practice skills and procedures ---------------------- A A A A

b) Look up ideas and information --------------------- A A A A

c) Do scientific procedures or experiments ----------------- A A A A

d) Study natural phenomena through simulations ------------ A A A A

e) Process and analyze data ------- A A A A

Questions 20–21 ask about resources for teaching science to the <<u>eighth-grade</u>> students in the <TIMSS class/class with the TIMSS students>.

20

When you teach science to this class, how do you use the following resources?

*Check **one** circle for each line.*

Basis for instruction

Supplement

Not used

a) Textbooks ----------------------- A A A

b) Workbooks or worksheets --------------------- A A A

c) Science equipment and materials ------------------------ A A A

d) Computer software for science instruction-------------- A A A

e) Reference materials (e.g., encyclopedia, dictionary) ------ A A A9 **<Grade 8> Teacher *Questionnaire – Science***

Science Topics Taught

Questions 22–23 ask about the topics taught and the content covered in teaching science to the <eighth-grade> students in the <TIMSS class/class with the TIMSS students>.

22

The following list includes the main topics addressed by the TIMSS science test. Choose the response that best describes when the students in this class have been taught each topic. If a topic was in the curriculum before the <eighth grade>, please choose "Mostly taught before this year." If a topic was taught half this year but not yet completed, please choose "Mostly taught this year." If a topic is not in the curriculum, please choose "Not yet taught or just introduced."

*Check **one** circle for each line.*

Mostly taught before this year

A. Biology

a) Major organs and organ systems in humans and other organisms (structure/function, life processes that maintain stable bodily conditions) -- A A A

b) Cells and their functions, including respiration and photosynthesis as cellular processes --------------------------------- A A A

c) Reproduction (sexual and asexual) and heredity (passing on of traits, inherited versus acquired/learned characteristics) -- A A A

d) Role of variation and adaptation in survival/extinction of species in a changing environment ---------------------------- A A A

e) Interdependence of populations of organisms in an ecosystem (e.g., energy flow, food webs, competition, predation) and the impact of changes in the physical environment on populations (e.g., climate, water supply) --------- A A A

f) Reasons for increase in world's human population (e.g., advances in medicine, sanitation), and the effects of population growth on the environment --- A A A

g) Human health (causes of infectious diseases, methods of infection, prevention, immunity) and the importance of diet and exercise in maintaining health -- A A A

B. Chemistry

a) Classification, composition, and particulate structure of matter (elements, compounds, mixtures, molecules, atoms, protons, neutrons, electrons) --- A A A

b) Solutions (solvent, solute, concentration/dilution, effect of temperature on solubility) ------------------------------------ A A A

c) Properties and uses of common acids and bases --- A A A

d) Chemical change (transformation of reactants, evidence of chemical change, conservation of matter, common oxidation reactions – combustion, rusting, tarnishing) --- A A A

22

The following list includes the main topics addressed by the TIMSS science test. Choose the response that best describes when the students in this class have been taught each topic. If a topic was in the curriculum before the <eighth grade>, please choose "Mostly taught before this year." If a topic was taught half this year but not yet completed, please choose "Mostly taught this year." If a topic is not in the curriculum, please choose "Not yet taught or just introduced."

*Check **one** circle for each line.*

Mostly taught before this year

Mostly taught this year

Not yet taught or just introduced

C. Physics

a) Physical states and changes in matter (explanations of properties in terms of movement and distance between particles; phase change, thermal expansion, and changes in volume and/or pressure) ------------------------- A A A

b) Energy forms, transformations, heat, and temperature --- A A A

c) Basic properties/behaviors of light (reflection, refraction, light and color, simple ray diagrams) and sound (transmission through media, loudness, pitch, amplitude, frequency, relative speed of light and sound) --- A A A

d) Electric circuits (flow of current; types of circuits - parallel/series; current/voltage relationship) and properties and uses of permanent magnets and electromagnets -- A A A

e) Forces and motion (types of forces, basic description of motion, effects of density and pressure) ------------------------- A A A

D. Earth Science

a) Earth's structure and physical features (Earth's crust, mantle and core; composition and relative distribution of water, and composition of air) --- A A A

b) Earth's processes, cycles and history (rock cycle; water cycle; weather patterns; major geological events; formation of fossils and fossil fuels) -- A A A

c) Earth's resources, their use and conservation (e.g., renewable/nonrenewable resources, human use of land/soil, water resources) -- A A A

d) Earth in the solar system and the universe (phenomena on Earth - day/night, tides, phases of moon, eclipses, seasons; physical features of Earth compared to other bodies; the Sun as a star) --- A A A11 **<Grade 8> Teacher *Questionnaire – Science***

Science Content Coverage

23

By the end of this school year, approximately what percentage of teaching time will you have spent during this school year on each of the following science content areas for the students in this class?

Write in the percentage for each.

a) Biology (e.g., structure/function; life processes, reproduction/heredity, natural selection; ecosystems, human health)-- _____%

b) Chemistry (e.g., classification, composition and properties of matter; chemical change)--------------------------- _____%

c) Physics (e.g., physical states/ changes in matter; energy; light; sound; electricity and magnetism; forces and motion)-------------------------------------- _____%

d) Earth science (e.g., Earth's structure, processes, and resources; the solar system and universe)-------------------------- _____%

e) Other--- _____%

Total = 100%

Science Homework

Question 24 asks about science homework for the <eighth-grade> students in the <TIMSS class/class with the TIMSS students>.

24

A. How often do you usually assign science homework to the students in this class?

*Check **one** circle only.*

I do not assign science homework---- A

(Go to #25)

Less than once a week---- A

1 or 2 times a week---- A

3 or 4 times a week---- A

Every day---- A

B. When you assign science homework to the students in this class, about how many minutes do you usually assign? (Consider the time it would take an average student in your class.)

*Check **one** circle only.*

15 minutes or less---- A

16–30 minutes---- A

31–60 minutes---- A

61–90 minutes---- A

More than 90 minutes---- A

C. How often do you do the following with the science homework assignments for this class?

*Check **one** circle for each line.*

Always or almost always

Sometimes

Never or almost never

a) Correct assignments and give feedback to students ------ A A A

b) Have students correct their own homework ----------- A A A

c) Discuss the homework in class -------------------------- A A A

d) Monitor whether or not the homework was completed ----- A A A

e) Use the homework to contribute towards students' grades or marks ------ A A A13 **<Grade 8> Teacher *Questionnaire – Science***

Science Assessment

Questions 25–27 ask about science assessment for the <eighth-grade> students in the <TIMSS class/class with the TIMSS students>.

25

How much emphasis do you place on the following sources to monitor students' progress in science?

*Check **one** circle for each line.*

Major emphasis

Some emphasis

Little or no emphasis

a) Evaluation of students' ongoing work ------------------- A A A

b) Classroom tests (for example, teacher-made or textbook tests) ----------------- A A A

c) National or regional achievement tests -------------- A A A

26

How often do you give a science test or examination to this class?

*Check **one** circle only.*

About once a week---- A

About every two weeks---- A

About once a month---- A

A few times a year---- A

Never---- A

27

How often do you include the following types of questions in your science tests or examinations?

*Check **one** circle for each line.*

Always or almost always

Sometimes

Never or almost never

a) Questions based on knowing facts and concepts ---- A A A

b) Questions based on the application of knowledge and understanding ------------- A A A

c) Questions involving developing hypotheses and designing scientific investigations ------------------- A A A

d) Questions requiring explanations or justifications -------------------- A A A**<Grade 8> Teacher *Questionnaire – Science*** 14

Preparation to Teach Science

28

In the past two years, have you participated in professional development in any of the following?

*Check **one** circle for each line.*

Yes

No

a) Science content ----------------------------------- A A

b) Science pedagogy/instruction ------------------- A A

c) Science curriculum ------------------------------- A A

d) Integrating information technology into science --------------------------------------- A A

e) Improving students' critical thinking or inquiry skills -------------------------------------- A A

f) Science assessment ------------------------------- A A

g) Addressing individual students' needs ----------- A A

29

How well prepared do you feel you are to teach the following science topics? If a topic is not in the <eighth-grade> curriculum or you are not responsible for teaching this topic, please choose "Not applicable."

*Check **one** circle for each line.*

Not applicable

Very well prepared

Somewhat prepared

Not well prepared

A. Biology

a) Major organs and organ systems in humans and other organisms (structure/function, life processes that maintain stable bodily conditions) --- A A A A

b) Cells and their functions, including respiration and photosynthesis as cellular processes --------------------------------- A A A A

c) Reproduction (sexual and asexual) and heredity (passing on of traits, inherited versus acquired/learned characteristics) --- A A A A

d) Role of variation and adaptation in survival/extinction of species in a changing environment ---------------------------- A A A A

e) Interdependence of populations of organisms in an ecosystem (e.g., energy flow, food webs, competition, predation) and the impact of changes in the physical environment on populations (e.g., climate, water supply) -- A A A A

f) Reasons for increase in world's human population (e.g., advances in medicine, sanitation), and the effects of population growth on the environment --- A A A A

g) Human health (causes of infectious diseases, methods of infection, prevention, immunity) and the importance of diet and exercise in maintaining health -- A A A A

B. Chemistry

a) Classification, composition, and particulate structure of matter (elements, compounds, mixtures, molecules, atoms, protons, neutrons, electrons) --- A A A A

b) Solutions (solvent, solute, concentration/dilution, effect of temperature on solubility) ------------------------------------ A A A A

c) Properties and uses of common acids and bases --- A A A A

d) Chemical change (transformation of reactants, evidence of chemical change, conservation of matter, common oxidation reactions – combustion, rusting, tarnishing) --- A A A A

29

How well prepared do you feel you are to teach the following science topics? If a topic is not in the <eighth-grade> curriculum or you are not responsible for teaching this topic, please choose "Not applicable."

*Check **one** circle for each line.*

Not applicable

Very well prepared

Somewhat prepared

Not well prepared

C. Physics

a) Physical states and changes in matter (explanations of properties in terms of movement and distance between particles; phase change, thermal expansion, and changes in volume and/or pressure) ------------------------- A A A A

b) Energy forms, transformations, heat, and temperature -- A A A A

c) Basic properties/behaviors of light (reflection, refraction, light and color, simple ray diagrams) and sound (transmission through media, loudness, pitch, amplitude, frequency, relative speed of light and sound) -- A A A A

d) Electric circuits (flow of current; types of circuits - parallel/series; current/voltage relationship) and properties and uses of permanent magnets and electromagnets -- A A A A

e) Forces and motion (types of forces, basic description of motion, effects of density and pressure) ------------------------ A A A A

D. Earth Science

a) Earth's structure and physical features (Earth's crust, mantle and core; composition and relative distribution of water, and composition of air) --- A A A A

b) Earth's processes, cycles and history (rock cycle; water cycle; weather patterns; major geological events; formation of fossils and fossil fuels) -- A A A A

c) Earth's resources, their use and conservation (e.g., renewable/nonrenewable resources, human use of land/soil, water resources) -- A A A A

d) Earth in the solar system and the universe (phenomena on Earth - day/night, tides, phases of moon, eclipses, seasons; physical features of Earth compared to other bodies; the Sun as a star) -- A A A A