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DOCTORATE DISSERTATION NO. 2022:13

College of Education

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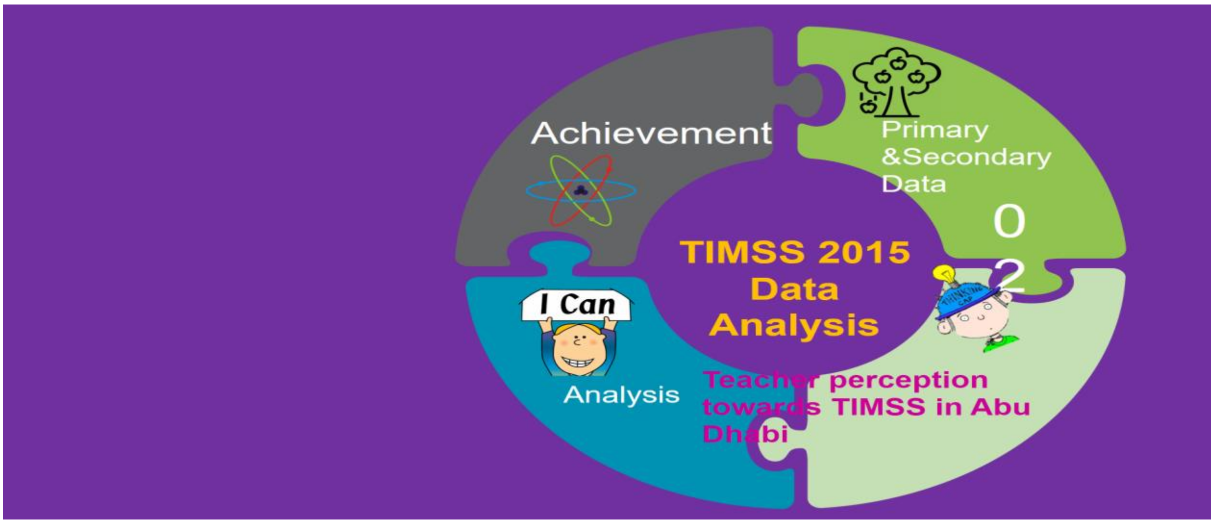
Yousef Ahmed Salem Wardat



April 2022

United Arab Emirates University

College of Education

FACTORS AFFECTING EIGHTH GRADE STUDENTS' MATHEMATICS ACHIEVEMENTS IN TIMSS 2015 IN ABU DHABI EMIRATE

Yousef Ahmed Salem Wardat

This dissertation is submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Under the Supervision of Dr. Shashidhar Belbase

June 2022

Declaration of Original Work

I, Yousef Ahmed Salem Wardat, the undersigned, a graduate student at the United Arab Emirates University (UAEU), and the author of this dissertation entitled "*Factors affecting eighth grade students' mathematics achievement in TIMSS 2015 in Abu Dhabi Emirate.*" hereby, solemnly declare that this is the original research work that has been done and prepared by me under the supervision of Dr. Shashidhar Belbase, in the College of Education at UAEU. This work has not previously been presented or published and has neither formed the basis for the award of any academic degree, diploma or a similar title at this or any other university. Any materials borrowed from other sources (whether published or unpublished) and relied upon or included in my dissertation have been properly cited and acknowledged in accordance with appropriate academic conventions. I further declare that there is no potential conflict of interest with respect to the research, data collection, authorship, presentation and/or publication of this dissertation.

Student's Signature: ______________________ Date: ____7/07/2022 ___

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Abstract

This study aimed to identify the factors affecting mathematics achievement of eighth grade students in Trends in International Mathematics and Science Study (TIMSS, 2015) and to determine mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools The first part of the study sample consisted of 4,838 students of grade eight (2,172 girls, 2,666 boys) and 156 respective school principals, and 220 mathematics teachers from Abu Dhabi, who attended TIMSS 2015. Study data was obtained from TIMSS 2015 student, teacher, school questionnaires, as well as cognitive test scores for mathematics. The second part of the study included data from 522 mathematics teachers from Abu Dhabi gathered through a perception questionnaire to examine their perception of TIMSS in four areas viz. Mathematics Teachers' Perceptions of TIMSS, Mathematics Teachers' Practices of TIMSS, Readiness of Students for TIMSS, and School and Classroom Environment for TIMSS.

Principal component analysis (PCA) was applied to reduce the number of item-wise variables into a few composite variables for student, teacher, and school questionnaires from TIMSS 2015. Prior to further analyses, the suitability of the PCA was assessed. The Kaiser-Meyer-Olkin (KMO) overall measures were 0.77 for the school questionnaire, 0.94 for the student questionnaire, and 0.88 for the teacher questionnaire, and Bartlett's sphericity tests were statistically significant ($p<0.05$), indicating that it was likely that the data could be factorized. The five factors from the school questionnaire were General School Resources, School Discipline and Safety, Parental Support, Principal Experience and Education, and Library and Instruction Resources. The five factors from the student questionnaire were Mathematics in School, Students' Safety and Behavior, Attitude towards Mathematics, School and Classroom Environment, and the effect of Internet and Tablets (Technology for Students). The factors from the teacher questionnaire were - School Emphasis on Academic Success, Teaching Mathematics to the TIMSS Class, Resources and Time, Mathematics Topics Taught to TIMSS, and Mathematics Assessment of TIMSS. Multistage Multiple Regression models have been implemented. The models are statistically significant, indicating a significant linear relationship between students' achievement in TIMSS and the variables and factors related to students, teachers, and school-related factors. In the meantime, basic diagnostic tests such as the normality test, the autocorrelation test, the heteroscedasticity test, the multicollinearity test, and the outliers test were carried out, and all conditions were satisfactorily met, making the results of the model robust, valid, and not misleading.

A multiple regression models was implemented to examine the impact of student, mathematics teacher, and school factors on student achievement in TIMSS 2015. The full model of mathematics teachers' factors on multiple regression revealed that all the five factors were statistically significant except teaching mathematics to the TIMSS class, as well as, the full model of student factors’ multiple regression revealed that all the student’s factors were statistically significant predictors of student achievement in TIMSS 2015. Meanwhile, the full model of school factors multiple regression revealed that all the school factors are statistically significant except Factor1: General School Resources.

One-Sample t-test, Independent Sample t-test, and ANOVA tests were performed for each component variable of teacher perceptions. The results showed a statistically significant difference in the overall perception of TIMSS-related practices by teachers. The independent t-test showed no significant difference between male and female teachers in mathematics teaching practices of TIMSS, and neither were their perceptions of student readiness of TIMSS significantly different. The result, however, showed they had significantly different perceptions of the school and classroom environment. In addition, statistically, results showed no significant difference between public and private schools in the practice of mathematics teachers for TIMSS. Still, the difference was significant in views regarding student readiness for TIMSS and the school and classroom environment. Performance indicators showed that students’ results in TIMSS tended to fall annually. Thus, there is a need to enhance and improve activities related to the student, teacher, and school-related factors by creating an ideal learning environment for students to improve their academic achievement in TIMSS.

Keywords: Multiple regression model, ANOVA, t-test, PCA, TIMSS, Eighth Grade, Mathematics Achievement, TIMSS 2015.

Title and Abstract in Arabic

العوامل المؤثرة في إنجازات طلاب الصف الثامن في الرياضيات في TIMSS 2015 في إمارة أبو ظبي

الملخص

هدفت هذه الدراسة إلى تحديد العوامل التي تؤثر على تحصيل طلاب الصف الثامن في الرياضيات في دراسة الاتجاهات الدولية في الرياضيات والعلوم (TIMSS, 2015) وتحديد تصورات معلمي الرياضيات عن TIMSS في مدارس إمارة أبوظبي. يتكون الجزء الأول من عينة الدراسة من 4838 طالبًا في الصف الثامن (2172 فتاة، 2666 فتى) و 156 مدير مدرسة، و 220 معلمًا للرياضيات من أبوظبي، حضروا TIMSS 2015. تم الحصول على بيانات الدراسة من TIMSS 2015 طالب، مدرس، واستبيانات المدرسة، وكذلك درجات الاختبار المعرفي للرياضيات. تضمن الجزء الثاني من الدراسة بيانات من 522 معلمًا للرياضيات من أبوظبي تم جمعها من خلال استبيان تصور لفحص تصورهم لـ TIMSS في أربعة مجالات. تصورات معلمي الرياضيات ع TIMSS، وممارسات معلمي الرياضيات لـ TIMSS، واستعداد الطلاب لـ TIMSS، وبيئة المدرسة والفصول الدراسية لـ TIMSS تم تطبيق تحليل المكون الرئيسي (PCA) لتقليل عدد المتغيرات من حيث العناصر إلى عدد قليل من المتغيرات المركبة للطلاب والمعلمين واستبيانات المدرسة من TIMSS 2015. قبل إجراء مزيد من التحليلات، تم تقييم مدى ملاءمة PCA. كانت مقاييس Kaiser-Meyer-Olkin (KMO) الإجمالية 0.77 لاستبيان المدرسة، و 0.94 لاستبيان الطالب، و 0.88 لاستبيان المعلم، وكانت اختبارات Bartlett الكروية ذات دلالة إحصائية (P <0.05)، مما يشير إلى أنه من المحتمل أن يمكن تحليل البيانات. كانت العوامل الخمسة من استبيان المدرسة هي الموارد المدرسية العامة، والانضباط المدرسي والسلامة، ودعم الوالدين، وخبرة المدير والتعليم، وموارد المكتبة والتعليم. كانت العوامل الخمسة من استبيان الطالب هي الرياضيات في المدرسة، وسلامة الطلاب وسلوكهم، والموقف تجاه الرياضيات، وبيئة المدرسة والفصول الدراسية، وتأثير الإنترنت والأجهزة اللوحية (التكنولوجيا للطلاب). كانت العوامل من استبيان المعلم - تركيز المدرسة على النجاح الأكاديمي، تدريس الرياضيات لفصل TIMSS، الموارد والوقت، موضوعات الرياضيات التي تم تدريسها في TIMSS، وتقييم الرياضيات لـ TIMSS. تم تنفيذ نماذج الانحدار المتعدد المراحل. تعتبر النماذج ذات دلالة إحصائية، مما يشير إلى وجود علاقة خطية ذات دلالة

إحصائية بين تحصيل الطلاب في TIMSS والمتغيرات والعوامل المتعلقة بالطلاب والمعلمين والعوامل المتعلقة بالمدرسة. في غضون ذلك، تم إجراء الاختبارات التشخيصية الأساسية مثل اختبار الحالة الطبيعية، واختبار الارتباط الذاتي، واختبار عدم التجانس، واختبار الخطية المتعددة، واختبار القيم المتطرفة، وتم استيفاء جميع الشروط بشكل مرض، مما يجعل نتائج النموذج قوية وصحيحة، وليس مضللا .تم تنفيذ نماذج انحدار متعددة لفحص تأثير الطالب ومعلم الرياضيات والعوامل المدرسية على تحصيل الطلاب في TIMSS 2015. أظهر النموذج الكامل لعوامل معلمي الرياضيات على الانحدار المتعدد أن جميع العوامل الخمسة كانت ذات دلالة إحصائية باستثناء تدريس الرياضيات إلى كشف صف TIMSS، بالإضافة إلى النموذج الكامل للانحدار المتعدد لعوامل الطالب، أن جميع عوامل الطالب كانت تتنبئ ذو دلالة إحصائية بتحصيل الطلاب في TIMSS 2015 وفي الوقت نفسه، أظهر النموذج الكامل لعوامل الانحدار المتعدد المدرسة أن جميع العوامل المدرسية ذات دلالة إحصائية باستثناء العامل 1: موارد المدرسة العامة .تم إجراء اختبارات t للعينة الواحدة واختبارات t للعينة المستقلة واختباراتANOVA لكل متغير مكون لتصورات المعلم. أظهرت النتائج فرقًا ذا دلالة إحصائية في الإدراك العام للممارسات المتعلقة بـ TIMSS من قبل المعلمين. أظهر اختبار t المستقل عدم وجود فروق ذات دلالة إحصائية بين المعلمين والمعلمات في ممارسات تدريس الرياضيات في TIMSS، ولم تكن تصوراتهم عن استعداد الطلاب لـTIMSS مختلفة بشكل كبير. ومع ذلك، أظهرت النتيجة أن لديهم تصورات مختلفة بشكل كبير عن المدرسة وبيئة الفصل. بالإضافة إلى ذلك، من الناحية الإحصائية، أظهرت النتائج عدم وجود فروق ذات دلالة إحصائية بين المدارس الحكومية والخاصة في ممارسة معلمي الرياضيات في .TIMSS ومع ذلك، كان الاختلاف كبيرًا في وجهات النظر فيما يتعلق باستعداد الطلاب لـ TIMSS وبيئة المدرسة والفصول الدراسية. أظهرت مؤشرات الأداء أن نتائج الطلاب في TIMSS تميل إلى الانخفاض سنويًا. وبالتالي، هناك حاجة لتعزيز وتحسين الأنشطة المتعلقة بالطالب والمعلم والعوامل المتعلقة بالمدرسة من خلال خلق بيئة تعليمية مثالية للطلاب لتحسين تحصيلهم الأكاديمي في تيمز.

مفاهيم البحث الرئيسية: نموذج الانحدار المتعدد، تحليل التباين، اختبار t، الصف الثامن، تحصيل الرياضيات.

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Without you all, my dream would not have been achieved. Thank you.

Dedication

To my parents, I hope I will always make you proud

My family has always supported and encouraged me to pursue my dreams.

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List of Abbreviations

SES	Socio-Economic Status
DV	Dependent Variable
EG	Experimental Group
GCC	Gulf Cooperation Council
IEA	International Association for the Evaluation of Educational Achievement
IRT	Item Response Theory
IV	Independent Variable
KMO	Kaiser-Meyer-Olkin
MOE	Ministry of Education
N	Number
NCTM	National Council of Teacher Mathematics
PCA	Principal Component Analysis
PIRLS	Progress in International Reading Literacy Study
PISA	Programmed for International Student Assessment
S.E.	Standard Error
SPSS	Statistical Packages for the Social Sciences (software for data analysis)
STEM	Science, Technology, Engineering, and Mathematics
TIMSS	Trends in International Mathematics and Science Study
UAE	United Arab Emirates
α	Cronbach's Alpha Coefficient Value

Chapter 1: Introduction

1.1 Overview

The Trends in International Mathematics and Science Study (TIMSS) provides reliable and valuable data about student performance in mathematics and science in the participating countries. It also focuses on the relationship between student-teacher and school characteristics and student achievement.

TIMSS was first administered in 1995 by the International Association for the Evaluation of Educational Achievement (IEA) and has continued to be administered every four years. For the third time, in 2015, the UAE participated in TIMSS. Both private and public schools participated in 2007, 2011, 2015, and 2019 TIMSS cycles. The Emirate of Abu Dhabi has been participating consistently since 2011. According to TIMSS 2015 mathematics results, UAEU students ranked 36th amongst 4th graders and 24th amongst 8th graders. More specifically, in the UAE, regarding Abu Dhabi's Emirate, TIMSS 2015 results indicated that students performed below the international average, with an average score of 419 for grade four and 442 for grade eight mathematics (Mullis et al., 2016). These scores are below the national averages in mathematics of both grades for the UAE in TIMSS 2015. The results provide a landscape for the researcher to explore and identify the factors contributing to math achievement among students in Abu Dhabi. In addition, researchers are now interested in exploring factors and variables that can accurately and appropriately predict mathematics achievement. Bearing these incentives in mind, this study investigates the influence of student, teacher, and school factors in predicting the mathematics achievement of 8th-grade students in TIMSS 2015.

By determining significant and reliable factors in predicting the influence of students, teachers, and school factors, the study results are expected to contribute towards achieving a desired positive outcome in mathematics at the school level. According to Pennington (2016), UAE students have improved in mathematics and science since 2014, when the teachers' licensing system was introduced, and the 2021 professional scheme was initiated. However, students continued to perform below the expected international levels in TIMSS 2015. In 2015, approximately 18,000 8^{th} graders from public and private schools in the UAE participated in the TIMSS assessments (Mullis et al., 2016). The 8^{th} grade UAE students performed better in mathematics and science than their GCC neighboring counterparts, reflecting a cumulative grade score of around four hundred and fifty (Mullis et al., 2016). With the international benchmark being five hundred, nearly two thirds of students hailing from GCC countries underperformed, scoring between four hundred and four hundred and sixty points in the PIRLS and TIMSS assessments (Mullis et al., 2016).

TIMSS has been designed to contribute in improving teaching and learning in mathematics and science for students through evidence-based results. Besides, TIMSS informs educational policy leaders similarities and differences among the participating countries in student learning and performance, both in quantity and quality (AL Shannag et al., 2013). For the first time, the United Arab Emirates participated in the International Mathematics Trends Study (TIMSS) in 2007, thereby joining 67 other countries. This global comparative assessment was conducted under the management of the International Association for the Assessment of Educational Achievement (IEA) (Mullis et al., 2016).

1.2 Statement of the Problem

Every country set targets and envisions a future for its educational system. The UAE, like other countries, aimed to be among the top 20 performing countries in PISA and amongst the top 15 countries in TIMSS performance by 2021. This was a challenge as well as an ambitious goal, which might seem complicated, but certainly not impossible. The UAE did not achieve outstanding results in TIMSS 2015. The 8th-grade students performed below average in TIMSS 2015, probably because the students and the teachers were not aware of the consolidated mathematics and science curriculum for TIMSS, and the teaching and learning were not aligned with the patterns of TIMSS. There had not been any further upgrades in the mathematics and science curriculum in the UAE to align the practices with TIMSS. Most schools in the UAE could not provide practical training to their teachers to align teaching and learning with TIMSS. This might have eventually resulted in a lack of proficiency amongst the 8th-grade students (Mullis et al., 2016).

1.2.1 UAE's National Agenda

The latest PISA results showed that even though the UAE outperformed other participating Arab countries in mathematics, the overall scores were not impressive. Student achievement moved up one level in mathematics but dropped by two levels in science (Burroughs et al., 2019). Although these results may seem disappointing, it is essential to note that many countries that historically performed well in TIMSS experienced a decline in their scores in 2015 (Hu et al., 2018). Despite this decline, these countries still outperformed the UAE.

Regarding the student performance in TIMSS, it is important to examine factors that may influence student performance in mathematics. To understand why

Grade 8 students in Abu Dhabi performed below the average, the current study aims to investigate the factors that might have affected mathematics achievement of eighth-grade students in Abu Dhabi and investigate mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools. The aim behind studying the perceptions of mathematics teachers in Abu Dhabi schools came about to confirm the results that the researcher would obtain after analyzing the secondary data from TIMSS 2015.

The TIMSS 2015 report contains authentic data on factors related to teachers, students, homes, and schools. In-depth data analysis may provide insights into why the Emirate of Abu Dhabi is performing at an intermediate level in TIMSS 2015 when examined closely. The UAE government set the two targets for enhancing knowledge and awareness in science and mathematics, including ensuring the UAE is on the list of 15 top-performing countries in TIMSS and the 20 highest performing countries in PISA. These two goals have been set as national priorities by the country. To fulfill these goals, Knowledge and Human Development Authority (KHDA) has undertaken specific system-level approaches for sharing responsibility, essential life skills, and personal attributes in addition to academic achievement (Badri, 2019).

In 2015-2016, KHDA introduced the UAE National Agenda Parameter (NAP) to bring all schools together and encourage them to participate in external benchmarking assessments. Therefore, the country has taken initiatives to support the development of students in the upcoming TIMSS and PISA assessments. It seemed that this goal would be achievable within three years but would require a collaborative effort by all participating stakeholders. Since the goal was not fully achieved, now it is high time for the government to identify the underlying factors that might have affected students’ performance in TIMSS that may help in policy interventions to improve teaching and learning mathematics and students' performance in national and international tests, such as TIMSS and PISA.

1.2.2 UAE's Ambition and International Achievement

For the UAE to secure one of the top fifteen positions in TIMSS internationally, it would be incumbent on students to secure more than average scores in mathematics. Statistical data provided by previous researchers, such as Liang and colleagues (2015), show that grade 4 pupils in the UAE achieved an average score of 452 in mathematics and 451 in science. A score of 500 was the average benchmark requirement for TIMSS 2015 (Mullis et al., 2016). The TIMSS 2015 score for UAE pupils, reflected a below score, with grade 4 students scoring 434 in mathematics and 428 in science respectively. In TIMSS 2011, grade 8 students in the Abu Dhabi Emirate attained a score of 449 in mathematics and 461 in science. In TIMSS 2015, the grade 8 students obtained 461 in mathematics and 454 in science. These results show that mathematics scores have increased since 2011, whereas science scores for grade 8 decreased in 2015. The latest results, however, show that the UAE had outperformed all other GCC countries except Bahrain, in grade 4 science. The Abu Dhabi grade 4 and grade 8 pupils eventually scored considerably less in mathematics in TIMSS 2011 and also in TIMSS 2015, which may be attributed to factors related to inadequate training and preparation of teachers for the new international benchmark standards which, in turn, resulted in inadequate preparation of pupils in the subject (Badri, 2019).

Moreover, most teachers in Abu Dhabi were not made adequately aware of the enormity of the new curriculum requirements, which was introduced and implemented for the TIMSS 2015 exams. As a result, pupils were underprepared for the syllabus requirements and, therefore, produced below international average results in TIMSS

2015. However, the score has risen significantly in comparison to previous years (Table 1).

Table 1: Student Mathematics Grade 8th Performances in TIMSS Across the UAE and Abu Dhabi Emirates During 2017-2019

TIMSS	UAE Performance	Abu Dhabi Emirate Performance	Difference
2007	461	-	-
2011	456	449	-7
2015	465	442	-23
2019	473	436	-37

1.2.3 Research Gap in the UAE's Context

Previous attempts to investigate the factors that affect students' performance in mathematics have been limited to teachers and students. However, some of these studies have only examined the factors confined to one of the three sources, i.e., school, teacher, and student. For instance, (Badri, 2019) considered the effect of school factors, e.g., classroom size, on students' performance in mathematics; (Badri, 2019) considered the impact of teacher factors, e.g., teacher self-efficacy, on students' performance in mathematics; and (Ibrahim & Alhosani, 2020) assessed the effect of language and curriculum on students' mathematics performance in the UAE. Meanwhile, there is a scarcity of studies investigating the factors that affect students' performance in mathematics interactively, factors emanating from schools, teachers, and students. Some of the previous attempts (Ersan & Rodriguez, 2020; Kilic & Askin, 2013; Yalcin et al., 2017) were made outside the United Arab Emirates, whose results may not be generalizable due to social and cultural differences. As such, the present study attempts to provide empirical evidence for the factors that affected students' performance in mathematics with a triadic source, i.e., school, teacher, and student, within the context of Abu Dhabi in the United Arab Emirates.

1.2.4 Student Performance in TIMSS and Teacher Perceptions

Teachers' perception is essential because the way in which teachers perceive their world may influences their instructional practices (Nespor, 1987). Perceptions about mathematics and mathematics teaching and learning might define how teachers interact with students in the classroom and how they perceive and develop students' skills (Pajares, 1992). Furthermore, the way teachers approach the content, the methodological choices they make, and the assessment practices they use may also be affected by their instruction (Barkatsas, 2005). In other words, Teachers' attitudes influence how they engage with pupils in the classroom, affecting the quality of their education and, as a result, the learning outcomes of their students (Voss et al., 2013).

A teacher may play a crucial role in the educational process in the classroom. The teacher is the one who sees clearly and can identify the strengths and weaknesses of each student in mathematics. For example, teacher perceptions can be influenced in the following ways: (1) the way students answer questions related to mathematics; (2) how students respond when presented with a variety of problem-solving strategies; (3) how students react to being provided with challenging tasks especially for more capable students; (4) how the teacher adapts teaching to engage students' interest and meeting their needs; and (5) helping students appreciate the value of learning mathematics. Therefore, the researcher thought he should study mathematics teachers' perceptions in Abu Dhabi schools towards TIMSS. After analyzing TIMSS 2015 results, the factors affecting students' achievement in TIMSS would be identified along with any other negative factors that may have affected student's achievement. These results would provide decision-makers, in the Abu Dhabi Education Council and Ministry of Education and other stakeholders, with the necessary information to develop appropriate plans to improve Abu Dhabi's results in TIMSS in line with Abu Dhabi vision 2030.

1.3 Purpose of the Study

This research study attempted to explore student, teacher, and school-related factors that might have affected mathematics achievement of eighth-grade students in Abu Dhabi Emirate in TIMSS 2015. Many studies (Badri, 2019; Ersan & Rodriguez, 2020; Kilic & Askin, 2013; Yalcin et al., 2017) have previously been undertaken to assess different factors associated with students' mathematics achievement, but in different contexts.

Alam and Ahmad (2018) have identified some features and characteristics of highly influential teachers in enhancing student performance and achievement. Teacher expertise in the subject as well as a high level of subject matter knowledge are crucial in influencing and encouraging students to perform better. Additionally, teacher collaboration can have a direct positive effect on student learning. Teachers have an essential role in facilitating a sense of belonging by creating an environment that allows students to work autonomously while providing support, guidance, and positive feedback when needed (Doyle, 2008). A positive school climate and environment can indirectly enhance student learning by facilitating greater teacher job satisfaction and self-efficacy. A positive school climate also identifies aspects that contribute to a positive school climate that leads to more extraordinary student achievement. Those aspects include respect for students and teachers, a safe school environment, and effective communication among school administrators, teachers, parents, and students. On a similar note, the role of students as learners of mathematics contributes significantly to their performances (Rechtschaffen, 2014). However, research on contributing factors to students' performances in mathematics in TIMSS 2015 needs in-depth analysis and interpretation to understand the significant hindrances in students' learning and motivation. Therefore, the purpose of this study was to identify the student, teacher, and school-related factors that influenced Abu Dhabi 8th grade students' mathematics achievement in the Trends in International Mathematics and Science Study (Rechtschaffen, 2014) and examine mathematics teachers' perceptions of TIMSS.

1.4 Research Objectives

To achieve the purpose mentioned above, the consolidated objectives of this research were;

1. To determine the factors that affected students' achievement in mathematics in the TIMSS 2015 for eighth grade in the Emirate of Abu Dhabi.
2. To determine how the school, students, and math teacher-related variables might have affected 8^{th}-grade students' performance in mathematics in TIMSS 2015 in Abu Dhabi Emirate.
3. To examine the mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools.

1.5 Research Questions

The study's overall goal was to investigate the student, teacher, and school factors that affected the achievement of eighth-grade students in mathematics in TIMSS 2015 in Abu Dhabi. The following research questions were formulated in light of the above research objectives.

1. What are the student-related factors that affected 8^{th}-grade students' achievement in mathematics in the TIMSS 2015 exam in the Emirate of Abu Dhabi?
2. What are the teacher-related factors that affected 8^{th}-grade students' achievement in mathematics in the TIMSS 2015 exam in the Emirate of Abu Dhabi?
3. What are the school-related factors that affected 8^{th}-grade students' achievement in mathematics in the TIMSS 2015 exam in the Emirate of Abu Dhabi?
4. What are the mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?

Subsidiary Research-Questions:

The following subsidiary research questions were formulated in order to study the relationship of the factors associated to students, teachers, and schools that influenced students' achievements in TIMSS 2015 as well as factors related to teachers' perceptions of TIMSS:

1. Were there any statistically significant student-related factors in the 8^{th}-grade students' mathematics achievement in TIMSS 2015 in Abu Dhabi schools?
2. Were there any statistically significant teacher-related factors in the 8^{th}-grade students' mathematics achievement in TIMSS 2015 in Abu Dhabi schools?
3. Were there any statistically significant school-related factors in the 8^{th}-grade students' mathematics achievement in TIMSS 2015 in Abu Dhabi schools?

4. Do mathematics teachers' have positive, neutral, or negative perceptions of TIMSS in Abu Dhabi Emirate schools?
5. Is there a statistically significant difference between male and female teachers with respect to their perceptions of TIMSS in Abu Dhabi Emirate schools?
6. Is there a statistically significant difference between public and private schools with respect to mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?
7. Is there a statistically significant difference between mathematics teachers' perceptions with respect to years of experience?
8. Is there a statistically significant difference between mathematics teachers' perceptions with respect to different qualifications?

1.6 Significance of the Study

This study was conducted in order to offer some insights into 8th-grade students' achievement in TIMSS 2015 that may support the UAE education system's enhancement of mathematics performance. Additionally, the data analysis results were interpreted according to the specific national agenda needs and goals in education. Policymaking in science and mathematics in schools is important since it allows the proper curriculum alignment within the school areas. The implications of the school setting have also been deemed crucial. It may inform the teachers and the school administrators to resume or reform any new curriculum that needs improvement in a school setting for the students' overall benefit. Student and parental support are also necessary and crucial for the learning and development progression of the students and the school's education system since they encourage the school administrators to maintain the required quality standard in schools.

1.6.1 Policy Level Significance

The finding of this study could provide insight into 8th-grade students' achievement that could help the UAE education system improve students' mathematics performance. Furthermore, the findings were evaluated in the light of the UAE's national agenda, educational objectives, and goals. Science and mathematics education policymaking in schools is critical because it allows for optimal curriculum alignment within the schools and classroom practices to improve students' learning and achievement.

The UAE's educational policy coincides with its desire to be recognized as a global leader. The UAE (together with other Arabian Gulf governments) wants to shift away from being a recipient of ideas and aid from the Global North and instead become a provider of ideas and an equal partner in global policymaking circles, such as the OECD (Morgan, 2018). Starting in the 1950s, the UAE implemented an educational borrowing policy, recruiting foreign instructors and staff and importing curricula, textbooks, and teacher training to accelerate its socio-economic development (Aydarova, 2012; Morgan, 2018). As we will demonstrate in our findings, participating in public evaluations such as PISA and TIMSS is a strategic option for the UAE and its citizens to ensure the nation accomplishes its strategic aims.

The UAE government regards international student assessments as critical benchmarking tools for determining the country's level of socio-economic development (Morgan, 2018). It compares its performance and curriculum to high-performing countries using comparative data from international assessments such as PISA and TIMSS (Morgan, 2018). Since implementing significant educational reforms and investing significantly in its educational systems, the UAE has adopted international tests as credible and objective measures for assessing educational progress (Morgan, 2018). UAE students have made some modest improvements in these assessments, but they continue to fall short of the OECD average in PISA 2012 and PISA 2015, as well as the TIMSS average in TIMSS 2011 and TIMSS 2015 (Sanderson, 2019). The low performance of students enrolled in government-run schools compared to students enrolled in private schools on these global tests is of concern to educational authorities.

1.6.2 Curricular Significance

TIMSS 2015 data analysis and math teacher perception results in Abu Dhabi could help policymakers integrate test content into the curriculum, conduct practice test sessions prior to the administration dates, modify the curriculum to incorporate the content included in the international student assessments, and conduct professional development activities for teachers to enhance their teaching mathematics. Sample questions could be added to the curriculum to familiarize students with the types of questions asked on TIMSS. The study's findings may provide some insights to identify areas for training teachers before international tests and provide them with released items to receive a better education.

School improvement consistently shows the valuable role of international tests and benchmarking in driving educational reform. Results enable educational authorities to modify and consider curriculum content changes and to adapt cognitive skill domain outcomes. In addition, there is a need to systematically evaluate the performance of Abu Dhabi students in TIMSS assessment over several years, as we have begun in this study, which may help educational officials to invest in human and education resources and improve accountability. Education policymakers in the UAE need to evaluate the national mathematics curriculum across all grades by bringing it into alignment with international standards requirements. This will be regarded as a step towards developing a new competence-based curriculum. It is envisaged that the clear presentation of these results will serve as motivation to improve education in the UAE. Furthermore, it is envisioned that the Abu Dhabi education authorities, and educational leaders, will continue to assess student performance, systematically analyze and discuss results and related activities, and design and test remedial interventions. Finally, we hope that this study's findings will help suggest solutions and proposals to improve Abu Dhabi students' performance in mathematics.

1.6.3 Pedagogical Significance

The finding of this dissertation could adopt a test preparation approach to improving the UAE’s international exam ranking by benchmarking the curricula from top-performing countries and integrating test questions into mathematics curricula. Furthermore, schools appeared to have had a test preparation culture before TIMSS and PISA were introduced in the UAE, through active participation of ADEC officials, school principals and teachers. Teaching towards the test may have some positive effects, such as helping teachers shift from lower-order cognitive skills to higher-order cognitive thinking.

The frequency and format of assessments are crucial markers of teaching and school pedagogy; the importance of assessment in the teaching and learning process cannot be overstated. Instructors should measure how students learn the course information to evaluate their teaching performance strategically. TIMSS results demonstrate that frequent testing improves student progress (Başol & Johanson, 2009). TIMSS evaluations assist teachers in identifying individual requirements, assessing presentation rates, and adapting instruction. The teacher-created and standardized exams are commonly used to make significant student choices, such as grades, or schools for accountability purposes. Teachers examine a wide range of subject and cognitive skills using several methods. The questions that appear on tests and quizzes can send strong messages to pupils about what matters.

1.6.4 Epistemic Significance

The findings of this dissertation focus on identifying the students, mathematics teachers, and school factors that affect students' achievement in mathematics in Abu Dhabi 8th grade in Trends in International Mathematics and Science Study (Lindfors et al., 2017). The findings of this study aim to contribute to knowledge and practices related to student achievement in mathematics and teacher perception of TIMSS. The epistemic significance of this study is to improve students' achievement in mathematics and enhance the whole process by knowing teacher perceptions of TIMSS so that an appropriate professional development plan may be designed with the aim of meeting this goal. In another way, the study's outcomes as contributing factors of student achievement in TIMSS and mathematics teacher perceptions can be linked to mathematics teaching and learning associated with students' achievement goals and their learning behavior (Lindfors et al., 2017). Furthermore, regression models of student factors, teacher factors, and school factors to predict the variation in student performance in TIMSS 2015 may contribute to factors impacting student performance. Considering these variables, school teachers, leaders, and education authorities may have insights for raising student achievement in Abu Dhabi schools.

1.7 Limitations of the Study

The study sample is limited to 8th-grade students' achievement in TIMSS 2015 in the Emirate of Abu Dhabi and mathematics teachers who responded the perceptions questionnaire. TIMSS provides a quick overview of students' skills thereby implying that only a limited set of skills can be evaluated at a time and does not therefore provide information about student progress. Due to the constraint of sample size, considering that only students who participated in the TIMSS exam were sampled, effectively excluding all other levels of mathematics students, it is quite natural that this study will fall short of statistical data and significance depending on which of the underlying factors have been tried to be focused upon by the research. It is essential to have as much diversified data from the UAE as possible, including math achievements from girls and boys, low-achievement, as well as high-achievement schools. This study does not provide information on the value of schools and school systems that add to student progress (Jerrim & Shure, 2016). Therefore, the results may not necessarily reflect the actual effects of the education system or specific policies or reforms, so possibly the cause-effect relationships may also be a challenge to determine.

1.8 Definition of Terms

School Environment: The school environment can be described as the domain which provides quality education and educational programs offering learners the experience and information to cope with changing developments throughout their lives and to coexist in harmony with others. This can be achieved by focusing on the mastery of basic modern skills such as collecting information that enables problem solving. Mastery happens when these activities take place within an atmosphere of fun to motivate students to learn and endure difficulties to get information (Martin & Dowson, 2009).

Achievement**:** An outcome expressed either numerically or alphabetically that reflects the student's objectives and acquired knowledge, skills, and values after passing through the experiences and attitudes of the educational subject (Marzano et al., 2003).

TIMSS**:** Trends in International Mathematics and Science Studies: It is an acronym for international tests for studying global trends in science and mathematics. It conducts global tests to assess trends in students' achievement in science and mathematics, and students are evaluated in the fourth grade, eighth grade, and final year of high school. It is a global study focusing on educational policies and systems, studying the effectiveness of the applied curricula and teaching methods, practical application, assessment of achievement, and provision of information to improve the teaching and learning of mathematics and science. This study was conducted under the international organization's supervision to Evaluate Educational Achievement (IEA) (Ming et al., 2011).

1.9 Organization of the Dissertation

In this dissertation, the researcher organized the chapters as follows:

Chapter one: This chapter is organized into six sections: Statement of the Problem, Purpose of the Study, Research Questions, Significance of the Study, Limitations of the Study, and Definition of Terms.

Chapter two: This chapter is organized into three sections**:** theoretical framework, Variables Impacting Student Achievement in Mathematics, and Studies on mathematics teachers' perceptions in schools.

Chapter three: This chapter is organized into three sections. The first section restates the purpose of the study and the research questions. The second section talks about the research design, including the source of data for this study, the sample for the study, the achievement instrument, and the student questionnaires, mathematics teachers' questionnaires, school background questionnaires, and a questionnaire for mathematics teacher perception of TIMSS in Abu Dhabi Emirate schools. Section three presents the methods of data analysis that include the variables for the study, data reduction techniques, descriptive analysis, a one-sample t-test, a two-sample independent t-test, one-way ANOVA, and Multiple Regression.

Chapter four: This chapter is organized into six sections. The first section consists of - The Principal Component Analysis for the student, mathematics teachers, and school questionnaires. The second section includes descriptive statistics results. The third section consists of a one-sample t-test. The fourth section has an independent t-test, and the fifth section a one-way ANOVA. The last section contains the results of the multiple regression analyses.

Chapter five: This chapter is divided into seven sections. The first section provides an overview of the current study, the research questions, and a summary of the methods employed to address the research questions. The results for TIMSS 2015 and the results for the Mathematics Teacher's perception of TIMSS in Abu Dhabi Emirate schools are provided in Section 2. Section 3 discusses and interprets the current study results in terms of the literature review. The limitations of this study are presented in Section 4. The conclusions are contained in Section 5. Implications for practice and recommendations for future research are provided in the last two sections.

Chapter 2: Review of Related Work

2.1 Overview

This chapter has been organized into three sections: Theoretical framework, variables impacting student achievement in mathematics, and studies on mathematics teachers' perceptions in schools.

2.2 Introduction

Education is a crucial factor in the betterment of any nation. Every country must educate its people to improve their socio-economic status and compete with other countries. As education and the quality of education are crucial for development, countries have started comparing their education systems and the skills of their students with the students and education systems of other countries by participating in programs such as Trends in International Mathematics and Science Studies (TIMSS). The International Association for the Assessment of Educational Achievement (IEA) comprises government agencies and independent international cooperatives of national research institutions that have continuously contributed to cross-national achievement research since 1959 (Mullis & Martin, 2012). TIMSS 2015 and PIRLS 2016 are also significant contributions of the IEA, which helps identify the trends in the achievement of mathematics, science, and reading. In 2015, IEA conducted TIMSS 2015 through the collaboration of the International Study Centre at Boston College for students in fourth and eighth grades and TIMSS Advanced 2015 for students enrolled in the final year of secondary school (Mullis et al., 2016). The tests were conducted to explore and analyze students' proficiencies in mathematics and science. Both the TIMSS 2015 and the TIMSS Advanced 2015 effectively provided a 20-year trend measurement for the nations that participated in the first TIMSS assessment, first held in 1995 (Mullis et al., 2016).

The long history of international mathematics and science assessments conducted by the IEA is continued through TIMSS and TIMSS Advanced. This IEA was an acclaimed embodiment of independence and international cooperation associated with national research institutions and government-run agencies (Mullis et al., 2016). Last, two entities (TIMS and PIRLS) have been related to conducting cross-national and cross-cultural studies since 1959. The IEA pioneered international comparative evaluations with respect to educational achievements in the early 1960s to understand the effectiveness of policies across different national educational systems (Caruso, 2008). The IEA's TIMSS and PIRLS International Study Centre is in the Lynch School of Education situated at Boston College and has also been held responsible for all the TIMSS and TIMSS Advanced studies.

Mathematics has been considered a subject where problems are solved, evaluations are made, and figures are worked upon. Scientifically, it is regarded as the basis of science, which helps understand and promote science (Schoenfeld, 1985). Mathematics has its utility as a sharpening tool for intelligence. Most people do not see mathematics as something that can be used on a day-to-day basis. For them, gaining mathematics skills is essential to shaping the economy (McLeod & Adams, 2012). There are two perspectives regarding mathematics: one considers mathematics as a body of language leading towards mathematical theory, whereas the other considers mathematics a process (Schoenfeld, 1985). It is worth mentioning that the advantages of mathematics lie in all aspects of life, whether academic or practical, as such a tool is deemed indispensable in purchasing, estimating, computing prices and other daily-life processes. Furthermore, mathematics skills are essential for college success (Waits & Demana, 1988). Therefore, mathematics is an important subject, and mathematical achievement is also crucial for higher studies in STEM.

The main objective of this chapter is to review literature focusing on variables impacting student achievement in mathematics, with particular emphasis on mathematics achievement. These variables include studies on the impact of school variables on students' mathematics achievements, studies on the impact of parental variables on students' mathematics achievements, studies on the impact of teacher variables on students' mathematics achievements, and studies on the perceptions of mathematics teachers about TIMSS. The purpose of the review is to analyze previous studies in order to identify variables that impact student achievement in mathematics.

This chapter is divided into two sections. The first section provides an overview of the theoretical framework used in this study. The second section reviews studies related to students, teachers, parents, and school variables on student achievement and the perceptions of mathematics teachers about TIMSS that have been presented.

2.3 Theoretical Framework

The theoretical framework of this study is based on theories in mathematics education, the positivist paradigm, assessment in math education, and three models to interpret student achievement in TIMSS: deficit model, equity model, and comparative model.

The educational systems worldwide focus on improving students' achievements in all subjects, particularly mathematics achievement, which is considered one of the central academic concerns worldwide (Schleicher, 2012). Mathematics competence is highly valued for success in STEM (science, technology, engineering, and mathematics) educational, and employment fields (Jordan et al., 2010). Whether at an educational, employment, or national level, the importance of mathematics reveals that it is a significant subject studied in school and university and a skill employed in practical life (Jordan et al., 2010).

The International Association for the Evaluation of Educational Achievement (IEA) has identified and adopted Trends in the International Mathematics and Science Study (TIMSS) to measure, monitor, and compare progress in mathematics achievement worldwide (Ministry of Education, 2020). In 2015, Singapore and Hong Kong were the most advanced countries in mathematics achievements. In the Western world, Norway ranked first, while the United Arab Emirates (UAE) showed the best result in the GCC region. The findings of such a study indicates that students' achievements in mathematics are very high in the UAE; the reason behind that is attributed to “SES” status with students' mathematics achievement (Ministry of Education, 2020). Two aspects of mathematics learning have accompanied the deficit perspective: labeling the students and the restricted definition of mathematics (Battey & Leyva, 2016). Students get labeled without conscious realization through terminology. Some of the terminologies such as slow kids, low kids, high kids, and bubble kids have been intentionally utilized within one's decisions regarding any student's readiness towards mathematics learning (Darling-Hammond et al., 2016). Whether or not these terms or names have been said out loud, they have been known by almost all the students in the classroom regarding the categories the teachers eventually make them fall into (Barwell et al., 2016). All students can learn mathematics at a higher cognitive level than the level for which they are credited. According to the knowledge deficit model for mathematics education, one of the teachers' primary goals and responsibilities has been to cultivate and improve positivity in mathematical learning and identity and affect the students as doers of mathematics (Celedón-Pattichis et al., 2018). This model will help in identifying deficit areas in students' performance.

On the other hand, the equity model and perspective in mathematics education has been a concern for almost all nations, irrespective of their development status quo or transition towards development (Staats & Robertson, 2017). Many believe that inequality in education eventually leads to the wastage of human potential (LeVine & White, 2017). Equity has remained a constant in mathematical education and learning agenda over the last four decades (Glatthorn et al., 2018). This model will help identify any concerns or issues of equity in mathematics teaching-learning in the UAE.

Finally, the comparative model of mathematics education eventually reflects the pattern of mathematical knowledge collected by pupils within a range of demographics, especially in different countries (Brezovszky et al., 2019). Research has stated that eastern world students have shown consistency in achieving higher grades in mathematics compared to other parts of the world (Woessmann, 2016). Although the exact reason has not been analyzed yet, the probable cause may be the framework of the mathematics curriculum and the consistent inclination towards the subject from a very young age, both in school and at home (Tatto & Hordern, 2017). Recent times have shown a climactic intensity of globalized economic competition in education. This has eventually persuaded governments to become dramatically obsessed with the international rankings associated with measured educational consequences (Gillis, 2016).

Many variables might impact students' mathematics achievements, such as students, teachers, and the school environment. Such variables have a considerable impact on students' mathematics achievement. The study aims to shed light on the variables that impact Abu Dhabi Emirati 8th grade students' mathematics achievements in TIMSS 2015. The identified independent variables from TIMSS 2015 are the three independent variables: school, students, and teacher characteristics that converge into the students' performances in mathematics. The performance needs to be analyzed and shaped into results that may have implications for policies, schools, and classroom practices (Figure 1).

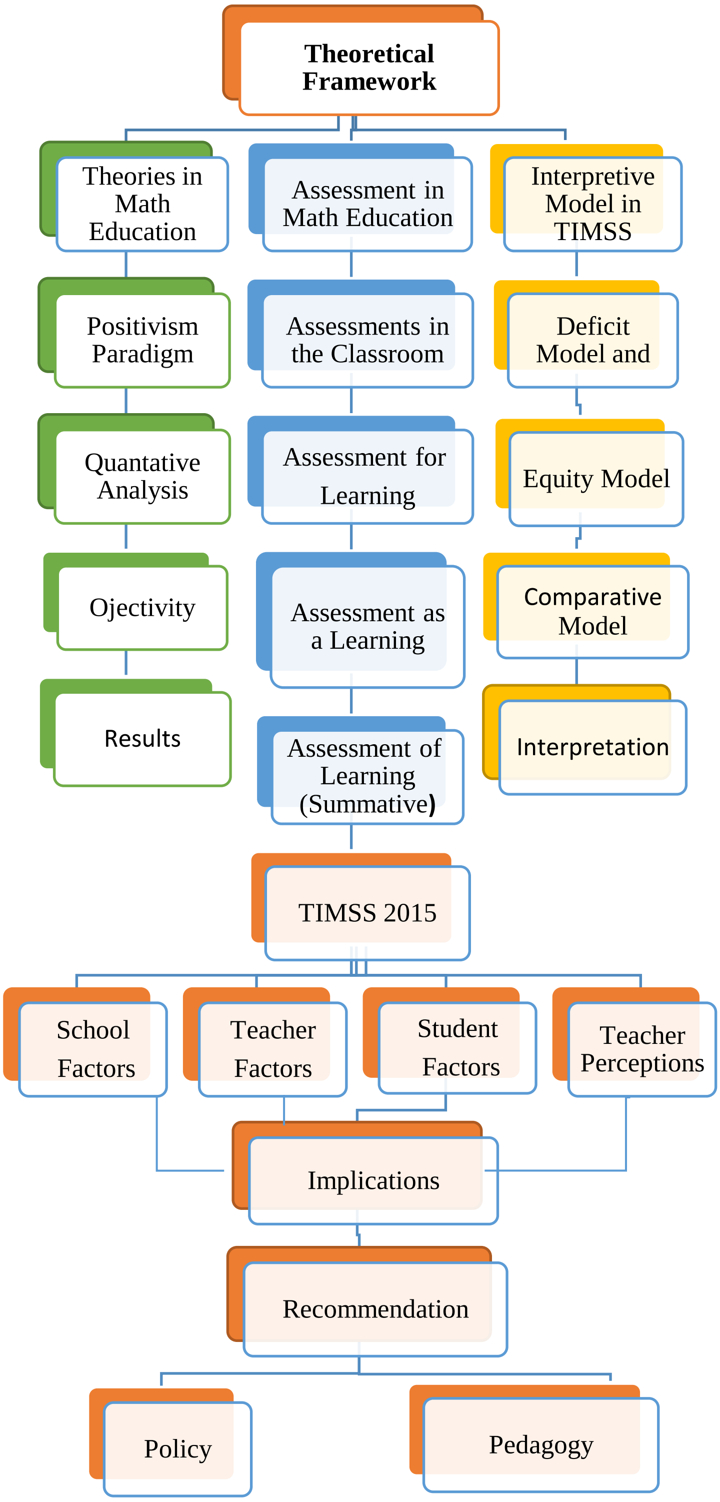

Figure 1: Conceptual Framework of TIMSS 8th Grade Mathematics Test

2.3.1 Theoretical Lens in This Research

Mathematics education theories are essential to any meaningful development effort. Any significant development in teaching, learning, and assessment endeavor requires a solid understanding of mathematics education theory. Diverse cultures and societies have different educational beliefs, particularly regarding the teaching and learning of mathematics as depicted in their curricula. Other mathematics educational systems may emerge due to these differences in ideas and ideals about mathematics learning.

Theories associated to this study are behaviorist, cognitive, constructivist, and positivist paradigms. These theories and their applications in the mathematics teaching methods play an essential role in teaching mathematics. This research aimed to analyze TIMSS 2015 results to determine significant factors that impacted students' achievement in mathematics, and determine mathematics teacher perceptions of TIMSS, so the researcher followed the positivism paradigm in this study to analyze the quantitative data to examine the objective facts related to the variables of interests in this study.

2.3.1.1 Positivist Paradigm

The positivist paradigm investigates, confirms, and predicts law-like behavior patterns (Cohen et al., 2018). It is commonly applied in the physical and natural sciences and social science; whereby large sample sizes are involved. According to Creswell (2008), the positivism paradigm mainly focuses on the objectivity of the research process.

The positivist paradigm entails quantitative methodologies, experimental methods, and control groups (Cohen et al., 2018). Furthermore, it involves the administration of both pre and post-tests to find the score value. Being a philosophy, the positivism paradigm purports that only factual knowledge is achieved through the senses. According to positivism, the researcher is only required to deal with data collection, analysis, and interpretation guided by empiricism (Cohen et al., 2018). One can understand the findings from the analyzed and interpreted data since they are observable and quantifiable (Antwi & Hamza, 2015). This phenomenon relies on quantifiable observations, leading to statistical inference and analysis (Antwi & Hamza, 2015).

Researchers have found that, as a philosophy, the act of positivism is consistent with the empiricist view that knowledge is generated by human experience (Mathotaarachchi & Thilakarathna, 2021). It comprises an atomistic, ontological argument of the world and the events that interact in an observable, determined, and regular manner (Mathotaarachchi & Thilakarathna, 2021).

In addition, the researcher is independent in positivism, which ensures no provisions for human interests within the study (Brenner, 2021). Positivism relates to researchers sticking to the facts and evading fallacies, whereas the phenomenon mainly has no provisions for human interests (Kumatongo & Muzata, 2021). Many principles underlie positivism in terms of objectivity, universality, and empirical data driven results. Among these are no logical differences when it comes to inquiry across sciences. The researcher should mainly focus on explanation and prediction; the research should be empirically observable and objective (Kumar & Samadder, 2020). And finally, the researcher should keep in mind that science and common sense are two different things (Kumar & Samadder, 2020).

The positivist research paradigm is based on the quantitative approach. The positivist paradigm's realist/objectivist ontology and empiricist epistemology necessitate objective or detached research techniques. The focus is on measuring variables and putting hypotheses to the test related to causal explanations (Marczyk et al., 2005; Sarantakos, 2005). In positivist research, experimental designs are used measure effects, typically through group changes. The data collection approaches are centered on acquiring complicated data in numbers to offer evidence in a quantitative format (Neuman, 2003; Sarantakos, 2005). In terms of technique, truth is attained in positivist inquiry through the verification of observable findings (Lincoln & Guba, 2005), variable manipulations of research objects (Lincoln & Guba, 2005), and statistical analysis (Bryman, 1998). Positivists, therefore, emphasize the use of valid and reliable methods to describe and explain the events.

Because the focus is on only one or a few causative elements at a time, positivist research frequently employs a "narrow-angle lens." The factors that aren't being researched are held constant by positivist researchers (Lincoln & Guba, 2005). This is frequently achieved in the laboratory, when an experimenter divides individuals into groups at random, manipulates only one component, and then analyses the results (Cohen et al., 2018).

Quantitative research presents statistical outcomes as numerical or statistical statistics. Questionnaires, surveys, and experiments are used in quantitative research to collect data, then reviewed and tabulated in numbers, allowing the data to be characterized by statistical analysis (Hittleman & Simon, 1997). Quantitative researchers use effect statistics like correlations, relative frequencies, and differences between means to express the relationship between variables on a sample of participants (Cohen et al., 2018). Quantitative methodology is based on the positivism paradigm; the quantitative method is concerned with attempts to quantify social phenomena and collect and evaluate numerical data, focusing on the relationships between a limited numbers of qualities across many cases (Cohen et al., 2018).

In this dissertation, the researcher relied heavily on the positivist paradigm with a quantitative method to collect and analyze data, obtain results, and find out relationships between variables and factors that affect students' achievement (Cohen et al., 2018). The researcher analyzed the secondary data, which consisted of three questionnaires (a student questionnaire, a mathematics teacher questionnaire, and the principal school questionnaire). The aim of the analysis in this Dissertation is to determine the factors affecting the achievement of eighth-grade students in mathematics in TIMSS 2015. At each stage of the analysis, the results are interpreted, factors affecting students' progress in mathematics are identified, and positive factors in the process of learning mathematics are promoted.

The positivist research paradigm also appeared in this research in analyzing the primary data that focused on constructing a questionnaire to measure mathematics teachers' perceptions towards TIMSS 2015. Teachers'responses are analyzed and, with the interpretation of the results, it is aimed to raise the mathematics level of students in TIMSS in Abu Dhabi in future. In conclusion, the positivism paradigm is a critical phenomenon that should be considered without negligence while objectively conducting studies.

2.3.2 Assessment in Mathematics Education

Large-scale and classroom assessments have different histories, with learning theories and viewpoints influencing them differently (Glaser & Silver, 1994). Large-scale assessment is typically conducted from a psychometric/ measuring standpoint, focusing on group or individual scores rather than students' thinking and communication processes (Rosen et al., 2021). A psychometric approach aims to accurately measure the consequences of learning rather than the learning itself (Rosen et al., 2021). Mathematics problems with a single, correct solution are the types of problems typically employed in large-scale assessment (Van den Heuvel-Panhuizen & Becker, 2003). Because they often focus on discrete components of knowledge, these types of inquiries may appear to be more aligned with a behaviorist or cognitivist perspective to some extent (Scherer & Federici, 2015). Focusing on problems with only one correct answer can be incompatible with classroom assessments that encourage various responses and allow students to demonstrate their reasoning and creativity. Research is currently examining large-scale assessment items that promote different responses (Schukajlow et al., 2015). Current classroom assessment methodologies have changed from seeing assessment as a series of events that objectively quantify knowledge acquisition to viewing assessment as a social practice that gives ongoing insights and information to enhance student learning and affect teacher practice. These perspectives on learning are from cognitive, constructivist, and socio-cultural perspectives (Gipps, 1994; Lund, 2008; Shepard, 2000). According to Gipps (1994), the dominant modes of large-scale assessment did not seem to mesh well with constructivist theories, but classroom evaluation, particularly formative assessment, did. More research has shifted to socio-cultural theories as a means of theorizing work in classroom assessment (Black & Wiliam, 2006; Pryor & Crossouard, 2008), as well as understanding the role of context in international assessment results (Black & William, 2006; Pryor & Crossouard, 2008).

Large-scale international assessment design has started examining items that question this standard method in the previous decade. Some recent PISA examinations, for example, have sought to support multiple solutions (Schukajlow et al., 2015).

Mathematical processes, as well as mathematical content, are still ongoing through changes and revisions in school curriculum and assessment practices. They were creating a design that incorporates both content knowledge and mathematical procedures. Large-scale examinations are unlikely to go away in many countries since policymakers see them as a way to monitor the educational system or compare students' performance within or between countries (Schukajlow et al., 2015). In other circumstances, they may serve as a criterion for gaining entry into higher education. (Swan & Burkhardt, 2012) highlight design concepts to assure high-quality assessments that reinforce the aims of mathematics contained in many nations' curriculum texts, given the constraints of timed situations in which such tests occur.

TIMSS is an international assessment that evaluates performance in mathematics and science. Assessment tests given to students in fourth and eighth grade give an accurate account of their performance. TIMSS aims to improve learning in mathematics and science by providing necessary information related to students' performance in the subjects. TIMMS determines the formulation of policies in the education system by highlighting the areas that need improvement (Cordero et al., 2018). A school that records below-average performance may need to change the educational practices it has employed in order to record better performances (Chien & Wu, 2020).

The international test (e.g., TIMSS) is one of the tests in the classroom, and it's similar to continuous assessment at the school, whether they are formative or summative tests. These tests occur once every four years to raise students' mathematics and science achievements worldwide. TIMSS is considered a formative and summative assessment in the classroom which endeavors to measure all the mathematical knowledge that the student gains in mathematics domains viz. (numbers, algebra, geometry, and probability). In addition, TIMSS can be regarded as a summative assessment because they measure what the student has learned of mathematical skills by the end of the fourth and eighth grades.

2.3.2.1 Assessments in the Classroom

Making assessment a regular part of math instruction is a difficult task. It necessitates devising precise strategies for determining what pupils grasp and don't grasp through assignments and discussions. It also necessitates that the teachers be prepared to cope with their students' answers. It's far easier to identify when pupils make mistakes than figure out why they're doing them (Burns, 2005). The latter requires close attention and a thorough understanding of the mathematics topics and principles taught (Nichols & Gianopulos, 2021). We can address the needs of students who are eager for new challenges and assist those who are struggling thanks to the insights we obtain by making assessment a common element of education (Burns, 2005).

Assessment is an integral part of the teaching-learning process since it helps students learn and improves training. It can take many different forms. According to the review of learning philosophy, assessment for learning, knowledge assessment and assessment of learning are the three forms used in the classroom (Kesianye, 2015).

Assessment and teaching should be integrated. The power of such an evaluation may not originate from the use of complex technology or the use of a specific assessment tool. It stems from recognizing how much learning occurs during the routine chores of the school day and how much information teachers can glean about student learning from this material (Kesianye, 2015) (Table 2).

Table 2: Student Mathematics Grade 8th Performances in TIMSS Across the UAE and Abu Dhabi Emirates (Assessments in the Classroom).

Assessment for Learning (Formative)	**Assessment of Learning (Summative)**
• Assesses learning to determine what to do next and then provides suggestions or solutions of what to do—teaching and learning are indistinguishable from assessment.	• It checks the learner's progress.
• It assists educators and students in improving learning.	• It provides information to those not directly involved in daily learning and teaching (school administration, parents, school board) in addition to educators and students.
• It is used continually by providing descriptive feedback.	• It is present in periodic reports.
• Usually uses comprehensive, distinct, and illustrative feedback—in a formal or informal report.	• Usually compiles data into a single number, score or mark as part of a formal report.
• It is not part of an achievement grade.	• It is part of an achievement grade.
• Usually focuses on enhancement, compared with the student's "previous best" (self-reflexive, making learning more personal).	• Usually weighs the student's learning either with other students' learning (norm-referenced, making education highly competitive) or the standard for a grade level (criterion-referenced, making learning more collaborative and individually focused).
• It involves the student.	• It does not always involve the student.

Students' metacognitive skills are developed and supported through assessment as they study (Benseman, 2008). This type of evaluation is critical in assisting students in becoming lifelong learners. Students learn to make sense of material, relate it to existing knowledge, and apply it to new learning when participating in peer and self-assessment (Benseman, 2008). When students use teacher, peer, and self-assessment feedback to adjust, improve, and change what they understand, they gain a sense of ownership and efficacy (Kissling & O'Donnell, 2015).

2.3.2.2 Assessment for Learning [Formative Assessment]

The major aim of TIMSS is to assess and compare students' performances with international students based on their mathematical, science, and reading skills (Klenowski, 2009). TIMSS is considered an assessment for learning to assess educators and students in improving learning, determine what to do next, and then provide suggestions or solutions for what to do—teaching and learning are indistinguishable from assessment (Black & Wiliam, 2009). As well as TIMSS being used to compare countries' levels of education, TIMSS is a survey made in the mathematics and science sectors of different institutions to give a clear overview of education internationally, which is trustworthy and timely. This data is taken after evaluating the students' achievements, and it is compared to that of other students studying in other countries (Wiliam, 2011). It also summarizes the crucial developments and trends in the education system. The report can contribute to improving education from pre-kindergarten to post-secondary education (Wiliam, 2011). In addition to that, it is essential to include the outcomes in the labor force and international comparisons. Leahy et al. (2005) as cited in Wiliam (2011), stated about formative assessment:

1. Teachers should clarify learning outcomes and conditions for success and then share them with students.
2. Teachers should engage students in classroom activities that provide evidence of learning.
3. Teachers should provide feedback to help students make progress.

4. Students should be resources for each other.
5. Students should own their learning (adapted from).

2.3.2.3 Assessment of Learning [Summative Assessment]

Summative assessments are used to assess students' learning, skill acquisition, and academic accomplishments at the end of a specific educational period, such as a project, unit, course, semester, program, or school year (Wiliam, 2011). Three major requirements define summative assessments (Black et al., 2004).

1. Tests, assignments, and projects are used to see if pupils have grasped the material.
2. To put it another way, what makes an exam, assignment, or self-evaluation "summative" is how it is used.
3. To decide if and to what extent pupils have understood the subject.

As a result, they're usually evaluative rather than diagnostic—that is, they're better for determining learning progress.

Because summative assessments are given at the end of a specific instructional period, they are evaluative rather than diagnostic. They are better suited to determining learning progress and achievement, evaluating the effectiveness of educational programs, measuring progress toward improvement goals, or making course placement decisions, among other things. Summative assessment findings are frequently recorded as scores or grades, which are then incorporated into a student's permanent academic record (Krzywacki et al., 2012), whether as letter grades on a report card or test score used in the college admissions process. While most districts, schools, and courses use summative assessments as a major component of the grading process, not all summative assessments are graded (Suurtamm et al., 2010; Suurtamm & Koch, 2014).

2.3.2.4 Large Scale Assessment [TIMSS and PISA]

National Large-Scale Assessment (NLSA*)*. The United Arab Emirates National Assessment Program (UAENAP) has been examining pupils in grades 3, 5, 7, and 9 since 2003 and regularly since 2010 (Clarke, 2012). The NLSA is authorized by a formal, publicly available policy document, and there is a written plan for future NLSA activity (Clarke, 2012). In addition, the government provides ongoing support for all core NLSA functions as well as research and development. Teachers are occasionally given opportunities to learn more about the NLSA (Ministry of Education, 2020). The United Arab Emirates National Assessment Program (UAENAP) has been examining pupils in grades 3, 5, 7, and 9 since 2003, and on a regular basis since 2010. The NLSA is authorized by a formal, publicly available policy document, and there is a written plan for future NLSA activity. In addition, the government provides ongoing support for all core NLSA functions as well as research and development. Teachers are occasionally given opportunities to learn more about the NLSA. The UAE has participated in PIRLS (2011), TIMSS (2011), and TIMSS (2015) in the recent five years. The UAE had taken concrete steps to participate in PIRLS (2016), TIMSS (2019), and PISA at the time of data collection (2012, 2015). All essential ILSA activities are funded by a regular government budget. In the United Arab Emirates, many people can learn about ILSAs (Liu & Steiner-Khamsi, 2020). While UAE-specific ILSA results are regularly and publicly published in the country, it is unknown whether actions based on ILSA results have positively impacted accomplishment levels at the time of data collection (Barnes et al., 2000).

Large-scale assessments are tests or other data-gathering methods given to a large number of pupils at once. These tests are frequently used to assess student achievement in the context of educational accountability, in which the system or individuals within it are held accountable for student performance (Suurtamm et al., 2016). By gathering and sharing data that may be used to inform future improvement, the UAE has proved its commitment to assessing success against international standards and playing an active part in the global education community (Barnes et al., 2000). TIMSS, PIRLS, and PISA are studies that focus on student accomplishment in reading, mathematics, and science. They are coordinated by the IEA and OECD but provided separately in each study. Nonetheless, they are expanding into other outcome measures as well. These studies also collect a wealth of supplementary information about students, schools, and family environments (Care et al., 2014).

TIMSS (Trends in International Mathematics and Science Study) is a large-scale international assessment of mathematics and science in Year 10 and Year 14, conducted by the International Association for the Evaluation of Educational Achievement (IEA). The UAE and Abu Dhabi have been participating in this study since 2007.

2.3.3 Interpretive Models for TIMSS

In this study, three models serve as a path to interpret the context, process, and outcomes of student's performance in TIMSS 2015. These models include mathematics teacher perception of TIMSS in Abu Dhabi schools, deficit perspective of mathematics learning, labelling students and the restricted definition of mathematics (Battey & Leyva, 2016). Some of the terminologies such as slow kids, low kids, high kids, and bubble kids have been intentionally utilized within one's decisions regarding any student's readiness towards mathematics learning (Darling-Hammond et al., 2016). The equity model and perspective in mathematics education has been a concern for almost all nations, irrespective of their development status quo or transition towards development (Staats & Robertson, 2017). The comparative model of mathematics education eventually reflects the pattern of mathematical knowledge gathering by pupils within various demographics, especially in different countries (Brezovszky et al., 2019). These models are the Deficit model, Equity model, and Comparative model.

2.3.3.1 Deficit Model and TIMSS

Mathematics education is transforming, and various changes in mathematics education are bringing about a change in the mathematics teaching and learning process. Need analysis is a significant component of the teaching and learning process. The deficit model also emphasizes need analysis and determining what students already know, what they do not know, what they can do, and what they cannot do (Frade et al., 2013). In this model, the instructors labeled students as slow kids, fast kids, etc. These labels are not unintentional; the teacher first observes the students deeply and then gives them labels based on their readiness to perform a specific mathematical task (Darling-Hammond et al., 2016). This model might have a relationship with students' performance in TIMSS because the teacher assesses students' performance and does a needs analysis before allowing students to participate in TIMSS. The instructor focused on weak areas of the participants by attempting to eliminate their problems. Furthermore, according to the knowledge deficit model for mathematics education, one of the teachers' primary goals and responsibilities has been cultivating and sustainably improving positivity in mathematical learning and identity and affecting the students as doers of mathematics (Celedón-Pattichis et al., 2018).

2.3.3.2 Equity Model and TIMSS

Every nation’s significant dream is to achieve equity in education, even if the nation is fully developed, developed, or in developing stages. A lot of work has been done regarding the equity of mathematics education (Grouws, 2006). Furthermore, one of the studies claimed that the necessary ingredients for achieving success in mathematical education are equity, high expectations, and strong support from all students (Ferrini-Mundy, 2000). It is also believed that wastage of human potential is associated with inequality in education (LeVine & White, 2017). The terms "equity" and "equality" are being used interchangeably, but the Oxford Dictionary defines equity as the quality of a fair and impartial person. Equality implies that all are equal in every aspect, including status, rights, and opportunities. The agenda of mathematical education equity has been persistent for the last four decades (Glatthorn et al., 2018). As TIMSS's major agenda is to identify trends in performance or achievement, one objective might be to provide equity in mathematics education. This is because based on students' performance, it may be an indicator that students who performed well in TIMSS might be using an effective curriculum. On the other hand, the fact that students underperformed, may be indicative of a curriculum flaw thereby suggesting that revision of the curriculum may be required to enact equality in education. Furthermore, the equity model aims to identify any concerns or issues of equity in mathematics teaching and learning in the UAE.

2.3.3.3 Comparative Model and TIMSS

As the name suggests, this model mainly compares mathematic performance in two different countries. Furthermore, it would be useful to identify various patterns in the way that students acquire mathematical knowledge in various geographical areas (Brezovszky et al., 2019). Woessmann (2016) conducted a research study and identified that Eastern world students had shown consistency in achieving higher grades in mathematics compared to other countries. There might be several reasons for it. Among those are the mathematical curriculum framework and the consistent inclination towards the subject from a very tender age, both in school and at the pupils' home (Tatto & Hordern, 2017). It is an age of economic competition, so it is necessary to improve the quality of education compared to other countries and become more conscious regarding international rankings associated with measuring educational consequences (Gillis, 2016). Students from various countries participate in TIMMS compared with other countries based on their mathematical, science, and reading skills. TIMMS effectively compiles the data and generates a comparison-based list of results. That is why the comparative model for mathematics education is being successfully considered.

2.4 Variables Impacting Student Achievement in Math

Students' mathematics achievements are also dependent on the student, teacher, and school environment. Student-related factors include their characteristics, their interests, and their participation. Whereas teachers are the role models for students, their experience, capabilities, and belief in students also influence students' mathematical achievement. Furthermore, the school environment is another critical factor, including infrastructure, rules, regulations, equipment, etc. All three factors are important in predicting students’ mathematical achievement. This chapter goes over previous studies in TIMSS 2015, specifically the impact of student, teacher, and school variables on student mathematics achievement and mathematics teachers' perceptions of TIMSS.

2.4.1 Studies on the Impact of Student Variables on Mathematics Achievements

This part of the review focuses on discussing findings presented by different studies about the influence of student variables on academic achievement. Specifically, the influence of student variables on the performance in various mathematical assessments has been evaluated by considering the findings of different studies. Herges and colleagues (2017) conducted a cross-national study of student-related factors influencing mathematics achievement in the United States of America (USA) and Australia. The study's data depended on the Third International Mathematics and Science Study (TIMSS) to determine the impact of students’ related mathematics achievement variables. To this end, the study employed Hierarchical Linear Modeling (HLM) by Raudenbush and Bryk (2002). The study adopted two analyses for both the USA and Australia to know the variation between American and Australian students’ performance. To illustrate, the first set tackled the following students’ variables, such as gender, language background, family size, socio-economic status, families of a single parent, and parents’ place of birth. On the other hand, the study touched upon the time students spent on homework, their attitude towards mathematics, and their importance. The findings revealed that students' mathematical achievement in Australia was higher compared to students in the USA.

Yalcin et al. (2017) conducted a study on the effect of student characteristics on the TIMSS 2011 mathematics achievement of fourth- and eighth-grade students in

Turkey. The study applied a hierarchical linear modeling analysis. Most importantly, the ANOVA model was used for both fourth and eighth-grade students to know the differences in the mathematics achievement of schools in TIMSS 2011. The findings concluded that the more students were forced to study, the less likely they were to attain a high mathematics achievement. On the contrary, the more the students were willing to study, the greater their mathematics achievement (Mullis & Martin, 2012).

Many researchers have attempted to study the underlying factors related to student learning, especially in mathematics, physics, and other allied science subjects, in the past two decades. These previously undertaken studies have found that there is a consistent relationship between some of the associated background measurements that comprise the size of the family, ethnicity, socio-economic status, as well as the learning capability and interests of the students, which are seldom associated in the form of determinants towards student outcomes (Acharya, 2017).

Fung et al. (2018) conducted a study on student engagement and mathematics achievement: unraveling the main and interactive effects. The study was confined to 15-year-old students from 11,767 secondary schools from 34 countries that participated in PISA 2018. The study applied a hierarchical linear modeling analysis, an independent t-test and a three-level fixed-effect HLM with total maximum likelihood estimation. In addition, independent sample t-tests were next employed to examine whether students benefited from having higher levels of engagement in two different components simultaneously. For example, they compared students with a high level of interest in mathematics and behavior math with students who had either an interest in mathematics or behavior math but not both. The findings revealed that the more students engaged in learning mathematics, the higher their mathematics achievement (Fung et al., 2018). Confidence levels might have a significant effect on the achievement of students. It is indicated in a research study that students' confidence in mathematics has a considerable impact on students' achievements in 2011, not in 2007. Students' valuing of mathematics variables did not significantly correlate with students' mathematics achievement in either year (Lee & Stankov, 2018).

In conclusion, students are affected by several factors, either personal or in their environment, that determine their academic performance. The main factors include parental background, peer influence, and the students' learning skills (Farooq et al., 2011). A parental background that encourages the student to learn will positively impact the student's performance. Students from stable homes that provide a positive and stress-free environment, perform better than less stable ones. Peer influence is a significant factor; friends with a positive influence can motivate better academic performance, whereas friends with a lousy influence can lead the student to deteriorated academic performance. Learning skills determine how well they can understand and practice concepts, which contribute to their academic performance (Lee & Stankov, 2018).

2.4.2 Studies on the Impact of Teacher Variables on Students' Mathematics Achievements

This specific review focuses on how teacher variables influence students' performance in mathematical assessments. Different studies have been conducted here to understand the impact of teacher factors or characteristics on students' mathematics achievements.

Lamb and Fullarton (2002) conducted a comparative study on teachers' effects on eighth-grade students' mathematics achievements between America and Australia. The study touched upon the impact of the teacher on students' mathematics achievements by taking into consideration the following variables: teachers' gender, qualifications, years of experience, and practical experience. The findings showed that having the same teacher for the whole time does not relate to students' mathematics achievement in the two countries. Besides, there was a significantly considerable impact on students' vulnerabilities to homework on their optimal mathematics achievements in both countries (Lamb & Fullarton, 2002).

Akyuz and Berberoglu (2010) conducted a study to analyze the impacts of classroom and teacher characteristics on students' mathematics achievements in TIMSS. This study's factors were teachers' characteristics such as gender, experience, education level, classroom teaching, background, teachers' instructional practices, and class characteristics. In contrast, the dependent variables in this study were the mathematics achievement scores of students. Furthermore, the size of the class, the climate of the classroom, and limitations to teaching were also studied in association with mathematics achievement. This study has proposed a multi-level model for indicating the association between mathematics teacher/classroom characteristics and students' mathematical achievements in TIMSS-R data across Turkey and European Union (EU) countries (Akyuz & Berberoglu, 2010). To this end, four related questionnaires were used to collect data at diverse levels of the educational system in the TIMSS-R. They are questionnaires related to the curriculum, school, teachers, and students (Akyuz & Berberoglu, 2010).

Akyuz and Berberoglu (2010) have highlighted that teacher gender, culture, experience, additional qualifications, etc., are different. Somewhere, these factors have positively influenced the students' performance, and in other places, nothing much can be understood clearly. Regarding classroom variables, homework review had no influence, but the emphasis on homework did help improve performance. The study findings revealed that classroom practices and characteristics significantly influenced students' performance in TIMSS (Akyuz & Berberoglu, 2010).

Schmidt et al. (2011) conducted a study on mathematics teachers' perceptions across six countries. The following countries that participated in TIMSS were included in the study: Bulgaria, Germany, South Korea, Taiwan, Mexico, and the U.S. and the following variables were studied: students, classrooms, teachers, mathematics, mathematics pedagogy, and general pedagogy (Schmidt et al., 2011). The findings have indicated that teachers' perceptions of TIMSS, PISA, and education significantly affect students' performance. The current training programs and teaching policies are not efficient enough in enhancing the capabilities of the teachers. It is indicated that students' poor performance in TIMSS and PISA indicates that teachers' training with changing patterns is urgently required (Schmidt et al., 2011).

Dodeen et al. (2012) analyzed teachers' qualifications on students' achievement in TIMSS. The study tackled the following factors: teachers' characteristics and qualifications on students' achievement, teachers' professional development, and teachers' quality (Dodeen et al., 2012). Their study compared the traits of mathematics teachers between Saudi and Taiwanese schools. To do so, a questionnaire was employed as a tool for collecting data. The sample included mathematics teachers for 8^{th}-grade students from TIMSS in 2017. The Saudi sample contained 171 mathematics teachers. However, the Taiwanese sample had 152 mathematics teachers (Dodeen et al., 2012). The findings show significant differences between the two countries regarding teachers' preparation for teaching specific mathematics topics, advanced mathematics programs, and teachers' realization about the impacts of the school environment on students' TIMSS results (Dodeen et al., 2012). Moreover, the differences were observed in the domain of questions related to student-student and student-teacher interactions in interactive sessions given to the students in the exams, which, in turn, affected their mathematics academic performance (Dodeen et al., 2012).

Adnan et al. (2014) carried out a study on students' learning environments and mathematics achievement in high-performance schools. The sample of the study consisted of 362 students. The study employed a questionnaire instrument for data collection (Adnan et al., 2014). The study examined students' realization of student closeness, teacher support, engagement, collaboration, and justice in the classroom learning environment. The study's findings revealed that students positively perceive all the learning environment elements (Adnan et al., 2014). The students had the best realization of the student closeness element with other students, with the highest mean compared to other elements. This was followed by collaboration, justice, teacher support, and engagement (Adnan et al., 2014).

Yalcin et al. (2017) carried out a study on the teachers' characteristics of Turkey's TIMSS 2011 mathematics achievement of fourth-and eighth-grade students. The study applied hierarchical linear modeling. The ANOVA model was used for both fourth and eighth-grade students to know the differences in the mathematics achievement of schools in TIMSS 2011 (Yalcin et al., 2017). The findings revealed that teachers who were willing to develop themselves were strongly related to students' mathematics achievements. Teachers' job satisfaction, enthusiasm, and improvement efforts greatly enhanced students' mathematics achievement (Yalcin et al., 2017).

Contrary to common belief, the findings showed no significant relationship between students' mathematics performance and teachers' efforts to enhance their students' performance. However, the results showed that students' mathematics performance primarily depended on those not subjected to cheating at school (Yavuz et al., 2017). The assessment showed no significant relationship between students' mathematics achievement, teachers' working conditions, and collaboration.

In conclusion, teachers play an essential role in the learning process, aside from passing knowledge, they influence the students' expectations and self-belief, ultimately determining their performance. The major teacher-related factors affecting academic performance are motivation, background, and communication skills (Agbor & Ashabua, 2020). Teacher motivation affects their delivery in class; overworked and underpaid teachers tend to deliver poorly in class, leading to underperformance by the students. The teacher's educational background will affect the quality of their work, as those who are not adequately trained in the profession will not deliver effectively. Communication skills, including listening and speaking, are essential in teaching. A teacher's ability to communicate effectively will ensure that students are learning in class and promote a healthy student-teacher relationship that will positively influence the students' academic performance.

2.4.3 Studies on the Impact of School Variables on Students' Mathematics Achievements

This review section has concentrated on analyzing different school variables' influences on the students' academic achievements. Studies from different periods have been utilized to tally the findings and understand the school variables' impact on the students' mathematics achievements. Lamb and Fullarton (2002) performed a comparative study on the effect of the classroom and school on eighth-grade students' mathematics achievements between America and Australia. To achieve this goal, the study examined the average classroom size, school size, the kinds of schools (whether rural, urban, city-based, or remote), students' admission to the school (i.e., if the student was selected due to their academic performance or if the student obtained open access), the duration that students spend on studying mathematics, and the school environment regarding students' absenteeism rate and behavior (Lamb & Fullarton, 2002). The findings revealed that students' classroom interaction in both countries relied heavily on their higher vulnerability to SES composition. The researchers stated that both the classroom environment and the interaction pattern between the students are crucial in improving students' achievement (Lamb & Fullarton, 2002). If the classroom and the study pattern are interactive, such as when the curricula are framed, interactive sessions and learning from each other's knowledge get adorned (Malik & Rizvi, 2018). Learning becomes much more accessible than conventional classroom teaching using chalk and duster. Researchers have also stated that classrooms that encourage interactive sessions amongst students are more prone to showcasing high attendance than other classes that reflect a heavy amount of absenteeism due to a lack of motivation inside the classrooms (Kottasz, 2005). This, in turn, might improve students' achievement because when students do not attend classes, they will not understand the concepts, which might affect their achievement. (Kottasz, 2005).

Ruffina et al. (2018) investigated how class and school size affect students' academic performance across specified public schools in Anambra state. The study was descriptive, and data analysis was done using SPSS. The results showed that when students were placed in a smaller classroom setting, they were more engaged socially and academically. The study concluded that a large class setting promoted cheating and less concentration among students (Ruffina et al., 2018). The effect of class size, school size, and school has a powerful influence on students' performance.

Sheldon et al. (2010) conducted a study to determine whether creating partnerships can improve mathematics proficiency among students. The assessment based on the multilevel statistical software (SPSS) only analyses direct 'effects' of variables and interaction ‘effects’ on the dependent variable (Sheldon et al., 2010). The researchers in this study also illustrated the utility of interactive sessions that can be considered in the classroom settings in schools to encourage students to improvise their interests and inclinations towards mathematics (Sheldon et al., 2010). In this case, the researchers have utilized statistical support to demonstrate the students' encouragement during the interactive sessions. It has been seen that students have become much more interested when introduced to interactive sessions in the case of science subjects as compared to conventional classroom teaching. It is beneficial in improving students’ achievement levels because when students take an interest in the lesson, they understand it better, thus enhancing their achievement level (Idris, 2009).

Alshehri and Ali (2016) carried out a study on the compatibility of developed mathematics textbooks' content in Saudi Arabia (Grades 6-8) with NCTM Standards. The study explored the factors related to student-centered learning, multimedia-based learning, multiple entry learning, knowledge sharing, connection, and representation in multiple ways, learning through collaborative, active learning based on survey and exploration, development of thinking skills, decision-making skills, development of planned initiatives; and linking the learner with real-life contexts. On the other hand, the mathematics score variables were addressed in the mathematics textbooks’ content and students’ achievements (Alshehri & Ali, 2016). The assessment applied NCTM standards in number and operations, algebra, geometry, measurement, data analysis, and probability. The subject-centered model has been utilized to complete this research so that effective orientation and analysis of the data findings against the variables and their interpretations can be obtained. The study findings showed that the contents of the mathematics textbooks followed 96.3% of the NCTM standards. However, certain areas of the standard of the book's contents had not been fulfilled. The study recommended that there was a need to consider all NCTM standards for complete compatibility (Alshehri & Ali, 2016). Also, it emphasized the need for teachers' training to follow the curriculum and attain global standards.

Gustafsson et al. (2018) conducted a study to understand the school variables capable of moderating the link between mathematics achievements and the socio-economic status of grade 8 students. Evidence has been taken from 50 countries that participated in TIMSS 2011. The study examined school factors, educational systems, and organizational differentiation. The study employed a Program for International Student Assessment (PISA) 2000 data marks (Gustafsson et al., 2018). The findings showed that socio-economic status was the highest contributor to the difference between performances across schools. Schools in areas of high socio-economic status recorded better performances than those of lower status (Gustafsson et al., 2018).

Malik and Rizvi (2018) conducted a study on the impact of the classroom environment on students' mathematics achievements at the secondary level. The study was conducted in Tehsil Rawalpindi and Islamabad. The sample consisted of 500 eighth-grade students studying mathematics randomly from different schools (Malik & Rizvi, 2018). During the study, the students who believed in the investigation or used the inquiry approach to comprehend the content did not achieve good marks in the Pakistani context, which may be due to a lack of priority by agencies responsible for curriculum improvement and evaluation domain (Malik & Rizvi, 2018).

In conclusion, the school is the main center of learning for most students and is, therefore, a vital determinant of their performance. Classroom management, teacher-student ratio, and overall performance are primary school factors that affect student achievement (Kweon et al., 2017). Classroom management entails the number of students in a classroom; students in a small class tend to perform better than their counterparts in larger classrooms. The teacher-student ratio in a school will determine the amount of one-on-one time a student will spend with a teacher (Solheim et al., 2017). Schools with a lower teacher-to-student ratio tend to perform better than those with a higher one. The school's overall performance influences the attitudes and cultures that students develop. Students in a high-performing school will tend to develop cultures and attitudes that will lead them to academic success.

2.4.4 Studies on the Perceptions of Mathematics Teachers in Schools

The idea of studying the perceptions of mathematics teachers in Abu Dhabi schools came to confirm the results that the researcher would obtain after analyzing the secondary data, as well as allow teachers to reflect on the true impact of what is happening in their classroom practices and to reveal strengths and weaknesses in schools' practices. The mathematics teachers responsible for training students towards TIMSS, the suitability of the curriculum to TIMSS standards, the school environment, the classroom, promoting student readiness for the TIMSS exam in terms of test content and motivating and encouraging students to train on the TIMSS exam models, all play an essential role towards students’ success in the TIMSS exam. The teacher devises solutions, ideas, and predictions to raise students’ scores in the TIMSS tests. The teacher observes all procedures related to the TIMSS exams and monitors students' and parents' practices to the extent of their interest in these tests. As a result, it is the teacher's responsibility to provide rich feedback to decision-makers, including positive ideas and suggestions, so that stakeholders can decide to find solutions and proposals based on the reality within schools and classrooms to raise students' achievement on the international TIMSS tests.

Kaur (2009) conducted the study entitled "TIMSS-students' and teachers' perspectives on mathematics instruction in Singapore schools." As part of the Third International Mathematics and Science Study (TIMSS), 14,140 primary school students and 8,238 secondary school students in Singapore completed the student questionnaire in 1994. This survey inquired about their impressions of how they learned mathematics in school, how they spent their time in and out of school, and specific background characteristics such as family size, parental and teacher expectations, and socio-economic position (Kaur, 2009). In 1994, 380 primary school teachers and 272 secondary school teachers completed the teacher questionnaire as part of the same study. These teachers were responsible for teaching mathematics. The teacher questionnaire collected information on background variables such as age, gender, qualifications, and so on and the teachers' pedagogical practices and concerns. The findings reported in this paper and students' and instructors' viewpoints on mathematics instruction in Singapore schools (primary and secondary) (Kaur, 2009).

Alqifari (2020) conducted the study with the title "The extent of Saudi teachers’ knowledge of TIMSS’ policies and assessment practices." A teacher’s job is critical in preparing pupils for work and social participation and boosting their academic level. In Saudi Arabia's school system, there is unhappiness with student outcomes in the Trends in International Mathematics and Science Study (TIMSS) assessments (Alqifari, 2020). This research investigates the extent to which the teacher's function is active in preparing pupils for the test. It also looks into whether or not teachers have the essential teaching and assessment skills and standards to do their jobs well (Alqifari, 2020). This study revealed that Saudi teachers are unaware of the TIMSS test's requirements and objectives. Furthermore, a slew of roadblocks continues to hamper academic progress. This study emphasizes the necessity of teacher participation in TIMSS procedures and disciplinary sessions in the school setting (Alqifari, 2020).

Shapira-Lishchinsky and Zavelevsky (2020) examined the TIMSS 2015 teacher surveys to see if they represented common perceptions about ethics in teaching. A four-dimensional structure of the concept "ethics in teachers' practice" emerged from quantitative analysis of teachers' replies to TIMSS questionnaires from 45 countries: caring about students' learning, connecting with colleagues, following the rules, and teacher professionalism (Shapira-Lishchinsky & Zavelevsky, 2020). Findings support the hypothesis that instructors' perceptions of ethical behavior reflect both universal and particularistic, national attitudes. The findings may aid teachers in developing ethical awareness in their profession and support the use of TIMSS teacher surveys to examine ethics in teachers' practice (Shapira-Lishchinsky & Zavelevsky, 2020).

Dodeen et al. (2012) conducted a study with the title "The effects of teachers' qualifications, practices, and perceptions on student achievement in TIMSS mathematics: A four-dimensional." The study compared mathematics teachers' credentials, procedures, and perceptions in Saudi and Taiwanese schools. The responses of mathematics instructors to the Teacher Background Questionnaire, 8th Grade, from the Trends in International Mathematics and Science Study (TIMSS) in 2007 were evaluated in this study (Dodeen et al., 2012). There were 171 teachers in the Saudi sample and 152 instructors in the Taiwanese sample. There were substantial disparities in teachers' preparation for teaching specific mathematical topics, professional development programs, and instructors' opinions of the effects of the school environment on students' TIMSS scores when the two nations were compared (Dodeen et al., 2012).

Furthermore, the outcomes of the two countries differed in terms of the mathematics topics that had not been taught to pupils, the assessment instruments typically employed in mathematics, and test question types (Dodeen et al., 2012). The qualifications and actions of some teachers were found to be linked to pupils' grades. The findings are analyzed, and educators and officials are given recommendations (Dodeen et al., 2012).

Alharbi et al. (2020) conducted the study with the title "Mathematics Teachers' Professional Traits that Affect Mathematical Achievement for Fourth-grade Students according to the TIMSS 2015 Results: A Comparative Study among Singapore, Hong Kong, Japan and Saudi Arabia." Furthermore, factors that influenced mathematical achievement for fourth grade students in TIMSS 2015 and which were investigated were professional traits of mathematics teachers, experience, degree of educational qualification, teacher specialization, and the amount of professional development teachers received as well as gender influences (Alharbi et al., 2020). This study employed a causal-comparative design utilizing the IEA website to examine the TIMSS 2015 outcomes of students in four countries (Singapore, Hong Kong, Japan, and Saudi Arabia). According to the findings, professional development, specialization, educational qualification, and teaching experience among mathematics teachers have varying levels of impact on fourth-grade student accomplishment in the participating nations, as stated in the discussion of the results (Alharbi et al., 2020).

On the other hand, the impact of teachers on student performance has also been investigated in relation to variables such as gender, teaching experience, types of schools (public vs. private), and qualifications. For example, Kartal (2020) suggested gender might influence student achievement. Burroughs et al. (2019) also suggested that various initiatives should include female teacher perceptions and how their perceptions might influence student performance in TIMSS.

Furthermore, other researchers considered variables related to schools themselves. For example, Cordero et al. (2018) pointed to efforts to ensure 8th-grade students in public and private schools perform better. Bdeir (2019) further supported this by pointing out that more effective measures should be implemented to support students' performance in public schools, particularly in mathematics. Students in public or private schools need to be provided with all the essentials in order to achieve their potential (Alenezi, 2017). Other studies such as Burroughs et al. (2019) and Abdelfattah & Lam (2018) showed that a teacher's experience is likely to come into play in determining an 8th-grade student's performance. This is particularly important as experienced teachers are more likely to use different and effective teaching strategies to teach mathematics to students. Contrary to Burroughs et al. (2019) and Abdelfattah and Lam (2018), and Alharbi et al. (2020) found that students' readiness for mathematics exams is not necessarily affected by the teachers' experience. Others argue that teaching experience is likely to allow teachers to understand the students more (Davis & Carlo, 2018) and hence aid in selecting teaching strategies congruent with student learning strategies.

2.5 Chapter Summary

This chapter has provided a brief background of the theoretical literature concerning the variables that impact students' mathematics achievements. This chapter discussed the variables that impacted students' mathematics achievements from the previous studies; these variables related to students, teachers, parents, and the school environment. Students' factors were related to their intelligence level, language background, family size, socio-economic status, etc. Teachers' factors were related to their gender, qualifications, years of experience, support, engagement, collaboration, etc. The school environment factors were related to classroom size, the standard classroom size, rurality, urbanity, city-based remoteness, student admission, etc.

It should be noted that there is a lack of studies on the student, teacher, and school environment variables related to eighth-grade students' mathematics achievement in TIMSS 2015 in Abu Dhabi. For this reason, a study needed to be conducted to bridge this gap by paving the way for further research in a very important field for the UAE. As mentioned in Chapter 1, previous studies investigated the specific factors that affected students' performance in mathematics. However, some of these studies have only examined the factors associated with confinement to one of the three sources, i.e., school, teacher, and student. Meanwhile, there is a lack of literature investigating the factors that affect students' performance in mathematics in an integrated view of factors emanating from school, teacher, and student questionnaires in TIMSS. Moreover, such a study has not been conducted in the UAE context yet. The present study provides empirical evidence for the factors that affect students' performance in mathematics with a triadic source, i.e., school, teacher, and student, within the content of the United Arab Emirates.

Chapter 3: Research Methodology

3.1 Introduction

This chapter has been organized into three sections. The first section restates the purpose of the study and the research questions. The second section talks about the research design, including the source of data for this study, the sample for the study, the achievement instrument, and the student questionnaires, mathematics teachers' questionnaire, school background questionnaires, and a questionnaire for mathematics teacher perception of TIMSS in Abu Dhabi Emirate schools. Section three presents the methods of data analysis that include treatment of missing data, the variables for the study, data reduction techniques, descriptive analysis, one-sample t-test, two-sample independent t-test, one-way ANOVA, and Multiple Regression.

3.2 Purpose of the Study

The study aimed to identify the factors affecting the mathematics achievement of 8th-grade students in the Trends in International Mathematics and Science Study (TIMSS) 2015 in Abu Dhabi. The present study aimed to identify student, math teacher, and school-related variables to explain grade 8 students' mathematics achievement in TIMSS 2015 and determine the mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools.

Because teachers play a significant role in the teaching and learning process, teachers' perceptions regarding any methodology or process of teaching and assessment matter a lot. If teachers negatively perceive TIMSS, it might affect both the mathematics teaching and the students' achievement in TIMSS.

3.3 Study Design

This section deals with a data source, instruments, participants, samples of research, and data collection methods**.** Each of these parts have been discussed under separate sub-headings.

3.3.1 Data Source

This study's data sources comprised the TIMSS 2015 data source and the mathematics teachers' perception of TIMSS in the Abu Dhabi schools questionnaire. The study sample for TIMSS 2015 consisted of 4,838 students in 8th grade; 2172 girls, 2666 boys, and 205 mathematics teachers from Abu Dhabi who participated in TIMSS 2015. Study data was obtained from TIMSS 2015 school, student and teacher questionnaires, and overall mathematics test scores with five plausible values. The sample of math teacher perceptions of TIMSS in Abu Dhabi Emirate schools included 522 mathematics teachers in Abu Dhabi emirate schools teaching in academic years 2020 – 2021.

3.3.1.1 TIMSS 2015 Data

This study used data concerning eighth-grade students' mathematics achievement from TIMSS 2015, conducted by the International Association for the Evaluation of Educational Achievement (IEA). As an independent international cooperative of research institutions and government agencies, IEA has conducted cross-national studies of student achievement in many subjects since 1959. TIMSS has assessed mathematics and science in 1995, 1999, 2003, 2007, 2011, 2015, and the 2019 (Martin et al., 2016). Apart from monitoring trends in mathematics and science achievement in the fourth and eighth grades, TIMSS collects a vast array of background information in the context of varying educational systems, organizational approaches of schools, and instructional practices. In this study, TIMSS 2015 sources, which covered 57 countries and 7 benchmarking entities worldwide, involving about 580,000 students, provided information about educational achievement across countries to serve as a resource for improving teaching and learning mathematics and science (Martin et al., 2016). ADEC (Abu Dhabi Education Council) is responsible for looking after 257 public schools across the Abu Dhabi Emirate. In addition to these, 188 private schools operate within the Abu Dhabi Emirate. There are 223,803 students in private schools and 127,770 students in public schools (Martin et al., 2016). The public-school population reflects the views of 23% expatriates and 77% of Emirati nationals. The private school population represents 24% of Emirati citizens and 76% expatriates (Martin et al., 2016). This data helped in making objective quantitative analysis and interpretations within the positivist paradigm to relate students' achievements with equity and deficit models.

3.3.1.2 Mathematics Teachers' Perception Questionnaire Data

A survey was designed to study mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirates schools because teachers' perceptions of TIMSS might significantly affect their students' performance and achievement. The survey was designed based on previous studies related to mathematics teachers' perceptions of TIMSS (Kaur, 2009; Alqifari, 2020; Dodeen et al., 2012; Alharbi et al., 2020; Kartal, 2020; Burroughs et al., 2019; Cordero et al., 2018; Bdeir, 2019; Alenezi, 2017; Abdelfattah & Lam, 2018; Davis & Carlo, 2018).

This study used the quantitative approach to examine mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools. The reason for using a quantitative approach was to collect data from as many varied participants as possible thus enabling a range of differing response options using any quantitative tool. The information was gathered from participants via an online questionnaire using Google forms, which consisted of 30 statements on a 5-point Likert scale. This survey generated data on math teachers' perceptions, attitudes, and opinions on TIMSS (Bryman & Cramer, 2012). Furthermore, as per the study's theoretical framework, three questionnaires were adapted to accommodate school-related, student-related, as well as teacher-related factors. The teacher perceptions of TIMSS data helped in making quantitative analysis and interpretations in an objective way within the positivist paradigm to discuss the perceptions in terms of classroom practices and student readiness for TIMSS.

3.4 Instruments

This study utilized data from TIMSS 2015 that included three questionnaires: a grade 8 student questionnaire, a mathematics teacher questionnaire, and a school questionnaire. In addition, the researcher developed a mathematics teachers' perception questionnaire to collect data from mathematics teachers in Abu Dhabi.

The final draft consisted of demographic information about the respondents' gender, years of teaching experience, level of education (Bachelor's degree, Master's degree, or PhD), and whether the teacher was teaching math in an Abu Dhabi Emirate school. Teachers' perceptions were measured using a four-dimensional scale (Dimension 1: Mathematics Teachers Practices and TIMSS, eight items; Dimension 2: Mathematics and Instruction, eight items; Dimension 3: Readiness of Students for TIMSS, eight items; and Dimension 4: School and Classroom Environment, six items). The questionnaire was based on a 5 point-Likert scale from Strongly Disagree (coded as 1), Disagree (coded as 2), Neutral (coded as 3), Agree (coded as 4), and Strongly Agree (coded as 5) (Altakhaineh & Alnamer, 2018).

3.4.1 TIMSS 2015

The data was retrieved from the official website of TIMSS (http://timssandpirls.bc.edu/), which is publicly available for research. The standard variables measured in grade 8 were obtained from three questionnaires: the students', teachers', and school questionnaires. In addition, all five plausible values were used to represent the students' mathematics scores accurately. These scores were obtained from the mathematics achievement test in TIMSS 2015.

In TIMSS 2015, the mathematics achievement test has two main domains, content and cognitive. The Content domain areas covered geometry, real numbers, algebra, statistics, and probabilities, while knowledge areas included knowing, applying, and reasoning (Mullis et al., 2016; Sandoval-Hernández & Białowolski, 2016). The number content domain consisted of skills and understandings related to whole numbers, fractions and decimals, integers, ratios, proportions, and percentages (Mullis et al., 2016). The major topics in algebra include patterns, algebraic expressions, equations, formulas, and functions. The geometry content domain covered geometric shapes, geometric measurement, and location and movement. The data and chance content domain included data organization and representation, data interpretation, and chance (probability). The TIMSS assessment framework included 30% of the test items from the numerical content domain, 30 % on algebra, 20% on geometry, and 20% on data and chance. The TIMSS assessment items were also designed to address different cognitive levels: knowing, applying, and reasoning. As for all content domains, 35% of the items were measured as knowing, 40% as applying, and 25% as reasoning (Table 3) (Mullis et al., 2016).

Table 3: Domains of TIMSS 8th Grade Mathematics Test.

Content Domain	**Testing Weight (%)**	**Cognitive Domain**	**Testing Weight (%)**
Algebra	30	Knowing	35
Real numbers	30	Applying	40
Geometry	20	Reasoning	25
Data and Chance	20		

3.4.2 Student Achievement on TIMSS 2015 (Plausible Values)

Due to the rotating booklet design for testing students in TIMSS 2015, special procedures and calculations were necessary to estimate population parameters and standard errors. Item Response Theory (IRT) was used to calculate the proficiency results in this study, as every student was not made to answer the same questionnaire (Mullis et al., 2016). Each student's proficiency range or division of possible values was calculated using this method instead of a single observed result (Mullis et al., 2016). TIMSS presented five possible arbitrary values from the conditional distribution of every student's proficiency scores. The measurement error was because these scores were calculated instead of analyzed (Gonzales et al., 2008). TIMSS 2015 reported students' achievement scores in five plausible values—they are random numbers drawn from the distribution of scores that could be reasonably assigned to each individual (Mullis et al., 2016). Following the advice from the TIMSS 2015 user guide and the TIMSS technical report (Foy & Yin, 2016).

3.4.2.1 TIMSS 2015 Questionnaires

Since learning takes place within a context, TIMSS collects information about the background and contextual factors that affect students' learning in mathematics and science. The questionnaires focus on the background and contextual variables that have been evidenced in the literature as essential variables in improving students' achievement in mathematics and science (Hooper et al., 2016). These factors include the type of school, school resources, instructional approaches, opportunity to learn, teacher characteristics, students' attitudes, and home support for learning (Hooper, 2016; Mullis et al., 2009). The TIMSS 2015 contextual framework consisted of the student questionnaire, mathematics teacher questionnaire, and school questionnaire.

3.4.2.1.1 Student Questionnaire

The grade eight student mathematics questionnaire contained 90 forced-choice questions about student background factors, home possessions, attitudes towards mathematics, learning mathematics, and perceptions about the school climate (Hooper et al., 2016). As a result of this study's goal, all questionnaire items related to the science context were removed, leaving only math-related data (Table 4).

Table 4: Students Questionnaire Items.

Categories	**Number of Questions**	**Total**
About You	Q1, Q2, Q3, Q4, Q5, Q6 (a- k), Q7(a-b), Q8, Q9(a-b), Q10, Q11, Q12, Q13(a-c), Q14(a-f).	33
Your School	Q15 (a-g), Q16 (a-i).	16
Mathematics in School	Q17(a-i), Q18(a-j), Q19(a-i), Q20(a-i)	37
Homework	Q25(a-b), Q26(a-b)	4
Total		90

3.4.2.1.2 Mathematics Teachers Questionnaire

The mathematics teacher questionnaire consists of 174 forced-choice questions about teachers' educational qualifications, licensure, teaching experience, professional development, pedagogical and instructional activities, and the implemented curriculum. Like in the students' questionnaire, all questionnaire items related to science context were removed, leaving only math-related data (Table 5).

Table 5: Mathematics Teachers Questionnaire Items.

Categories	**Number of Questions**	**Total**
About you	Q1, Q2, Q3, Q4, Q5(a-i)	13
School Emphasis on Academic Success	Q6(a-q)	17
School Environment	Q7(a-h), Q8(a-g)	15
About Being a Teacher	Q9(a-g), Q10(a-g), Q11(a-h)	22
About Teaching the TIMSS Class	Q12, Q13, Q14(a-g), Q15(a-g)	16
Teaching Mathematics to the TIMSS Class	Q16, Q17(a-i), Q18(a-j)	20
Using Calculators and Computers for Teaching Mathematics to the TIMSS Class	Q19a, Q19b(a-d), Q20a, Q20B(a-c), Q20C(a-d)	13
Mathematics Topics Taught to the TIMSS Class	Q21A(a-e), Q21B(a-f), Q21C(a-f), Q22D(a-e),	20
Mathematics Homework for the TIMSS Class	Q22a, Q22b, Q22c(a-e)	7
Mathematics Assessment of the TIMSS Class	Q23(a-c)	3
Preparation to Teach Mathematics	Q24(a-g), Q25, Q26A(a-e), Q26B(a-f), Q26C(a-f), Q26D(a-c)	28
Total		174

3.4.2.1.3 School Questionnaire

The school questionnaire contained 77 questions that asked the school's principal or headmaster to provide information about the school climate, resources for teaching and learning, the national curriculum, school location, and other information about the context within which mathematics is taught and learned. As a result of this study's goal, all questionnaire items related to the science context were removed, leaving only math in the data (Table 6).

Table 6: School Questionnaire Items.

Categories	Number of Questions	Total
School Enrolment and Characteristics	Q1, Q2, Q3(a-b), Q4, Q5(a-b), Q6(a-b)	9
Instructional Time	Q7(a-c), Q8(a-b), Q9(a-b)	7
Resources and Technology	Q10, Q11(a-b), Q12(a-b), Q13A(a-i), Q13B(a-e), Q13C(a-e)	24
School Emphasis on Academic Success	Q14(a-m)	13
School Discipline and Safety	Q15(a-k)	11
Teachers in Your School	Q16(a-c), Q17(a-c), Q18(a-b)	8
Principal Experience and Education	Q19, Q20, Q21, Q22(a-b)	5
Total		**77**

3.4.3 Mathematics Teachers Perception Questionnaire

With a five-point Likert scale for this study, the survey instrument utilized information about teaching curriculum, teaching-learning, and assessment. This scale was used to identify the teachers' related factors that might affect students' mathematics achievement in TIMSS. The survey was designed to investigate teachers' perceptions of TIMSS related to curriculum, teaching-learning, and mathematics assessment in Abu Dhabi Emirates schools. The survey used a Likert scale to measure teacher attitudes about TIMSS in relation to the curriculum, teaching-learning, and mathematics assessment on students' performance. The gender of the teacher, courses they were teaching, their teaching experience, and the region they were teaching in, in Abu Dhabi were all asked for in the survey

Teachers' perceptions were measured using four-dimensional scales, which were adapted from the study of Altakhaineh and Alname (2018):

- Dimension 1: Mathematics Teachers' Practices and TIMSS, which included 8 items.
- Dimension 2: Mathematics and Instruction, which included 8 items.

- Dimension 3: Readiness of Students for TIMSS, which included 8 items.
- Dimension 4: School and Classroom Environment, which included 6 items.

3.5 Population and Participants

This section included population and participants on TIMSS 2015 and population and participants on the mathematics teacher's perception of the TIMSS questionnaire in Abu Dhabi Emirate schools.

3.5.1 Population and Participants on TIMSS 2015

The study population consisted of grade 8 students in Abu Dhabi Emirate schools. The study sample included 8th grade students in mathematics in the Emirate of Abu Dhabi, including 156 public and private schools that participated in TIMMS 2015. The total number of students included 4,838 students (2,172 girls and 2,666 boys). In total, 205 mathematics teachers participated in TIMSS 2015 in Abu Dhabi Emirate schools in the academic year 2015 (Table 7).

Table 7: Participants of TIMSS 8th Grade Mathematics Test.

Country	**Number of Schools**	**Number of students**	**The average age of students**	**Number of males**	**Number of Females**	**Number of mathematics teacher**
UAE\Abu Dhabi	156 school	4,838	13.9 years	2,666	2,172	205

3.5.2 Population and Participants on the Mathematics Teacher Perception Survey

For the mathematics teacher perception survey, a quantitative survey approach was employed to collect data for this study in the Emirate of Abu Dhabi, United Arab Emirates. The population of mathematics teachers consisted of the total number of the full-time Mathematics teachers teaching mathematics at the grade 8 level in Abu Dhabi in the academic year 2020–2021. A total sample of 522 mathematics teachers (244 male and 278 female) voluntarily participated in this study out of 3,297 (female 2,391 and 906 male) mathematics teachers from about 449 schools in Abu Dhabi (El Afi, 2019; Ministry of Education, 2020). These numbers were estimated from the Ministry of Education data of mathematics teachers in Abu Dhabi and Government of Abu Dhabi data insights. This makes the sample proportion of about 15.83% of the population of mathematics teachers (although we have no information about how many mathematics teachers might have received the online questionnaire, as it was distributed through the private emails and social media groups of mathematics teachers). The data was collected from Abu Dhabi Emirates, including three regions (Abu Dhabi, Al Ain, and Al Dhafrah).

3.6 Data Collection

Data collection included TIMSS 2015 data and math teacher perceptions data. Each of these data have been explained separately.

3.6.1 TIMSS 2015 Data

Johansone (2016) explained data collection operations for TIMSS 2015 as scheduled according to 57 participating countries located in the southern and northern hemispheres. The school year typically ends in November or December for schools in the southern hemisphere and the TIMSS assessment was given out in October or November 2014. Whereas the school year usually ends in May or June for those schools in the northern hemisphere, the assessment was conducted in April, May, or June 2015 (Johansone, 2016). Survey and assessment operations procedures were developed and standardized to ensure the consistency and uniformity of high-quality, internationally comparable data among the participating countries. Each country or benchmark entity was charged with carrying out the data collection process and maintaining quality control procedures in accordance with the guidelines set by the IEA (Johansone, 2016). Testing administrators and participating school personnel were provided training in test security, timing, rules for answering students' questions, and control monitors to maintain the high quality and accuracy of the data for the TIMSS 2015 survey and assessment (Johansone, 2016).

The TIMSS eighth-grade mathematics test data can be processed into two main areas: content and cognitive domains. Content areas cover real numbers, geometry, algebra, statistics, and probabilities, while cognitive domains include knowledge, application, and thinking (Grønmo et al., 2015). These two areas are grouped and presented in tables for comparative and interrelated analysis (Grønmo, et al., 2015).

Factors which correlated to the students' performance in TIMSS as described by Kupari and Nissinen (2013), included interaction of students with peers, interaction between students and teachers, the scoring pattern, and the reliability of significant benefits over students. All these variables were extracted from the students' questionnaire, which, in turn, were then described and analyzed. For students, the variables include students' desire to do well in school, students' ability to reach the school's academic goals, respect for classmates who excel in school, and clarity of the school's educational objectives (Kromrey & Rendina-Gobioff, 2006).

The teacher questionnaire developed by TIMSS contained information related to the teacher background variables and how well the teachers were prepared to teach mathematics. The conditions under which mathematics learning took place in TIMSS selected classes, were analyzed. In this case, the underlying factors associated with teacher-student interaction and the overall teaching scenario pattern concerning teachers' behaviors in the interactive classroom sessions were identified. Altogether, the questionnaire consisted of 174 multiple choice questions answered by teachers (Fishbein et al., 2018). Questions were related to teachers' background characteristics, education and training in mathematics, how well-prepared teachers felt about teaching mathematics, and how their teaching practices represented the present study's focus (Fishbein et al., 2018). Other variables for the school environment, included the school's security policies and practices, school rules, public school resources, instructional materials (e.g., textbooks), mathematics instruction resources, school discipline and safety. Other factors are extensively covered and attached in the Appendix (Fishbein et al., 2018).

The three questionnaires, the school questionnaire, the student questionnaire, and the mathematics teacher questionnaire, in addition to the students' mathematics achievement on TIMSS 2015 were assimilated into one SPSS file, as the number of students in the eighth grade reached 4,838 in various Abu Dhabi public and private schools. The combined number of participating public and private schools totaled 156. These 156 school principals from the public and private sectors participated in this study, as well as the 205 mathematics teachers who taught the eighth-grade curriculum and participated in TIMSS 2015. It is worthy to note that each teacher was identified according to the subject taught and the schools they were affiliated to. The results which were analyzed, then took into consideration factors such as the qualifications of the teachers and their years of experience.

3.6.2 The Mathematics Teacher Perception Survey Data

A questionnaire was developed by the authors after a thorough review of the existing literature on teachers' perceptions of mathematics education in the context of TIMSS. A pilot study with an exploratory sample of sixteen teachers (none of whom participated in the main study) was carried out in order to establish the psychometric properties of the survey. To ensure the survey's validity, six faculty members specializing in mathematics education and familiar with the conceptual framework of TIMSS were asked to check the instrument's relevance to the study. Additionally, the survey was given to eight specialists, supervisors, and mathematics teachers for review and feedback. Further modifications were made based on collected comments, such as item rewording. Additionally, using Cronbach's Alpha, the instrument's reliability was found to be 0.93 after pilot testing on 16 teachers, indicating high reliability and high internal consistency.

The final draft of the questionnaire consisted of the following: demographic information about the mathematics teacher, gender, years of teaching experience, level of education (bachelor's degree, master's degree, Ph.D. degree, other), and whether the teacher was teaching mathematics in an Abu Dhabi Emirate school. Teachers' perceptions were measured using four-dimensional scales, which were adapted from the study of Altakhaineh and Alname (2018):

- Dimension 1: Mathematics Teachers' Practices and TIMSS, which included 8 items.
- Dimension 2: Mathematics and Instruction, which included 8 items.
- Dimension 3: Readiness of Students for TIMSS, which included 8 items.
- Dimension 4: School and Classroom Environment, which included 6 items.

The questionnaire was based on a 5 point-Likert scale from Strongly Disagree (coded as 1), Disagree (coded as 2), Neutral (coded as 3), Agree (coded as 4), and Strongly Agree (coded as 5). The survey was conducted with mathematics teachers in Abu Dhabi Emirate schools using an online Google form. Participation was voluntary and deliberate; no payments or other concessions were made.

The study proposal and questionnaire were reviewed and approved by the Social Sciences Research Ethics Committee (SS-REC) at the United Arab Emirates University. The study was approved by the SS-REC of the UAEU on October 22, 2020. The decision was favorable since it raised no major ethical concerns. Therefore, the proposal was approved for the research study duration, as shown in Appendix (F). Anonymity of participants was guaranteed to ensure confidentiality thereby preventing any privacy invasion. Thus, participants were numbered for use in the study and were requested to keep their participation confidential in the best interest of public sensitivities. All participants engaged willingly and voluntarily without any coercion from any labor-related authority sources or otherwise.

3.7 Method of Analysis

This section covers quantitative data analysis techniques such as factor analysis, descriptive analysis, a one-sample t-test, an independent t-test, one-way ANOVA, and multiple regression. Each of these analytical methods has been discussed separately.

3.7.1 TIMSS 2015 Data

3.7.1.1 Principal Component Analysis (PCA)

Factor analysis, in general, allows for the combination of variables with common characteristics. Two available methods can be distinguished: exploratory factor analysis and confirmatory factor analysis. While the former, especially in its form as principal component analysis, allows for identifying underlying patterns in previously unknown groupings of variables, confirmatory factor analysis is used to verify a hypothesized relation and group of certain identified factors (Cohen et al., 2007). As the current study's objective was to specify the school, teacher, and student questionnaire's underlying constructs, the principal component analysis was applied to extract the three questionnaires' main factors that might have influenced student achievement in mathematics (Watkins, 2021).

The suitability of each set of variables for principal component analysis was checked by verifying the sample sizes and the item correlation matrix. For this purpose, the Kaiser-Meyer-Olkin (KMO) criterion was applied to examine the sampling adequacy for the factor analysis from the questionnaire (Nayak & Singh, 2021). The KMO range was from 0 to 1, and the coefficient should be at an absolute minimum of 0.5 (Heene et al., 2011) for acceptable factor analysis results. Besides, the result of Bartlett's Test of Sphericity was considered to check the null hypothesis that the sample originates from a population where the considered variables are uncorrelated. Bartlett's test should significantly reject the null hypothesis with $p<0.05$ (Heene et al., 2011).

This step's objective was to reduce underlying constructs; factor extraction was performed by applying Principal Component Analysis (PCA). The PCA can reduce many possibly correlated variables to fewer uncorrelated factors (the principal components). As a result, the first factor (or a linear combination of variables) is extracted, such that the maximum shared variance of the original data set can be explained (George & Mallery, 2020). Other factors are then successively extracted in the subsequent steps, each trying to explain the maximum portion of the remaining variance—the extraction results in uncorrelated factors used as new composite variables for further analysis and interpretation. To determine the maximum number of factors to be extracted, in general, the Kaiser criterion was applied, meaning that all factors with an eigenvalue greater than 1 (which would correspond to the variance of one standardized variable) are extracted. The eigenvalue is a measure for explaining variance from one factor regarding the variable set's variance (Ledford & Gast, 2018).

Additionally, the Scree plot test's graphical representation was evaluated, and only factors above the elbow (or break) in the plot were retained (Heene et al.,2011) A factor rotation was performed to allow for a better interpretation of the obtained factor results. The Varimax rotation, an orthogonal rotation procedure, was applied for this study. Varimax rotation maximizes the variance between factors and helps identify the closely correlated groups and distinguishes them from other variables (Cohen et al., 2007).

Factor loadings, which represent the correlation between original variables and obtained factors, were examined. Factor loadings can assume values between -1.0 and 1.0, with higher absolute values indicating more robust relationships. For this study's purpose, loadings above 0.3 were considered acceptable (Heene et al., 2011) Additionally, the commonalities of each item after factor extraction were checked. At least 10% of the variance explained by the factor solution should be attained (Heene et al., 2011).

3.7.1.1.1 Student Questionnaire Principal Component Analysis (PCA)

The student questionnaire included 90 questions asking students in Abu Dhabi public and private schools to provide information about aspects of their home and school lives, including necessary demographic information, home environment, school climate for learning, and self-perception and attitudes toward learning mathematics.

3.7.1.1.2 Math Teacher Questionnaire Principal Component Analysis (PCA)

The math teacher's questionnaire contained 174 questions asking math teachers in Abu Dhabi public and private schools to provide information about teaching and learning. A math teacher questionnaire was administered to eighth-grade teachers to seek information about their academic and professional backgrounds, classroom resources, instructional practices, and attitudes toward teaching.

3.7.1.1.3 School Questionnaire Principal Component Analysis (PCA)

The school questionnaire contained 77 questions asking school principals or head teachers to provide information about the school contexts for teaching and learning. The school questionnaire was measured by class size and school resources for math instruction and teachers' perception of math instructional limitations due to student factors.

3.7.1.2 Reliability Analyses

Once suitable and interpretable constructs were obtained through the PCA step, the constructed scales' internal reliability as well as new factors such as composite variables, were assessed utilizing reliability analyses. The study adopted Cronbach's alpha (α) to measure the internal consistency of the scales created. Cronbach's alpha was used for multi-item scales and inter-item correlations by calculating each item's correlation with the sum of all other items (Cohen et al., 2007). The coefficient ranged from 0 to 1, and coefficients above 0.60 were mainly regarded as acceptable (Cohen et al., 2007). However, as the current study followed a quantitative research design and used background questionnaire data, a lower coefficient of 0.5 for the well-justified scales from a theoretical perspective was still considered for further analyses. This approach was in line with other researchers, such as Goertzen (2017) and Cho (2010). In general, an alpha value between 0.7 and 0.8 was judged as "acceptable," between 0.8 and 0.9 was judged as "good," and above 0.9 as "excellent." As an additional means of checking the scale homogeneity, every item was reviewed to ascertain whether the whole scale would obtain higher reliability if the item was dropped. If an item's removal would enhance the scale's reliability, it was dropped from the scale.

3.7.1.3 Multiple Regression Models

These are multiple regression models to explore relationships between a dependent variable and several independent variables by testing them. A numeric dependent variable is required by linear regression. The independent variables could be categorical or numeric. Multiple regression implies that the independent variables are not entered simultaneously but in steps into the regression. A multiple regression, for example, could examine the relationships in the first stage between achievement or performance as measured by some numerical scale and variables, including demographics such as age, gender, and ethnic group) as well as other variables in the second stage (such as scores). For prediction, multiple regression modelling can be used. It can also be utilized for data reduction purposes and help draw the causal inference out.

The multiple regression model for each level can be expressed as a model;

Yij=Boi + B1iXij + rij

Yij=dependent variable

$X_{ij=the}$ value of the predictor

$B_{oi=}$intercept for the unit.

B1i=regression coefficient associated with Xij for the level-2 unit and

$r_{ij=}$random error associated with the ith level-1 unit nested with the level-2 unit.

For multiple regression, our data should meet the following requirements.

- Linearity: The assumption of linearity established that there is a linear relationship between the variables
- Normality: Data is from a normal distribution.
- The error terms on every level of the model are approximately normally distributed
- Homoscedasticity: There should be homogeneity of variance, which assumes equality of population variance. The error term should have constant variance (Homoscedasticity), and violation of this assumption using leads to a heteroscedasticity problem.
- Independent observation: The assumptions state that explanatory variables should be uncorrelated with the error term. Still, when this is violated, we usually have a serial correlation or autocorrelation, which often happens when an important explanatory variable is omitted (Raudenbush & Bryk, 2002).

This study's analysis involves multiple regression to investigate the impact of variables related to students, schools, and mathematics teachers on students' achievement in TIMSS 2015. In the multiple regression analysis, the student's achievement in TIMSS 2015 was set as the dependent variable, and 15 factors from student, teacher, and school variables were selected as the independent variables. Those factors included five school factors, five student factors, and five math teacher factors. Multiple regression using the enter method was deemed a suitable analysis method (Darren & Paul, 2012). Before conducting the analysis, the relevant assumptions of this statistical analysis were examined. Tests concluded that the data met the assumptions of no multicollinearity (Hair et al., 2012; Marback et al., 2005) and no independent errors (Durbin-Watson=1.527).

Further analysis of standard residuals identified that the data obtained had no outliers (Std. Residual Min=- 4.159, Std. Residual Max=3.360). Scatter plots demonstrated that the assumptions of linearity and homogeneity were all satisfied (Hair et al., 2014). As all the assumptions were met, the multiple regression analysis commenced; through a fixed order of entry.

3.7.1.3.1 Model A: School Factors Multiple Regression

To investigate the effects of school factors (Factor 1: Technology for Instruction, Factor 2: School Discipline and Safety, Factor 3: Parental Support, Factor 4: Principal Experience and Education, Factor 5: Library and Instruction Resources) on students' achievement on TIMSS 2015, five-stage multiple regression using the enter method was deemed a suitable method of analysis (Darren & Paul, 2012).

3.7.1.3.2 Model B: Student Factors Multiple Regression

To investigate the effects of student factors:

- Factor 1: Mathematics in School.
- Factor 2: Students' Safety and Behavior.
- Factor 3: School and Classroom Environment.
- Factor 4: Attitude Toward Math.

- Factor. 5: Internet and Tablet on student achievement on TIMSS 2015, a five-stage multiple regression using the enter method was deemed a suitable method of analysis (George & Mallery, 2020).

3.7.1.3.3 Model C: Math Teacher Factors Multiple Regression

To investigate the effects of math teachers (Factor 1: School Emphasis on Academic Success, Factor 2: Teaching Mathematics to the TIMSS CLASS, Factor 3: Resources and Time, Factor 4: Mathematics Topics Taught to the TIMSS Class, Factor 5: Mathematics Assessment of the TIMSS Class) on students' achievement on TIMSS 2015, a five-stage multiple regression using the enter method was deemed a suitable method of analysis (Darren & Paul, 2012).

3.7.1.3.4 Model D: School, Students, and Math Teacher Factors in Multiple Regression

A separate three-stage multiple regression was conducted on student factors on student achievement on TIMSS 2015. A separate three-stage multiple regression was conducted on students' achievement on TIMSS 2015. Three-stage multiple regression using the enter method was deemed a suitable analysis method (Darren & Paul, 2012).

3.7.2 The Mathematics Teacher Perception Data

To answer the research questions, data collected via the online survey was analyzed using descriptive statistics, a one-sample t-test, an independent sample test, and a one-way ANOVA. Teachers' perceptions in different groups were analyzed across gender, teaching experience, and educational background (Daniel & Harland, 2017).

The means of four domains were calculated to interpret the overall mathematics teachers' perception of their practices, instruction, classroom environment, and student readiness for TIMSS in the Abu Dhabi Emirate schools. Each dimension and related item received a one-sample t-test. Dimension 1: Mathematics Teacher Practices for TIMSS, Dimension 2: Mathematics and Instruction, Dimension 3: Student Readiness for TIMSS, and Dimension 4: School and Classroom Environment received a one-sample t-test.

An independent sample t-test was utilized to examine whether there was any difference between males' and females' perceptions of TIMSS in Abu Dhabi Emirate schools. An independent sample t-test was also utilized to examine whether there existed any difference between public and private school teachers' perceptions of TIMSS in Abu Dhabi Emirate schools. A one-way ANOVA and post hoc comparisons were utilized to examine whether there is any difference in teachers' perceptions of TIMSS in Abu Dhabi Emirate Schools based on mathematic teaching experience. The one-way ANOVA test was used to determine if the differences in the mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirates schools were significant at level (at $\alpha \leq 0.05$)). A one-way ANOVA and post hoc comparisons were utilized to examine whether there was any difference in teachers' perceptions of TIMSS in Abu Dhabi Emirate Schools based on Math Teacher Qualifications. A one-way ANOVA and post hoc comparisons were utilized.

3.8 Validity and Reliability

3.8.1 TIMSS 2015 Validity and Reliability

TIMSS has furnished this instrument's validity and reliability during development and other secondary analysis studies. The Abu Dhabi Emirate's reliability coefficient has been found from the TIMSS 2015 profile and official bulletin. In the test preparation phase, measurement and program development professionals determined the scope, content, and face validity. TIMSS has been approved as a valid and reliable test globally (Martin et al., 2016). The accessibility and validity profiles of the variables, such as student-student interaction, shall be identified using live examples and observer analysis from the researchers' end. The same is true in the case of student-teacher interaction. Another validity issue that shall be addressed here will be a cross-referencing system regarding the teachers' test scores analysis and their reliability in the classroom session, especially in mathematics. A questionnaire was validated for the teachers' survey with expert's evaluation for content validity, construct validity, norm reference validity, and internal consistency.

3.8.2 The Mathematics Teacher Perception Survey Validity and Reliability

3.8.2.1 The Mathematics Teacher Perception Survey Validity

A group of mathematics teaching specialists as well as faculty members from United Arab Emirates University, who were all familiar with the (TIMSS) testing, were selected (see Appendix B) to read items of the tool, then ensure the linguistic integrity thereof. I In addition, these specialists would examine the extent of its relevance to the field, and whatever other relevant factors were deemed appropriate in verifying the tool’s validity. Based on valuable feedback given by the external examiners and after having made their observations and suggestions, some work was omitted from the project. All suggestions and advice given by the external examiners were heeded and after the amendments were made in their final form, the items were reduced from 40 to 30. Appendix C shows the questionnaire in its final form.

3.8.2.2 The Mathematics Teacher Perception Survey Reliability

Several steps were followed to ensure the reliability of the study tool which was piloted utilizing a limited sample of 15 teachers, and who had not been participants in the main study. After two weeks, the tool was re-applied to the same sample. Using the Pearson correlation coefficient, the reliability coefficient of the tool was 0.89 for the total degree. The Cronbach-Alpha equation was used to find the internal consistency coefficient, and the importance of the internal consistency coefficient of the dimensions ranged between 0.88 - 0.81. Table (8) shows the values of the reliability coefficients and the internal consistency of the survey:

Table 8: The Reliability of the Mathematics Teachers Perception Questionnaire on TIMSS in Abu Dhabi Emirate Schools

Number	**Dimension**	**Pearson correlation coefficient**	**Cronbach-Alpha**
1	Dimension 1: Mathematics Teachers Practices	0.80	0.82
2	Dimension 2: Mathematics and Instruction	0.87	0.81
3	Dimension 3: Readiness of Students for TIMSS	0.86	0.88
4	Dimension 4: School and Classroom Environment	0.89	0.89

3.9 Ethical Consideration

The study proposal and questionnaire were reviewed and approved by the Social Sciences Research Ethics Committee (SS-REC) at the United Arab Emirates

University. The decision was favorable since it raised no major ethical concerns. Therefore, the proposal was approved for the research study duration, as shown in Appendix F. Anonymity of participants ensured confidentiality, so any privacy invasion was prevented. To secure participants' privacy, all names were replaced with number for purposes of the study, and all requested not to make their participation in the program public due to possible public sensitivities. All participants were also asked to join this study willingly and voluntarily without any form of coercion. Also, for the policies and regulatory protocols mentioned in the Data Protection Act 2018, the secrecy of the collected first-hand data and the personal information of the selected respondents shall remain strictly confidential to avoid any third-party intervention.

Chapter 4: Results

4.1 Introduction

The analyses for the TIMSS 2015 data are presented in this chapter. The results of the mathematics teacher's perception of TIMSS in Abu Dhabi Emirate schools are also presented. This chapter is organized into six sections. The Principal Component Analysis for the student, math teachers, and Ts is presented in the first section. The second section includes the descriptive statistics results, the third section a one-sample t-test, the fourth section an independent t-test, and the fifth section a one-way ANOVA. The last section contains the results of the multiple regression analyses.

4.2 Factor Analysis of the Student Questionnaire

A Principal Components Analysis (PCA) was run on a 90-item questionnaire that asked students in Abu Dhabi public and private schools to provide information about aspects of their home and school lives, their home environment, school climate for learning, and self-perception and attitudes toward learning mathematics in TIMSS 2015. Inspection of the correlation matrix showed that all variables had one correlation coefficient greater than 0.3. According to Kaiser (1974), the overall Kaiser-Meyer-Olkin (KMO) measure was 0.944, classified as marvelous ($0.9 \leq$ KMO). Bartlett's Test of Sphericity was statistically significant (p <0.05), indicating that the data was likely factorizable into underlying latent variables. The result of KMO and Bartlett's tests have been presented in Table 9.

Table 9: KMO And Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.944
Bartlett's Test of Sphericity	Approx. Chi-Square	38549.689
	Df	4005
	Sig.	0.000

PCA revealed five factors that had eigenvalues greater than one among the 19 potential factors, but others had a low-reliability coefficient and fewer items loaded with them. These five components accounted for 15.76%, 5.89%, 4.90%, 3.79%, and 3.25% of the total variance, respectively. Visual inspection of the scree plot indicated that five components should be retained (Cattell, 1966). In addition, a five-component solution met the interpretability criterion. As such, five components were retained (Table 10).

Table 10: Exploratory Factor Analysis of Student Questionnaire

	Initial Eigenvalues			**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**		
Component	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	14.184	15.760	15.760	14.184	15.760	15.760	12.919	14.355	14.355
2	5.297	5.886	21.646	5.297	5.886	21.646	5.086	5.651	20.006
3	4.407	4.897	26.543	4.407	4.897	26.543	4.568	5.076	25.082
4	3.413	3.792	30.335	3.413	3.792	30.335	4.487	4.985	30.067
5	2.928	3.253	33.588	2.928	3.253	33.588	3.169	3.522	33.588
6	2.725	3.028	36.616						
7	2.045	2.272	38.888						
8	1.816	2.018	40.906						

The five factors were selected based on several criteria. The first criterion is that an eigenvalue of less than one indicates that the component explains less variance than a variable would and hence should not be retained. Unfortunately, in this study, the other components from sixth to nineteenth have an eigenvalue between (2.725 and 1.027). Still, these factors had a low-reliability coefficient, and fewer items were loaded with them. Therefore, the interpretation is fairly straightforward: components one to five were retained, and the sixth to the nineteenth component were not. The second criterion is based on the cumulative percentage of variance explained by a set number of components, where the first five factors explain less than 50% of the remaining 14 factors. This criterion aims to retain all components that can explain at least 60% of the total variance. However, this criterion has been violated as the five components account for 33.588% of total variances.

There are more than 60 components in the scree plot. The components to retain are those before the (last) inflection point of the graph. The inflection point represents where the graph begins to level out, and subsequent components add little to the total variance. In this study, visual inspection of the scree plot would lead to the retention of five components (Figure 2). The fourth criterion was reliability coefficients for each selected component. The study adopted Cronbach’s alpha as a measure of the internal consistency of the scales created, the internal consistency of the 5 components was very high to moderate at the acceptance level (0.957, 0.854, 0.818, 0.842, and 0.601, respectively). The components’ items were closely related, so this led to the retention of five components. The fifth criterion was the interpretability criterion. The interpretability criterion is arguably the most important. It largely revolves around the concept of "simple structure." That is a readily explainable division of variables into separate components. Extracting five components in this example has allowed the attainment of simple structure, and leaning towards extracting five components, re-ran the Principal Components Analysis but forcing only to extract (retain) five components instead of the default eigenvalue-one criterion to suppress all factor loading coefficients less than 0.3 (Straub et al., 2004).

The five-component solution explained about 33.588% of the total variance. A Varimax orthogonal rotation was employed to aid interpretability. The rotated solution exhibited a 'simple structure' (Thurstone, 1947). The interpretation of the data was consistent with the questionnaire designed to measure with strong loadings of items. Factor 1 was named Mathematics in School, Factor 2 was named Students Safety and Behavior, Factor 3 was named Attitude toward Math, Factor 4 was named School and Classroom Environment, and Factor 5 was named Internet and Tablet (Technology).

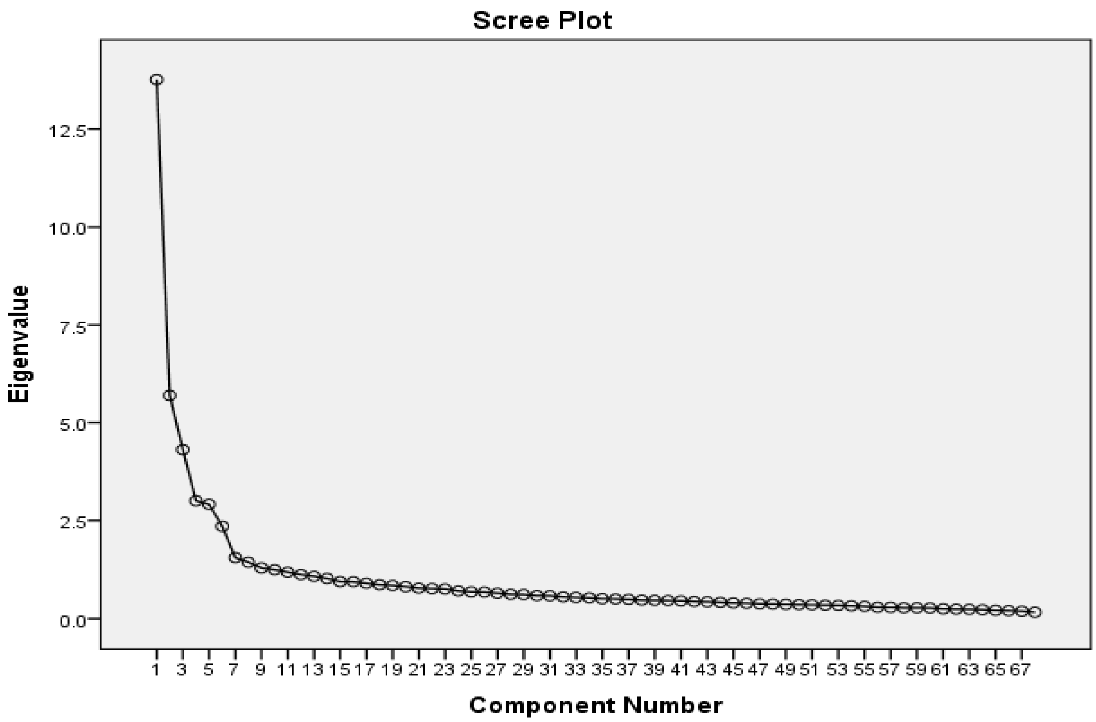

Figure 2: Plot of Eigenvalues from Exploratory Factor Analysis of the Students Questionnaire Variables

Table 11: Student's Questionnaire Factor Analysis and Reliability Statistic

No	Item code	Item	Factor Loading	Cronbach's Alpha	student factors
1	BSBM18E	MATH\AGREE\TEACHER CLEAR ANSWERS	.718	.957	Factor 1: Mathematics in School
2	BSBM18D	MATH\AGREE\INTERESTING THINGS TO DO	.712		
3	BSBM18F	MATH\AGREE\TEACHER EXPLAINS GOOD	.706		
4	BSBM18G	MATH\AGREE\TEACHER SHOWS LEARNED	.688		
5	BSBM18B	MATH\AGREE\TEACHER IS EASY TO UNDERSTAND	.685		
6	BSBM18I	MATH\AGREE\TELLS HOW TO DO BETTER	.681		
7	BSBM18C	MATH\AGREE\INTERESTED IN WHAT TCHR SAYS	.677		
8	BSBM18H	MATH\AGREE\DIFFERENT THINGS TO HELP	.671		
9	BSBM18J	MATH\AGREE\TEACHER LISTENS	.666		
1	BSBM20A	MATH\AGREE\MATHEMATICS WILL HELP ME	.665		
1	BSBM17H	MATH\AGREE\LOOK FORWARD TO MATH CLASS	.664		
1	BSBM20F	MATH\AGREE\GET AHEAD IN THE WORLD	.663		
2	BSBM20B	MATH\AGREE\NEED MAT TO LEARN OTHER THINGS	.652		
3	BSBM17D	MATH\AGREE\LEARN INTERESTING THINGS	.652		
4	BSBM17E	MATH\AGREE\LIKE MATHEMATICS	.646		
5	BSBM17I	MATH\AGREE\FAVORITE SUBJECT	.635		
6	BSBM20G	MATH\AGREE\MORE JOB OPPORTUNITIES	.635		
7	BSBM19D	MATH\AGREE\LEARN QUICKLY IN MATHEMATICS	.631		
8	BSBM20I	MATH\AGREE\IMPORTANT TO DO WELL IN MATH	.624		
9	BSBM17G	MATH\AGREE\LIKE MATH PROBLEMS	.623		
1	BSBM20C	MATH\AGREE\NEED MATH TO GET INTO <UNI>	.618		
1	BSBM19G	MATH\AGREE\I AM GOOD AT MATHEMATICS	.616		
1	BSBM17F	MATH\AGREE\LIKE NUMBERS	.611		
1	BSBM17A	MATH\AGREE\ENJOY LEARNING MATHEMATICS	.609		
1	BSBM20E	MATH\AGREE\JOB INVOLVING MATHEMATICS	.609		
1	BSBM20D	MATH\AGREE\NEED MAT TO GET THE JOB I WANT	.607		
1	BSBM19F	MATH\AGREE\GOOD AT WORKING OUT PROBLEMS	.557		

Table 11: Student's questionnaire Factor analysis and Reliability Statistic (continued)

No	Item code	Item	Factor loading	Cronbach's Alpha	student factors
17.	BSBM18A	MATH\AGREE\TEACHER EXPECTS TO DO	.555		
18.	BSBM20H	MATH\AGREE\PARENTS THINK MATHS IMPORTANT	.535		
19.	BSBM19A	MATH\AGREE\USUALLY DO WELL IN MATH	.526		
20.	BSBM20F	MATH\AGREE\GET AHEAD IN THE WORLD	.663		
21.	BSBM20B	MATH\AGREE\NEED MAT TO LEARN OTHER THINGS	.652		
22.	BSBM17D	MATH\AGREE\LEARN INTERESTING THINGS	.652		
23.	BSBM17E	MATH\AGREE\LIKE MATHEMATICS	.646		
24.	BSBM17I	MATH\AGREE\FAVORITE SUBJECT	.635		
25.	BSBM20G	MATH\AGREE\MORE JOB OPPORTUNITIES	.635		
26.	BSBM19D	MATH\AGREE\LEARN QUICKLY IN MATHEMATICS	.631		
1	BSBM20I	MATH\AGREE\IMPORTANT TO DO WELL IN MATH	.624		
1	BSBG16I	GEN\HOW OFTEN\THREATENED	.738		Factor 2: Students Safety and Behavior
1	BSBG16G	GEN\HOW OFTEN\EMBARRASSING INFO	.727	.854	
2	BSBG16F	GEN\HOW OFTEN\FORCE TO DO STH	.701		
3	BSBG16E	GEN\HOW OFTEN\HURT BY OTHERS	.690		
4	BSBG16H	GEN\HOW OFTEN\POSTED EMBARRASSING THINGS	.683		
5	BSBG16C	GEN\HOW OFTEN\SPREAD LIES ABOUT ME	.653		
6	BSBG16B	GEN\HOW OFTEN\LEFT OUT OF GAMES	.632		
7	BSBG16A	GEN\HOW OFTEN\MADE FUN OF	.588		
8	BSBG16D	GEN\HOW OFTEN\STOLE STH FROM ME	.562		
9	BSBM39AA	MATH\EXTRA LESSONS LAST 12 MONTH\MATHEMATICS	.322		
1	BSBM19HR UDENT	MATH\AGREE\MATHEMATICS HARDER FOR ME REVERSE	.701	.818	Factor 3: Attitude toward Math
2	BSBM19CR UDENT	MATH\AGREE\MATHEMATICS NOT MY STRENGTH REVERSE	.693		
3	BSBM19ER UDENT	MATH\AGREE\MAT MAKES NERVOUS REVERSE	.634		

Table 11: Student’s questionnaire Factor analysis and Reliability Statistic (continued)

No	Item code	Item	Factor loading	Cronbach's Alpha	student factors
4.	BSBM19BR STUDENT	MATH\AGREE\MATHEMATICS IS MORE DIFFICULT REVERSE	.633		
5.	BSBM17CR STUDENT	MATH\AGREE\MATH IS BORING REVERSE	.563		
6.	BSBM17BR STUDENT	MATH\AGREE\WISH HAVE NOT TO STUDY MATH REVERSE	.563		
7.	BSBM19IR STUDENT	MATH\AGREE\MAT MAKES CONFUSED REVERSE	.385		
1.	BSBG15G	GEN\AGREE\LEARN A LOT	.715	.842	Factor 4: School and Classroom Environment
2.	BSBG15F	GEN\AGREE\PROUD TO GO TO THIS SCHOOL	.700		
3.	BSBG15B	GEN\AGREE\SAFE AT SCHOOL	.693		
4.	BSBG15D	GEN\AGREE\LIKE TO SEE CLASSMATES	.678		
5.	BSBG15C	GEN\AGREE\BELONG AT SCHOOL	.668		
6.	BSBG15A	GEN\AGREE\BEING IN SCHOOL	.612		
7.		GEN\AGREE\FAIR TEACHERS	.596		
8.	BSBG03RT	GEN\OFTEN SPEAK <LANG OF TE HOME REVERSE	.401		
9.	BSBG15E	GEN\HOME POSSESS\STUDY DESI	.324		
1.	BSBG06H	GEN\HOME POSSESS\<COUNTRY SPECIFIC>	.502	.601	Factor 5: Internet and Tablet (Technology)
2.	BSBG06G	GEN\HOME POSSESS\GAMING SYSTEM	.472		
3.	BSBG06A	GEN\HOME POSSESS\COMPUTER TABLET OWN	.461		
4.	BSBG06I	GEN\HOME POSSESS\<COUNTRY SPECIFIC>	.442		
5.	BSBG13C	GEN\HOW OFTEN USE COMPUTER TABLET\OTHER	.434		
6.	BSBG06J	GEN\HOME POSSESS\<COUNTRY SPECIFIC>	.430		
7.	BSBG09B	GEN\FATHER BORN IN <COUNTRY>	.402		
8.	BSBG06D	GEN\HOME POSSESS\OWN ROOM	.370		
9.	BSBG09A	GEN\MOTHER BORN IN <COUNTRY>	.363		
10	BSBG06E	GEN\HOME POSSESS\INTERNET CONNECTION	.358		
11	BSBG06F	GEN\HOME POSSESS\OWN MOBILE PHONE	.343		
12	BSBG06K	GEN\HOME POSSESS\<COUNTRY SPECIFIC>	.335		

(Reverse Item): means that the numerical scoring scale runs in the opposite direction. So, in the above items: strongly disagree would attract a score of 5, disagree would be 4, neutral still equals 3, agree becomes 2, and strongly agree=1.

Table 11 shows that Factor 1: Mathematics in School is a combination of 30 variables coded as BSBM18E, BSBM18D, BSBM18F, etc. The value of Cronbach's alpha (α) for Factor 1 is 0.957, which is above 0.9; it is considered "excellent and acceptable" (Cho, 2010). It shows the high internal consistency of the variables within the factor. Therefore, the reliability of Factor 1 within the variables is excellent. For Factor 1: Mathematics in School, each component variable loaded moderately high on the underlying factor (loadings between 0.526 and 0.718), indicating that they measure the underlying construct relatively well. The variance in Factor 1 explained by the component variables was 15.76%, which is relatively high for a 30-items scale. Cronbach's alpha was 0.957, providing further evidence that the component items are valid. These variables work well as a unit to measure the underlying variable named Mathematics in School.

Factor 2: Students' Safety and Behavior, is a combination of 10 variables, i.e., BSBG16I, BSBG16G, BSBG16F, etc. The value of Cronbach's alpha (α) for Factor 2 is 0.854, which is considered excellent and acceptable and is above 0.8 as reported by Bos and Kuiper (1999) and Cho (2010). For Factor 2: Students' Safety and Behavior, each component variable loaded moderately high on the underlying factor (loadings between 0.322 and 0.738), indicating that they measure the underlying construct relatively well. The proportion of variation in Factor 2 explained by the component variables was 5.886%, which is moderate for a 10-items scale. Cronbach's alpha was 0.854, providing further evidence that the component items are valid. These variables work well as a unit to measure the underlying composite variable Students' Safety and Behavior.

Factor 3: Attitude toward Math, is a combination of 7 variables, i.e., BSBM19HRSTUDENT, BSBM19CRSTUDENT, BSBM19ERSTUDENT, etc. The value of Cronbach's alpha (α) for Factor 3, Attitude toward Math, is 0.818, which is considered good and acceptable and is above 0.80 as reported by Bos and Kuiper (1999) and Cho (2010). For Factor 3: Attitude toward Math, each component variable loaded moderately high on the underlying factor (loadings between 0.385 and 0.701), indicating that they measure the underlying construct relatively well. The percentage of variance in Factor 3 explained by the component variables was 4.897%, which is relatively moderate for a 7-items scale. Cronbach's alpha was 0.818, providing further evidence that the component items are valid. Component items work well as a unit to measure the underlying composite variable named as Attitude toward Math.

Factor 4: School and Classroom Environment, is a combination of nine variables, i.e., BSBG15G, BSBG15F, BSBG15B, etc. The value of Cronbach's alpha (α) for Factor 4: School and Classroom Environment is 0.842, which is good and acceptable. It shows the high internal consistency of the variables within the factor. For Factor 4: School and Classroom Environment, each component variable loaded moderately on the underlying factor (loadings between 0.324 and 0.715), indicating that they measure the underlying construct relatively well. The percentage of variance in Factor 4 explained by the component variables was 3.792%, which is relatively low for a 9-variable scale. Cronbach's alpha was 0.842, providing further evidence that the component items are valid. Component items work well as a unit to measure the underlying composite variable named School and Classroom Environment.

Factor 5: Internet and Tablet (Technology) is a mix of 12 variables, such as BSBG06H, BSBG06G, BSBG06A, and so on. Cronbach's alpha (α) value for Factor 5 Internet and Tablet (Technology) for Math is 0.601, moderate, and acceptable. For Factor 5: Internet and Tablet (Technology), each component variable loaded moderately on the underlying factor (loadings between 0.335 and 0.502), indicating that they measure the underlying construct relatively well. The percentage of variance in Factor 5 explained by the component variables was 3.253%, which is relatively low for a 12-items scale, and Cronbach's alpha was 0.601, providing further evidence that the component items are valid. Component items work well as a unit to measure the underlying composite variable named as Internet and Tablet (Technology) in TIMSS 2015.

Finally, the principal component analysis revealed five factors created throughout the students' questionnaire. Factor 1: Mathematics in School is a combination of 30 variables coded as BSBM18E, BSBM18D, BSBM18F, etc., Factor 2: Students' Safety and Behavior, a combination of 10 variables, i.e., BSBG16I, BSBG16G, BSBG16F, etc., Factor 3: Attitude toward Math, a combination of 7 variables, i.e., BSBM19HRSTUDENT, BSBM19CRSTUDENT, BSBM19ERSTUDENT, etc., Factor 4: School and Classroom Environment, a combination of 9 variables, i.e., BSBG15G, BSBG15F, BSBG15B, etc., and Factor 5: Internet and Tablet, is mix of 12 variables, such as BSBG06H, BSBG06G, BSBG06A, and so on. The nature of the student questionnaire was classified into four categories in TIMSS 2015. Category 1 was About Student is consisted of 33 variables, category 2: Students' School consisted of 15 variables, category 3: Mathematics in School consisted of 37 variables, and category 4: Homework consisted of 4 variables.

The exploratory factor analysis with principal component analysis helped in identifying the five underlying composite variables from the 90 items in the student questionnaire that are statistically more robust constructs without bias of the researcher, except in the selection of the number of components based on internal reliability coefficients and eigen-values criteria. This approach likely provided a different lens to view the underlying composite variables other than theoretically constructed groups of variables based on the related items in the student questionnaire. There was also a likely chance of violating the internal reliability of the items in such theoretically constructed composite variables by matching and grouping the items based on their nature and subjective alignment.

As a result of the factor analysis, five new factors were created throughout the students' questionnaire, which was entitled Factor 1: Mathematics in School, Factor 2: Students' Safety and Behavior, Factor 3: Attitude Toward Math, Factor 4: School and Classroom Environment, and Factor 5: Internet and Tablet (Technology). These factors were used on regression analysis to identify the most student factors affecting student achievement on TIMSS 2015.

4.3 One-Sample t-test of Student Questionnaire

Factor1: Mathematics in School

A one-sample t-test was conducted to examine students' perceptions of items related to Factor 1: Mathematics in School. These items had four-point Likert-scale responses from disagree a lot (coded 4) to agree a lot (coded 1); the neutral value of 2.5 was used as a test value. The one-sample t-test shows that all the rated items were less than neutral value. The highest-rated item was a favorite subject (Mean=2.37, SD=1.131 and $p<0.05$) and the lowest-rated item was important to do well in math (Mean=1.57, SD= 0.794 and $p<0.05$). Based on the coding of Likert-scale items, the average values greater than 2.5 meant negative (disagreement) and the average values less than 2.5 meant positive (agreement) toward the item statements or measure of underlying variable. In general, students had a positive attitude toward Factor 1: Mathematics in School (Mean=1.9552, SD=.62760, and $p<0.05$) as the mean score for their agreement level is lower than 2.5 and it is statistically significant (Appendix B).

Factor2: Safety and Behavior

A one-sample t-test was conducted to examine students' perceptions of Factor 2: Safety and Behavior items. These items had four-point Likert-scale responses from disagree a lot (coded 4) to agree a lot (coded 1). The neutral value of 2.5 was used as the test value. The one-sample t-test shows that all the rated items were more than neutral. Based on the coding of Likert-scale items, the average values greater than 2.5 meant negative (disagreement) and the average values less than 2.5 meant positive (agreement) toward the item statements or measure of underlying variable. The highest-rated item was posted with embarrassing things (Mean=3.72, SD=0.757, and $p<0.05$) and the lowest-rated item was extra math lessons from the last 12 months (Mean=2.56, SD= 0.869 and $p<0.05$). Overall, students had a negative perception toward Factor 2: Safety and Behavior (Mean=3.2490, SD=0.65445, and $p<0.05$) (Appendix B).

Factor3: Attitude toward Math

A one-sample t-test was conducted to examine students' perceptions of items related to Factor 3: Attitude toward Math. These items had four-point Likert-scale responses from disagree a lot (coded 4) to agree a lot (coded 1), and the neutral value of 2.5 was used as the test value. The one-sample t-test shows that all the rated items were less than neutral value. Based on the coding of Likert-scale items, the average values greater than 2.5 meant negative (disagreement) and the average values less than 2.5 meant positive (agreement) toward the item statements or measure of underlying variable. The highest-rated item was that math makes me confused (Mean=2.35, SD=1.666 and $p<0.05$) and the lowest-rated item was that I wish I had not studied math (Mean=2.18, SD= 1.089 and $p<0.05$). Overall, students had a positive perception toward Factor 3: Attitude toward Math (Mean=2.3458, SD=0.69183, and $p<0.05$) (Appendix B).

Factor 4: School and Classroom Environment

A one-sample test was calculated to examine the students' perceptions on items related to Factor 4: School and Classroom Environment. These items had four-point Likert-scale responses from disagree a lot (coded 4) to agree a lot (coded 1), and the neutral value of 2.5 was used as the test value. Based on the coding of Likert-scale items, the average values greater than 2.5 meant negative (disagreement) and the average values less than 2.5 meant positive (agreement) toward the item statements or measure of underlying variable. The one-sample t-test shows that the students had a significantly negative perception toward 1 item that spoke the home language on the math test (Mean= 3.1992, SD=0.98458, and $p<0.05$). However, students expressed positive perceptions toward 8 items: like to see classmates (Mean=1.95, SD=.786 and $p<0.05$), agree to fair teachers (Mean=2.37, SD=0.922 and $p<0.05$), agree being in school (Mean=2.39, SD=.935 and $p<0.05$). Overall, Students had a positive perception toward Factor4: School and Classroom Environment (Mean=2.4005, SD=.63389 and $p<0.05$) (Appendix B).

Factor 5: Internet and Tablet

A one-sample t-test was conducted to examine students' perceptions of Factor 5: the Internet and Tablet items. These items had four-point Likert-scale responses from Never or almost never (coded 4) to Every day or almost every day (coded 1), and the neutral value of 2.5 was used as the test value. The one-sample t-test shows that all the rated items were less than neutral values. Based on the coding of Likert-scale items, the average values greater than 2.5 meant negative (low use of technology) and the average values less than 2.5 meant positive (high use of technology) toward the item statements or measure of underlying variable. The highest-rated item was how often use computer tablet (Mean=2.20, SD=1.78 and $p<0.05$) and lowest rated item internet connection (Mean=1.06, SD= 0.230 and $p<0.05$). Overall, Students had a positive perception toward Factor5: Internet and Tablet (Mean=1.4664, SD=0.24359 and $p<0.05$) (Appendix B). Factor 5: Internet and Tablet align with the Deficit Model on the conceptual framework of this study; for example, the shortage of internet, computers, tablets, and different school resources has a negative impact on students' achievement.

4.4 Factor Analysis of the Math Teacher Questionnaire

A Principal Components Analysis (PCA) was run on a 174-item questionnaire that measured the responses of math teachers in Abu Dhabi public and private schools to provide information about the teachers of eighth-grade students and sought information about the teachers' academic and professional backgrounds, classroom resources, instructional practices, and attitudes toward teaching. The suitability of PCA was assessed before analysis. Inspection of the correlation matrix showed that all variables had one correlation coefficient greater than 0.3. The overall Kaiser-Meyer-Olkin (KMO) measure was 0.882. KMO measures greater than 0.882 have been classified as middling ($0.7 \leq KMO<0.8$), according to Kaiser (1974). Bartlett's Test of Sphericity was statistically significant ($p<0.05$), indicating that the data was likely factorizable (Table 12).

Table 12: KMO and Bartlett's Test

KMO and Bartlett's Test[a]		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.882
Bartlett's Test of Sphericity	Approx. Chi-Square	31679.748
	Df	1936
	Sig.	0.030

a. Based on correlations

PCA revealed five factors with eigenvalues greater than one among the 48 potential factors, but others had a low-reliability coefficient and fewer items loaded with them. The five factors explained 11.112%, 5.857%, 4.047%, 3.527%, and 2.994% of the total variance, respectively. Visual inspection of the scree plot indicated that five components should be retained (Cattell, 1966). In addition, a five-component solution met the interpretability criterion. As such, five components were retained. The five factors were selected based on several criteria. The first criterion is that a change in an eigenvalue of less than one indicates that the component explains less variance than a variable would and hence shouldn't be retained (Table 13). The Scree plot in Figure 3 shows the potentially several components with Eigenvalues greater than one. However, only five components were decided based on their internal reliability coefficient, and the number of items they included, although total variability with these components covered only 27.5% (Table 13).

Table 13: Initial Eigenvalues for PCA for Teacher Questionnaire

	Initial Eigenvalues			**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**		
Component	Total	% of Variance	Cumulative	Total	% Of Var.	Cum.	Total	% Of Var.	Cumulative
1	18.447	11.112	11.112	18.447	11.112	11.112	13.294	8.009	8.009
2	9.723	5.857	16.970	9.723	5.857	16.970	9.274	5.587	13.595
3	6.718	4.047	21.017	6.718	4.047	21.017	9.255	5.575	19.170
4	5.855	3.527	24.543	5.855	3.527	24.543	7.419	4.469	23.640
5	4.971	2.994	27.538	4.971	2.994	27.538	6.471	3.898	27.538
6	4.732	2.851	30.389						
7	4.175	2.515	32.904						
8	4.036	2.431	35.335						

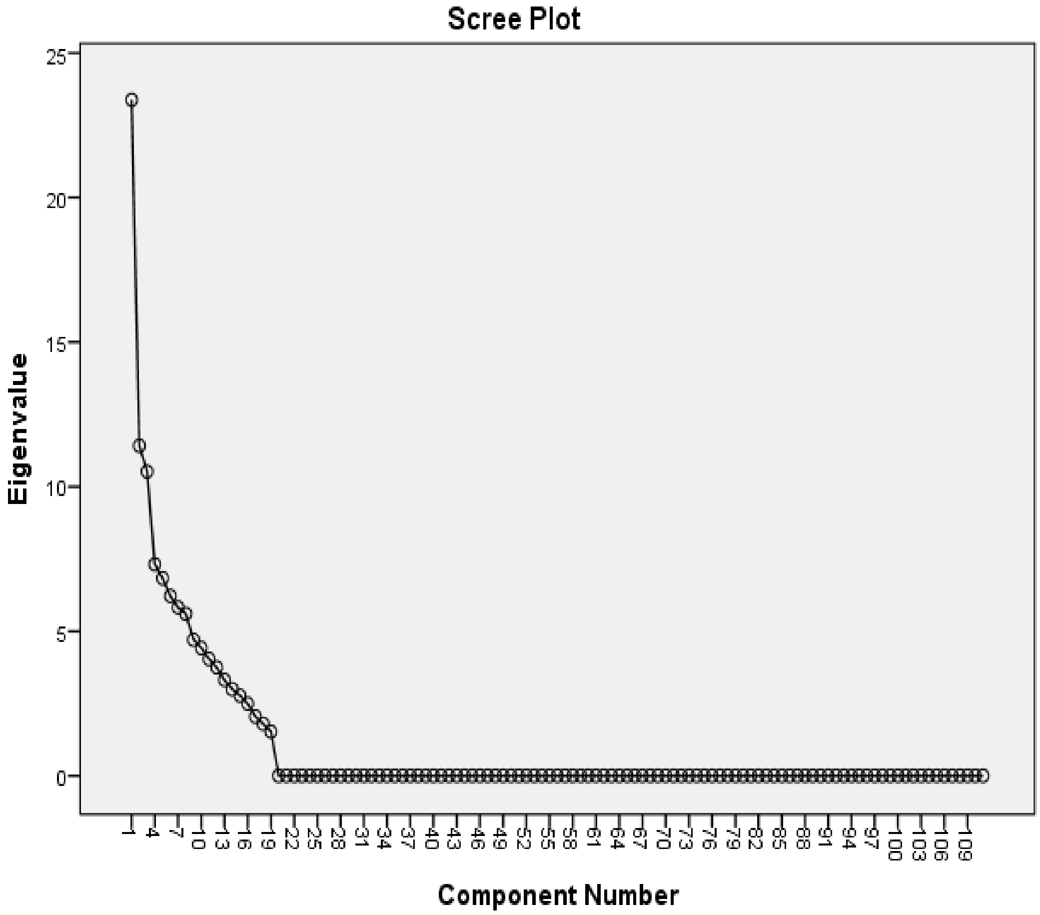

Figure 3: Plot of Eigenvalues from Exploratory Factor Analysis of the Math Teachers Questionnaire Variables

In the current study, the other components from sixth to forty-eighth have an eigenvalue between (4.732 to 1.002). Still, these factors had a low-reliability coefficient and a smaller number of items loaded with them. Therefore, the interpretation is fairly straightforward: components one to five were retained, and the sixth to forty-eighth components were not. The second criterion is based on the cumulative percentage of variance explained by a set number of components, where the first five factors explain less than 50% of the remaining 48 factors. This criterion aims to retain all components that can explain at least 60% or 70% of the total variance. The third criterion is a scree plot; there are 166 components in the scree plot. The components to retain are those before the (last) inflection point of the graph. The inflection point represents where the graph begins to level out, and subsequent components add little to the total variance. In this study, visual inspection of the scree plot would lead to the retention of five components. The fourth criterion is reliability. The study adopted Cronbach's alpha (α) to measure the internal consistency of the scales created; the internal consistency of the 5 components was high to moderate (0.952, 0.918, 0.817, 0.711, 0.772, respectively). The components' items are closely related, so this leads to the retention of five components. The fifth criterion is the interpretability criterion. The interpretability criterion is arguably the most important. It largely revolves around the concept of "simple structure," which is a readily explainable division of variables into separate components.

Extracting five components in this example has allowed the attainment of a simple structure. I reran the Principal Components Analysis, given the preference for extracting five components. Still, this time I forced SPSS Statistics to extract (retain) only five components rather than the default using the eigenvalue-one criterion, which suppressed all coefficients less than 0.3. The five-component solution explained 27.55% of the total variance. A Varimax orthogonal rotation was employed to aid interpretability. The rotated solution exhibited a 'simple structure' (Thurstone, 1947). The questionnaire was designed to measure with strong loadings of items on Factor 1 named as School Emphasis on Academic Success, dependability items on Factor 2 named as Teaching Mathematics to the TIMSS Class, the Factor 3 named as Resources and Time, the Factor 4 named as Mathematics Topics Taught to the TIMSS Class, and the Factor 5 named as Mathematics Assessment of the TIMSS Class (Straub et al., 2004) (Table 14).

Table 14: Mathematics Teachers Questionnaire Factor Analysis and Reliability Statistic

No	Item code	Item	Factor Loading	Cronbach's Alpha	Mathematics teachers' factors
1.	BTBG06O	GEN\CHARACTERIZE\COLLABORATION TO PLAN	.670	.952	
2.	BTBG06I	GEN\CHARACTERIZE\AMOUNT OF INSTR SUPPORT	.648		Factor 1: School Emphasis on Academic Success
3.	BTBM17H	MATH\CONFIDENT\MAKE MATH RELEVANT	.632		
4.	BTBG06N	GEN\CHARACTERIZE\CLARITY OF OBJECTIVES	.609		
5.	BTBG06G	GEN\CHARACTERIZE\PARENTAL COMMITMENT	.599		
6.	BTBG06L	GEN\CHARACTERIZE\ABILITY TO REACH GOALS	.596		
7.	BTBG10E	GEN\HOW FREQUENTLY\INSPIRES	.595		
8.	BTBG06F	GEN\CHARACTERIZE\PARENTAL INVOLVEMENT	.593		
9.	BTBM17E	MATH\CONFIDENT\APPRECIATE MATH	.586		
10	BTBG10F	GEN\HOW FREQUENTLY\PROUD	.578		
11	BTBG10B	GEN\HOW FREQUENTLY\SATISFIED TEACHER	.571		
12	BTBG06K	GEN\CHARACTERIZE\STUDENTS DESIRE	.571		
13	BTBG06Q	GEN\CHARACTERIZE\SUPPORT FOP PROF DEVELOPM	.556		
14	BTBG07H	GEN\THINKING ABT CURR SCH\RULES ENFORCEMENT	.555		
15	BTBG07D	GEN\THINKING ABT CURR SCH\STUD BEHAVE	.554		
16	BTBM17D	MATH\CONFIDENT\ENGAGE STUDENTS INTEREST	.552		
17	BTBG07G	GEN\THINKING ABT CURR SCH\CLEAR RULES	.544		
18	BTBM17G	MATH\CONFIDENT\IMPROVE UNDERSTANDING	.541		
19	BTBG09F	GEN\INTERACTIONS\WORK AS A GROUP	.536		
20	BTBG06E	GEN\CHARACTERIZE\TCHRS ABILITY TO INSPIRE	.532		

Table 14: Mathematics Teachers questionnaire Factor Analysis and Reliability Statistic (continued)

No	Item code	Item	Factor Loading	Cronbach's Alpha	Mathematics teachers' factors
21	BTBM17C	MATH\CONFIDENT\CHALLENGING TASKS	.527		
22	BTBG06M	GEN\CHARACTERIZE\RESPECT FOR CLASSMATES	.509		
23	BTBM17I	MATH\CONFIDENT\DEVELOP HIGHER THINKING	.506		
24	BTBG09C	GEN\INTERACTIONS TEACHERS\SHARE LEARNING	.504		
25	BTBG06C	GEN\CHARACTERIZE\TCHS EXPECTATIONS	.501		
26	BTBG06I	GEN\CHARACTERIZE\PARENTAL SUPPORT	.498		
27	BTBG06J	GEN\CHARACTERIZE\PARENTAL PRESSURE	.492		
28	BTBG10D	GEN\HOW FREQUENTLY\ENTHUSIASTIC	.492		
29	BTBM17F	MATH\CONFIDENT\ASSESS COMPREHENSION	.490		
30	BTBG09G	GEN\INTERACTIONS\CONTINUITY IN LEARNING	.490		
31	BTBG10C	GEN\HOW FREQUENTLY\MEANING AND PURPOSE	.490		
32	BTBG07F	GEN\THINKING ABT CURR SCH\RESPECT PROPERTY	.482		
33	BTBG09E	GEN\INTERACTIONS TEACHERS\WORK TOGETHER	.475		
34	BTBM17B	MATH\CONFIDENT\VARIETY PROBLEM SOLVING STRATEGIES	.463		
35	BTBM17A	MATH\CONFIDENT\INSPIRE STUDENTS	.459		
36	BTBM24D	MATH\PROF DEVELOPMENT\IT	.449		
37	BTBG09B	GEN\INTERACTIONS TEACHERS\COLLABORATE	.446		
38	BTBG06D	GEN\CHARACTERIZE\TCHRS WORKING TOGETHER	.441		
39	BTBG07E	GEN\THINKING ABT CURR SCH\STUD RESPECT	.440		
40	BTBG07C	GEN\THINKING ABT CURR SCH\SECURITY POLICIES	.437		
41	BTBG09A	GEN\INTERACTIONS TEACHERS\DISCUSS TOPIC	.406		
42	BTBG10G	GEN\HOW FREQUENTLY\CONTINUE AS A TEACHER	.403		

Table 14: Mathematics Teachers questionnaire Factor Analysis and Reliability Statistic (continued)

No	Item code	Item	Factor Loading	Cronbach's Alpha	Mathematics teachers' factors
43.	BTBG14A	GEN\HOW OFTEN\DAILY LIVES	.397		
44.	BTBG06A	GEN\CHARACTERIZE\TCHS UNDERSTANDING	.361		
45.	BTBG09D	GEN\INTERACTIONS TEACHERS\VISITS	.353		
46.	BTBG14G	GEN\HOW OFTEN\EXPRESS IDEAS	.334		
47.	BTBG14B	GEN\HOW OFTEN\EXPLAIN ANSWERS	.323		
48.	BTBM20CC	MATH\COMPUTER TABLET ACTIVITIES\LOOK UP IDEAS	.320		
49.	BTBG14D	GEN\HOW OFTEN\CLASSROOM DISCUSSIONS	.313		
50.	BTBG14C	GEN\HOW OFTEN\CHALLENGING EXS	.312		
1.	BTBM26DA	MATH\PREPARED\DATA\CHARACTERISTCS DATA	.680	.918	Factor 2: Teaching Mathematics to the TIMSS Class
2.	BTBM26DB	MATH\PREPARED\DATA\INTERPRETING DATA	.680		
3.	BTBM26AE	MATH\PREPARED\NUMBER\PROBLEM SOLVING	.679		
4.	BTBM26CA	MATH\PREPARED\GEOMETRY\GEOMETRIC PROPERTIES	.658		
5.	BTBM26BB	MATH\PREPARED\ALGEBRA\LINEAR EQUATIONS	.650		
6.	BTBM26BF	MATH\PREPARED\ALGEBRA\PROPERTIES OF FUNCS	.630		
7.	BTBM26AD	MATH\PREPARED\NUMBER\CONCEPT IRRATIONAL NUMS	.626		
8.	BTBM26CD	MATH\PREPARED\GEOMETRY\APP MEASUREMENT	.622		
9.	BTBM26BE	MATH\PREPARED\ALGEBRA\FUNCTIONS	.619		
10	BTBM26BD	MATH\PREPARED\ALGEBRA\NUMERIC	.614		
11	BTBM26BA	MATH\PREPARED\ALGEBRA\SIMPLIFYING	.610		
12	BTBM26DC	MATH\PREPARED\DATA\JUDGING, PREDICTING	.605		
13	BTBM26CB	MATH\PREPARED\GEOMETRY\CONGRUENT FIGURES	.603		
14	BTBM26CF	MATH\PREPARED\GEOMETRY\TRANSLATION	.601		

Table 14: Mathematics Teachers questionnaire Factor Analysis and Reliability Statistic (continued)

No	Item code	Item	Factor Loading	Cronbach's Alpha	Mathematics teachers' factors
15.	BTBM26CC	MATH\PREPARED\GEOMETRY\RELATION BTW SHAPES	.597		
16.	BTBM26AB	MATH\PREPARED\NUMBER\COMPARE ORDER NUMBERS	.591		
17.	BTBM26BC	MATH\PREPARED\ALGEBRA\SIMULTANEOUS EQUATION	.574		
18.	BTBM26CE	MATH\PREPARED\GEOMETRY\CARTESIAN PLANE	.571		
19.	BTBM26AC	MATH\PREPARED\NUMBER\COMPUTING RATIONAL NUMS	.548		
20.	BTBM26AA	MATH\PREPARED\NUMBER\COMPUTING	.547		
1.	BTBG11DRTEACHER	GEN\AGREEMENT\NEED MORE TIME TO PREPARE REVERSE	.732	.817	Factor 3: Resources and Time
2.	BTBG11CRTEACHER	GEN\AGREEMENT\TOO MANY HOURS REVERSE	.723		
3.	BTBG11ERTEACHER	GEN\AGREEMENT\NEED MORE TIME TO ASSIST REVERSE	.611		
4.	BTBG11BRTEACHER	GEN\AGREEMENT\TOO MUCH MATERIAL REVERSE	.519		
5.	BTBG11ARTEACHER	GEN\AGREEMENT\TOO MANY STUDENTS REVERSE	.515		
6.	BTBG08C	GEN\SEVERITY PROBLEM\MATERIAL UNAVAILABLE	.478		
7.	BTBG08F	GEN\SEVERITY PROBLEM\INADEQUATE TECH RESOURCES	.468		
8.	BTBG08E	GEN\SEVERITY PROBLEM\MAINTENANCE WORK	.461		
9.	BTBG08B	GEN\SEVERITY PROBLEM\INADEQUATE WRKSPACE	.440		
10.	BTBG08A	GEN\SEVERITY PROBLEM\BUILDING REPAIR	.384		

Table 14: Mathematics Teachers questionnaire Factor Analysis and Reliability Statistic (continued)

No	Item code	Item	Factor Loading	Cronbach's Alpha	Mathematics teachers' factors
11.	BTBG08G	GEN\SEVERITY PROBLEM\INADEQUATE SUPPORT FOR TECH	.379		
12.	BTBG11HRTEACHER	GEN\AGREEMENT\TOO MANY ADMINISTRATIVE TASKS REVERSE	.373		
13.	BTBG11GRTEACHER	GEN\AGREEMENT\CHANGES IN CURRICULUM REVERSE	.346		
14.	BTBM26CC	MATH\TOPIC\GEOMETRY\RELATION BTW SHAPES	.306		
1.	BTBM21AC	MATH\TOPIC\NUMBER\COMPUTING RATIONAL NUMS	.609	.711	Factor 4: Mathematics Topics Taught to the TIMSS Class
2.	BTBM21CA	MATH\TOPIC\GEOMETRY\GEOMETRIC PROPERTIES	.601		
3.	BTBM21BB	MATH\TOPIC\ALGEBRA\LINEAR EQUATIONS	.565		
4.	BTBM21BA	MATH\TOPIC\ALGEBRA\SIMPLIFYING	.493		
5.	BTBM21CB	MATH\TOPIC\GEOMETRY\CONGRUENT FIGURES	.472		
6.	BTBM25	MATH\<PROF DEVELOPMENT> HOURS	.470		
7.	BTBM21DA	MATH\TOPIC\DATA\CHARACTERISTICS DATA	.456		
8.	BTBM21AD	MATH\TOPIC\NUMBER\CONCEPT IRRATIONAL NUMS	.439		
9.	BTBM21CD	MATH\TOPIC\GEOMETRY\APP MEASUREMENT	.405		
10.	BTBM21AE	MATH\TOPIC\NUMBER\PROBLEM SOLVING	.379		
11.	BTBM21BF	MATH\TOPIC\ALGEBRA\PROPERTIES OF FUNCS	.357		
12.	BTBM21BC	MATH\TOPIC\ALGEBRA\SIMULTANEOUS EQUATION	.322		
13.	BTBM21CE	MATH\TOPIC\GEOMETRY\CARTESIAN PLANE	.318		
14.	BTBM21BE	MATH\TOPIC\ALGEBRA\FUNCTIONS	.311		

Table 14: Mathematics Teachers questionnaire Factor Analysis and Reliability Statistic (continued)

No	Item code	Item	Factor Loading	Cronbach's Alpha	Mathematics teachers' factors
1	BTBG06H	GEN\CHARACTERIZE\PARENTAL EXPECTATIONS	.500	.772	Factor 5: Mathematics Assessment of the TIMSS Class
2	BTBG15E	GEN\LIMIT TEACHING\UNINTERESTED STUDENTS	.471		
3	BTBG15C	GEN\LIMIT TEACHING\LACK OF SLEEP	.453		
4	BTBM20CARTEACHER	MATH\COMPUTER TABLET ACTIVITIES\EXPLORE CONCEPT REVERSE	.421		
5	BTBM22CARTEACHER	MATH\HOMEWORK\CORRECT ASSIGNMENTS REVERSE	.418		
6	BTBG15B	GEN\LIMIT TEACHING\LACK OF NUTRITION	.406		
7	BTBM21CFRTEACHER	MATH\TOPIC\GEOMETRY\TRANSLATION REVERSE	.405		
8	BTBM20CDRTEACHER	MATH\COMPUTER TABLET ACTIVITIES\PROCESS DATA REVERSE	.381		
9	BTBG15A	GEN\LIMIT TEACHING\LACKING KNOWLEDGE	.361		
1	BTBM23ARTEACHER	MATH\EMPHASIS\ASSESSMENT OF WORK REVERSE	.342		
1	BTBM19BCRTEACHER	MATH\HOW OFTEN USE CALC\COMPLEX PROBLEM REVERSE	.314		

Table 14 shows that Factor 1: School Emphasis on Academic Success is a combination of 51 variables coded as BTBG06O, BTBG06I, BTBM17H, etc. The value of Cronbach's alpha (α) for Factor 1 is 0.95, above 0.9, which is considered excellent and acceptable (Cho, 2010). It shows the high internal consistency of the variables within the factor. Therefore, the reliability of Factor 1 within the variables is excellent. For Factor 1: School Emphasis on Academic Success, each component variable loaded moderately high on the underlying factor (loadings between 0.312 and 0.670), indicating that they measure the underlying construct relatively well. The variance in factor 1, explained by the component variables, was 11.112%, which is relatively high for a 51-items scale. Cronbach's alpha was 0.952, providing further evidence that the component items loaded with the factor are valid. These items work well as a unit.

Factor 2: Teaching Mathematics to the TIMSS Class is a combination of 20 variables, i.e., BTBM26DA, BTBM26DB, BTBM26AE, etc. The value of Cronbach's alpha (α) for Factor 2 is 0.91, which is considered excellent and acceptable and is above 0.90 as reported by Bos and Kuiper (1999) and Cho (2010). For Factor 2: Teaching Mathematics to the TIMSS Class, each component variable loaded moderately high on the underlying factor (loadings between 0.547 and 0.680), indicating that they measure the underlying construct relatively well. The percentage of variance in Factor 2 explained by the component variables was 5.857%, which is relatively moderate for a 20-variable scale. Cronbach's alpha was 0.91, providing further evidence that the component variables are valid. These variables work well as a unit.

Factor 3: Resources and Time combines 14 variables, i.e., BTBG11DRTEACHER, BTBG11CRTEACHER, BTBG11ERTEACHER, etc. The value of Cronbach's alpha (α) for Factor 3 Resources and Time is 0.81, which is considered good and acceptable and is above 0.80 (Bos & Kuiper, 1999) and (Cho, 2010). For Factor 3: Resources and Time, each component variable loaded moderately high on the underlying factor (loadings between 0.306 and 0.732), indicating that they measure the underlying construct relatively well. The percentage of variance in Factor 3: explained by the component variables, was 4.047%, which is relatively moderate for a 14-variable scale, and Cronbach's alpha was 0.81, providing further evidence that the component variables are valid. Component variables work well as a unit.

The Factor 4 Mathematics Topics Taught to the TIMSS Class combines 14 variables, i.e., BTBM21AC, BTBM21CA, BTBM21BB, etc. Cronbach's alpha (α) value for Factor 4 Mathematics Topics Taught to the TIMSS Class is 0.71, moderate, and acceptable. It shows the moderate internal consistency of the variables within the factor. For Factor 4 Mathematics Topics Taught to the TIMSS Class, each component variable loaded moderately on the underlying factor (loadings between 0.311 and 0.609), indicating that they measure the underlying construct relatively well. The variance in Factor 4 explained by the component variables was 3.527%, which is relatively low for a 14-variable scale. Cronbach's alpha was 0.711, providing further evidence that the component variables are valid. Component variables work well as a unit.

The Factor 5 Mathematics Assessment of the TIMSS Class is a combination of 11 variables, i.e., BTBG06H, BTBG15E, BTBG15C, etc. The value of Cronbach's alpha (α) for Factor 5 Mathematics Assessment of the TIMSS Class is 0.77, moderate, and acceptable. For Factor 5 Mathematics Assessment of the TIMSS Class, each component variable loaded moderately on the underlying factor (loadings between 0.314 and 0.609), which measures the underlying construct relatively well. The percentage of variance in Factor 5 explained by the component variables was 2.994%, which is relatively low for an 11-variable scale. Cronbach's alpha was 0.77, providing further evidence that the component variables are valid. Component variables work well as a unit.

The factor analysis results show the internal consistency of Factors 1, 2, and 3 is very high (0.95, 0.91, 0.81), and the items in the factor are closely related. The internal consistency of Factor 4 and Factor 5 is moderate (0.71, 0.77) in comparison to the internal consistency of Factors 1, 2, and 3.

Finally, the principal component analysis revealed five factors created throughout the math teacher questionnaire. Factor 1: School Emphasis on Academic Success is a combination of 51 variables coded as BTBG06O, BTBG06I, BTBM17H, etc., Factor 2: Teaching Mathematics to the TIMSS Class is a combination of 20 variables, i.e. BTBM26DA, BTBM26DB, BTBM26AE, etc., Factor 3: Resources and Time combines 14 variables, i.e., BTBG11DRTEACHER, BTBG11CRTEACHER, BTBG11ERTEACHER, etc., Factor 4 Mathematics Topics Taught to the TIMSS Class combines 14 variables, i.e., BTBM21AC, BTBM21CA, BTBM21BB, etc., and The Factor 5 Mathematics Assessment of the TIMSS Class is a combination of 11 variables, i.e., BTBG06H, BTBG15E, BTBG15C, etc. Even though the nature of the math teacher questionnaire was classified into eleven Categories. Category 1: About teacher is consisted of 13 variables, category 2: School Emphasis on Academic Success consisted of 17 variables, category 3: School Environment, a consisted of 15 variables, category 4: About Being a Teacher, a consisted of 22 variables, category 5: About Teaching the TIMSS Class, a consisted of 16 variables, category 6: Teaching Mathematics to the TIMSS Class, a consisted of 20 variables, category 7: Using Calculators and Computers for Teaching, a consisted of 13 variables, category 8: Mathematics Topics Taught to the TIMSS Class, a consisted of 20 variables, category 9: Mathematics Homework for the TIMSS Class, a consisted of 7 variables, category 10: Mathematics Assessment of the TIMSS Class, a consisted of 3 variables, category 11: Preparation to Teach Mathematics, a consisted of 28 variables.

As a result of the factor analysis, five new factors were created throughout the math teacher questionnaire. They were entitled Factor 1: School Emphasis on

Academic Success, Factor 2: Teaching Mathematics to the TIMSS Class, and Factor 3: Time and Resources. Factor 4 was Mathematics Topics Taught to the TIMSS Class, and Factor 5: TIMSS Mathematics Assessment. These factors were used for descriptive analysis and regression analysis to identify the factors most affecting student achievement on TIMSS 2015.

4.5 One-Sample t-test of the Math Teacher Questionnaire

Factor 1: Teacher's School Emphasis on Academic Success

A one-sample test was calculated to examine the perceptions of the teacher on items related to Factor 1: the teacher's School Emphasis on Academic Success. These items had four-point Likert-scale responses from Very Low (coded 5) to Very high (coded 1), and the neutral value of 3 was used as a test value. Based on the coding of Likert-scale items, the average values greater than 3 meant negative (Low) and the average values less than 3 meant positive (High) toward the item statements or measure of underlying variable. The one-sample t-test shows that the math teachers had a significantly positive perception of all items. For example: Parental support for student achievement (Mean=2.76, SD=0.893 and p<0.01), Parental commitment to ensure that students are ready to learn (Mean=2.90, SD=0.893and p<0.01), Students' ability to reach school's academic goals (Mean=2.85, SD=0.717 and p<0.01) and so on. Overall, math teachers had a positive perception toward Factor 1: School emphasis on academic success (Mean=1.8726, SD=.38976 and p<0.01) (Appendix C).

Factor 2: Teaching Mathematics to the TIMSS Class

A one-sample t-test was conducted to examine math teachers' perceptions on items related to Factor 2: Teaching Mathematics to the TIMSS Class. These items had four-point Likert-scale responses from Not well prepared (coded 4) to Prepared (coded 1), and the neutral value of 2.5 was used as the test value. The one-sample t-test shows that all the rated items were less than neutral value. Based on the coding of Likert-scale items, the average values greater than 2.5 meant negative (Not well prepared) and the average values less than 2.5 meant positive (Prepared) toward the item statements or measure of underlying variable. The highest-rated item was "Computing with rational numbers" (fractions, decimals, and integers) (Mean=2.04, SD=0.367 and $p<0.05$) and the lowest-rated item was "Properties of functions (slopes, intercepts, etc.) (Mean=1.80, SD= 0.659 and $p<0.05$). Overall, math teachers had a positive perception toward Factor 2: Teaching Mathematics to the TIMSS Class (Mean=1.9438, SD=0.34356 and $p<0.05$) (Appendix C). This means, the teachers feel that they are prepared for teaching 8th grade mathematics for TIMSS.

Factor 3: Resources and Time

A one-sample test was calculated to examine the perceptions of the teacher on items related to Factor 3: Resources and Time. These items had four-point Likert-scale responses from disagree a lot (coded 4) to agree a lot (coded 1), and the neutral value of 2.5 was used as the test value. The one-sample t-test shows that the math teachers had an overall significant positive perception toward Factor 3: Resources and Time (Mean=2.1362, SD=0.46501, and $p<0.01$). It attained an overall mean of less than 2.5. Also, the one-sample t-test shows that the math teachers had a significantly negative perception toward (I need more time to prepare for class) (Mean=2.6632, SD=0.81835, and $p<0.01$). I have too many teaching hours (Mean=2.6075, SD=0.94953 and $p<0.01$), and I need more time to assist individual students (Mean=3.1943, SD=0.77488 and $p<0.01$) I have too much material to cover in class (Mean=2.7498, SD=0.88896, and p<0.01), There are too many students in the classes (Mean=2.6579, SD=1.03569, and p<0.01). On the other hand, Math teachers had positive perceptions of teachers who lacked adequate instructional materials and supplies (Mean=1.66, SD=0.779, and p 0.01). Likewise, teachers do not have adequate technological resources (Mean=1.60, SD=0.840 and p<0.01), and the school classrooms need maintenance work (Mean=1.64, SD=0.788, and p<0.01). Teachers do not have an adequate workspace (e.g., for preparation, collaboration, or meeting with students) (Mean=1.69, SD=0.819 and p<0.01). Similarly, the school building needs significant repair (Mean=1.71, SD=0.820 and p<0.01), and teachers do not have adequate support for using technology (Mean=1.62, SD=0.768, and p<0.01). In the same line, they opined that they have too many administrative tasks (Mean=2.3874, SD=0.87074, and p<0.01). I have difficulty keeping up with all of the changes to the curriculum (Mean=1.7968, SD=0. 81392and p<0.01) and the relationship between three-dimensional shapes and their two-dimensional representations (Mean=1.89, SD=0.661and p<0.01). Overall, math teachers had a positive perception toward Factor 3: Resources and Time (Mean=2.1362, SD=0.46501 and p<0.05) (Appendix C).

Factor 4: Mathematics Topics Taught to the TIMSS Class

A one-sample t-test was conducted to examine teacher perceptions of Factor 4: Mathematics Topics Taught to the TIMSS Class. These items had three-point Likert-scale responses from Not yet taught or just introduced (coded 3) to Mostly taught before this year (coded 1), and the neutral value of 2.0 was used as the test value.

According to the one-sample t-test, math teachers had a significant negative perception of professional development hours (Mean=3.56, SD=1.406 and p 0.05), function properties (slopes, intercepts, etc.) (Mean=2.45, SD=0.638 and p 0.05), and simultaneous (two-variable) equations (Mean=2.26, SD=0.645 and p 0.05), and so on. However, math teachers had a significant positive perception of four items: computing with rational numbers (fractions, decimals, and integers) (Mean=1.47, SD=0.514, and 0.05), problem-solving involving percent or proportions (Mean=1.73, SD=0.493, and p 0.05), and properties of functions (slopes, intercepts, and so on).Overall, math teachers had a positive perception toward Factor 4: Mathematics Topics Taught to the TIMSS Class \ Math Teachers Factors (Mean=2.4165, SD=0.88074, and $p<0.05$) (Appendix C).

Factor 5: Mathematics Assessment of the TIMSS Class

A one-sample t-test was conducted to examine teachers' perceptions on items related to Factor 5: Mathematics Assessment of the TIMSS Class. The items had a Likert-scale and the neutral values of 2.0, 2.5, and 3.0 were used as test values; the one-sample t-test shows that Math Teachers had a significant negative perception toward 3 items parental expectations for student achievement (Mean=2.51, SD=.873 and $p<0.05$), students suffering from lack of basic nutrition (Mean=1.73, SD=.640 and $p<0.05$) and students suffering from not enough sleep (Mean=1.85, SD=.620 and $p<0.05$), However, Math Teachers expressed significant positive perception toward 8 items explore mathematics principles and concepts (Mean=2.6961, SD= 0.89350 and <0.05), Correct assignments and give feedback to students (Mean=2.6795, SD=.50333 and $p<0.05$) and Process and analyze data (Mean=2.7024, SD=.81201 and $p<0.05$) and so on. Overall, math teachers had a positive perception toward Factor 5: Mathematics Assessment of the TIMSS Class (Mean=2.4165, SD=0.88074, and $p<0.05$) (Appendix C).

4.6 Factor Analysis of the School Questionnaire

A Principal Components Analysis (PCA) was run on a 77-item questionnaire administered to school principals or head teachers to provide information about the school contexts for teaching and learning. The suitability of PCA was assessed before analysis. The rotated component matrix inspection showed that all variables had a one-factor loading coefficient greater than 0.3. The overall Kaiser-Meyer-Olkin (KMO) measure was 0.771. The KMO measures all greater than 0.771 classifications as middling ($0.7 \leq KMO < 0.8$) (Kaiser, 1974). Bartlett's Test of Sphericity was statistically significant ($p<0.05$), indicating that the data was likely factorable. Component loadings and variables of the rotated solution are presented in Table 15.

Table 15: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.771
Bartlett's Test of Sphericity a. Based on correlations	Approx. Chi-Square	24302.067
	Df	1770
	Sig.	0.000

The PCA revealed five factors that had eigenvalues greater than one among the 14 potential factors. Still, the rest of the others had a low-reliability coefficient and the coefficient of items loading, which explained 17.3%, 14.5%, 7.8%, 5.6%, and 4.2% of the total variance. If the first five factors explained most of the variables' variability, they would be a good, more straightforward substitute for all variables. Therefore, I dropped the rest without losing much of the original variability. A visual inspection of the scree plot indicated that five components should be retained (Cattell, 1966). Besides, a five-component solution met the interpretability criterion. As such, five components were included. The five factors were selected based on several criteria. The first criterion was that an eigenvalue of less than one indicates that the component explains less variance than a variable would and hence shouldn't be retained.

Table 16: Exploratory Factor Analysis of School Questionnaire.

Initial Eigenvalues			**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**		
Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
10.392	17.320	17.320	10.392	17.320	17.320	9.154	15.257	15.257
8.710	14.517	31.837	8.710	14.517	31.837	7.162	11.937	27.194
4.713	7.855	39.693	4.713	7.855	39.693	6.991	11.651	38.845
3.383	5.638	45.331	3.383	5.638	45.331	3.586	5.977	44.823
2.538	4.230	49.561	2.538	4.230	49.561	2.843	4.738	49.561
1.928	3.213	52.774						
1.849	3.081	55.855						
1.513	2.522	58.377						

Extraction Method: Principal Component Analysis.

In this study, the other components from sixth to fourteenth have an eigenvalue between 1.928 and 1.132. Still, these factors had a low-reliability coefficient and fewer items loaded with them. Therefore, the interpretation is relatively straightforward: components one to five are retained, and the component from sixth to fourteenth was not. The second criterion is based on the cumulative percentage of variance explained by a set number of components, where the first five factors explain about 50% of the total cumulative variance. The remaining 14 factors in this criterion are to retain all components that can explain at least 60% or 70% of the total variance. Using the lower criterion of 60% would lead to the retention of the first five components (Straub et al., 2004). The third criterion is a scree plot; there are 60 components in the scree plot. The components to retain are those before the (last) inflection point of the graph. The inflection point represents where the graph begins to level out, and subsequent components add little to the total variance (Straub et al., 2004).

In this study, visual inspection of the scree plot would lead to the retention of five components. The fourth criterion is reliability. The study adopted Cronbach's alpha (α) to measure the internal consistency of the scales created; the internal consistency of the five components was high to low (0.94, 0.90, 0.91, 0.572, 0.695). One factor had a low internal reliability coefficient but was near 0.60 and was retained. The components' items were closely related, so this led to the retention of five components. The fifth criterion is the interpretability criterion. The interpretability criterion is arguably the most crucial. It mainly revolves around the concept of "simple structure," which is a readily explainable division of variables into separate components. Extracting five components in this example has allowed the attainment of simple structure, and given the leaning towards extracting five components, re-run the Principal Components Analysis but force SPSS Statistics only to extract (retain) five components instead of the default using the eigenvalue-one criterion and suppress all coefficients less than 0.3 (Straub et al., 2004).

The five-component solution explains approximately 50% of the total variance. A Varimax orthogonal rotation was employed to aid interpretability. The rotated solution exhibited a 'simple structure' (Thurstone, 1947). The interpretation of the data was consistent with the questionnaire designed to measure with strong loadings of items on Factor 1 named as General School Resources, items on Factor 2 named as School Discipline and Safety, Factor 3 named as Parental Support, Factor 4 named as Principal Experience and Education, and Factor 5 named as Library and Instruction Resources.

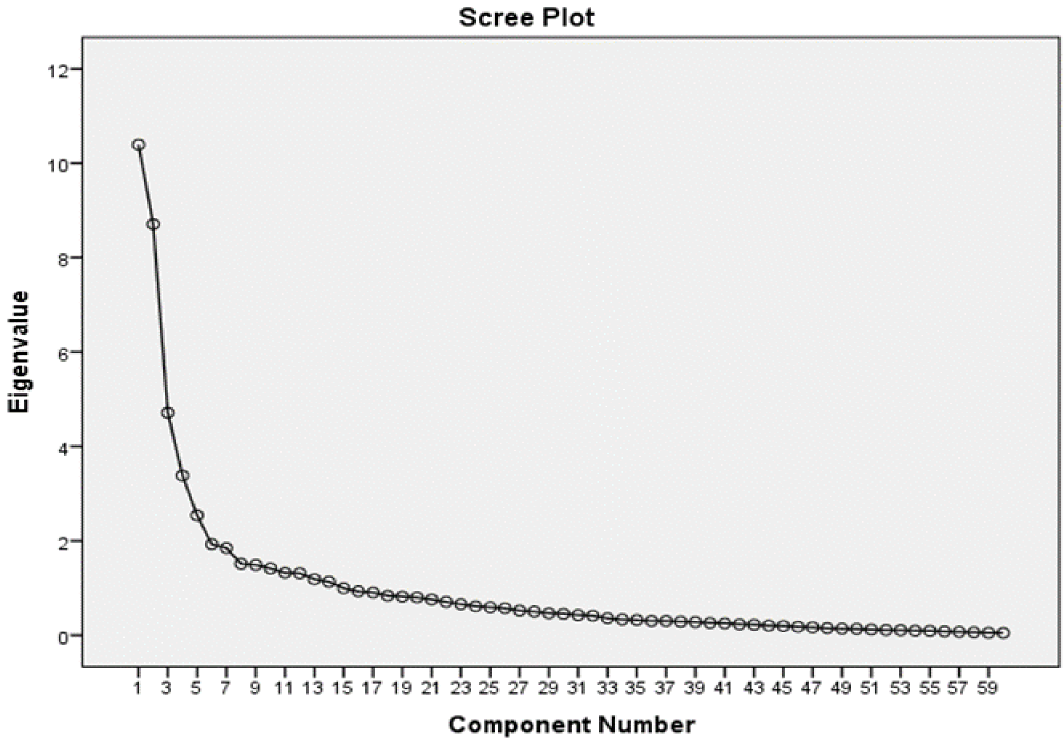

Figure 4: Plot of Eigenvalues from Exploratory Factor Analysis of the School Questionnaire Variables.

Table 17: School Questionnaire Factor Analysis and Reliability Statistics

No	Item code	Item	Loading Factors	Cronbach's Alpha	School Factors
1.	BCBG13AE	Gen\Shortage\Gen\Instructional Space	0.862	0.949	Factor 1: General School Resources
2.	BCBG13AD	Gen\Shortage\Gen\Heating Systems	0.843		
3.	BCBG13AF	Gen\Shortage\Gen\Technological Staff	0.843		
4.	BCBG13AA	Gen\Shortage\Gen\Instructional Material	0.840		
5.	BCBG13AG	Gen\Shortage\Gen\Audio-Video Res	0.837		
6.	BCBG13AC	Gen\Shortage\Gen\School Buildings	0.835		
7.	BCBG13AB	Gen\Shortage\Gen\Supplies	0.821		
8.	BCBG13BE	Gen\Shortage\Math\Concrete Objects	0.809		
9.	BCBG13AH	Gen\Shortage\Gen\Comp Technology	0.806		
10.	BCBG13BA	Gen\Shortage\Math\Teach Spec Math	0.801		
11.	BCBG13BC	Gen\Shortage\Math\Library Resources	0.747		
12.	BCBG13BD	Gen\Shortage\Math\Calculators	0.726		
13.	BCBG13BB	Gen\Shortage\Math\Computer Software	0.639		
14.	BCBG13AI	Gen\Shortage\Gen\Resources Std With Disab	0.431		

Table 17: School Questionnaire Factor Analysis and Reliability Statistics (continued)

No	Item code	Item	Loading Factors	Cronbach's Alpha	School Factors
1.	BCBG15F	Gen\Degree Probs\Vandalism	0.813	0.903	Factor 2: School Discipline and Safety
2.	BCBG15J	Gen\Degree Probs\Intimidation Of Teacher	0.786		
3.	BCBG15G	Gen\Degree Probs\Theft	0.784		
4.	BCBG15E	Gen\Degree Probs\Profanity	0.770		
5.	BCBG15H	Gen\Degree Probs\Intimidation Among Stud	0.737		
6.	BCBG15I	Gen\Degree Probs\Physical Injury	0.728		
7.	BCBG15D	Gen\Degree Probs\Cheating	0.684		
8.	BCBG15C	Gen\Degree Probs\Classroom Disturbance	0.677		
9.	BCBG15A	Gen\Degree Probs\Arriving Late At School	0.664		
10.	BCBG18A	Gen\Degree Probs Teach\Arriving Late At School	0.613		
11.	BCBG18B	Gen\Degree Probs Teach\Absenteeism	0.590		
12.	BCBG15K	Gen\Degree Probs\Physical Injury To Tch	0.585		
1.	BCBG14C	Gen\Sch Character\Tch Expectations	0.834	.917	Factor 3: Parental Support
2.	BCBG14E	Gen\Sch Character\Tchrs Ability To Inspire	0.786		
3.	BCBG14B	Gen\Sch Character\Tch Success	0.780		
4.	BCBG14K	Gen\Sch Character\Std Desire To Do Well	0.744		
5.	BCBG14A	Gen\Sch Character\Tch Understanding	0.732		
6.	BCBG14D	Gen\Sch Character\Tchrs Working Together	0.717		
7.	BCBG14G	Gen\Sch Character\Parental Commitment	0.703		
8.	BCBG14I	Gen\Sch Character\Parental Support	0.653		
9.	BCBG14L	Gen\Sch Character\Ability To Reach Goals	0.652		
10.	BCBG14J	Gen\Sch Character\Parental Pressure	0.628		
11.	BCBG14H	Gen\Sch Character\Parental Expectations	0.626		

Table 17: School Questionnaire Factor Analysis and Reliability Statistics (continued)

No	**Item code**	**Item**	**Loading Factors**	**Cronbach's Alpha**	**School Factors**
1.	BCBG14F	Gen\Sch Character\Parental Involvement	0.583	.572	Factor 4: Principal Experience and Education
2.	BCBG14M	Gen\Sch Character\Respect For Classmates	0.510		
3.	BCBG21RSCHOOL	Gen\Highest Level Of Formal Education (Reverse)	0.692		
4.	BCBG04RSCHOOL	Gen\Percent Of Students <Lang Of Test> (Reverse)	0.680		
5.	BCBG22A	Gen\Degrees In Education Leadership\Isced 7	0.491		
6.	BCBG22B	Gen\Degrees In Education Leadership\Isced 8	0.487		
7.	BCBG03A	Gen\Students Background\Economic Disadva	0.384		
1.	BCBG12BBRSCHOOL	Gen\Magazines In Library\Digital (Reverse)	0.553	.695	Factor 5: Library and Instruction Resources
2.	BCBG03BRSCHOOL	Gen\Students Background\Economic Affluent (Reverse)	0.548		
3.	BCBG12BARSCHOOL	Gen\Magazines In Library\Print (Reverse)	0.536		
4.	BCBG08A	Gen\Have Place For Schoolwork	0.473		
5.	BCBG12ABRSCHOOL	Gen\Books In Library\Digital (Reverse)	0.455		
6.	BCBG12AARSCHOOL	Gen\Books In Library\Print (Reverse)	0.392		
7.	BCBG17A	Gen\Use Incentives\Math	0.300		

(Reverse Item): means that the numerical **scoring** scale runs in the opposite direction. So, in the above items: strongly disagree would be **score** of 5, disagree 4, neutral 3, agree becomes 2, and strongly agree 1.

Table 17 shows that Factor 1: General School Resources combines 14 variables coded as BCBG13AE, BCBG13AE, BCBG13AE, etc. The value of Cronbach's alpha (α) for Factor 1 is 0.949, which is above 0.9 and considered excellent and acceptable (Cho, 2010). It shows the high internal consistency of the variables within the factor. Therefore, the reliability of Factor 1 within the variables is excellent. For Factor 1: General School Resources, each component variable loaded moderately high on the underlying factor (loadings between 0.431 and 0.862), indicating that they measure the underlying construct relatively well. The variance in Factor 1 explained by the component variables was 17.32%, which is relatively high for a 14-items scale.

Cronbach's alpha was 0.949, providing further evidence that the component variables are valid. These items work well as a unit to measure the underlying composite variable named General School Resources.

Factor 2: Discipline and Safety combines 12 variables, i.e., BCBG15F, BCBG15G, BCBG15H, etc. The value of Cronbach's alpha (α) for Factor 2 is 0.903, which is considered excellent and acceptable and is above 0.9 as reported by Bos (1999) and Cho (2010). For Factor 2: Discipline and Safety, each component variable loaded moderately high on the underlying factor (loadings between 0.585 and 0.813), indicating that they measure the underlying construct relatively well. The variance in Factor 2 explained by the component variables was 14.51 percent, which is relatively high for a 12-items scale. Cronbach's alpha was 0.903, providing further evidence that the component items are valid. These items variables work well as a unit to measure the underlying composite variable named Discipline and Safety.

Factor 3: Parental Support combines 13 variables, i.e., BCBG14A, BCBG14D, BCBG14G, etc. The value of Cronbach's alpha (α) for Factor 3 Parental Support is 0.917, which is considered excellent and acceptable and is above 0.9 as reported by Bos (1999) and Cho (2010). For Factor 3 Parental Supports, each component variable loaded moderately on the underlying factor (loadings between 0.300 and 0.553), indicating that they measure the underlying construct relatively well. The percentage of variance in Factor 3 explained by the component variables was 7.855%, which is relatively moderate for a 13-variable scale. Cronbach's alpha was 0.917, providing further evidence that the component variables are valid. The component variables work well as a unit.

Factor 4: Principal Experience and Education combines five variables, i.e., BCBG22A, BCBG22A, BCBG03A, etc. Cronbach's alpha (α) value for Factor 4 experience and education is 0.572, which is low but still acceptable. It shows the high internal consistency of the variables within the factor. For Factor 4: Principal Experience and Education, each component variable loaded moderately on the underlying factor (loadings between 0.384 and 0.692), indicating that they measure the underlying construct relatively well. The percentage of variance in Factor 3 explained by the component variables was 5.638%, which is relatively moderate for a five-variable scale. Cronbach's alpha was 0.572, providing further evidence that the component variables are valid. Component variables work well as a unit.

Factor 5: Library and Instruction Resources combines 7 variables, i.e., BCBG17A, BCBG08A, BCBG03BRSCHOOL, etc. The measure of internal consistency and reliability value of Cronbach's alpha (α) for factor 5 Library and Instruction Resources is 0.695, which is good and acceptable. For Factor 5 Library and Instruction Resources, each component variable loaded moderately on the underlying factor (loadings between 0.300 and 0.553), indicating that they measure the underlying construct relatively well. The percentage of variance in Factor 3 explained by the component variables was 4.230%, which is relatively low for a 7-variable scale. Cronbach's alpha was 0.695, providing further evidence that the component variables are valid. Component variables work well as a unit.

Finally, the principal component analysis revealed five factors created throughout the school questionnaire Factor 1: General School Resources combines 14 variables coded as BCBG13AE, BCBG13AE, BCBG13AE, etc., Factor 2: Discipline and Safety combine 12 variables, i.e., BCBG15F, BCBG15G, BCBG15H, etc., Factor 3: Parental Support combines 13 variables, i.e., BCBG14A, BCBG14D, BCBG14G, etc., Factor 4: Principal Experience and Education combines five variables, i.e., BCBG22A, BCBG22A, BCBG03A, etc., and The Factor 5: Library and Instruction

Resources combines 7 variables, i.e. , BCBG17A, BCBG08A, BCBG03BRSCHOOL, etc. Even though the nature of the school questionnaire was classified into seventh Categories. Category 1: School Enrolment and Characteristics is consisted of 9 variables, Category 2: Instructional Time, consisted of 7 variables, Category 3: Resources and Technology, a consisted of 24 variables, Category 4: School Emphasis on Academic Success, a consisted of 13 variables, Category 5: School Discipline and Safety, a consisted of 11 variables, Category 6: Teachers in Your School, a consisted of 8 variables, Category 7: Principal Experience and Education, a consisted of 5 variables.

The factor analysis results showed the internal consistency of factors 1, 2, and 3 were very high (0.94, 0.90, and 0.91), and the items in the factors were closely related. The internal consistency of factors 4 and 5 was moderate (0.572, 0.695) in comparison to the internal consistency of factors 1, 2, and 3. As a result of the factor analysis, five new factors were created throughout the school questionnaire, which was entitled Factor 1: General School Resources, Factor 2: Discipline and Safety, Factor 3: Parental Support, Factor 4: Principal Experience and Education, and Factor 5: Library and Instruction Resources. These factors were used for descriptive and regression analysis to identify the most common school factors affecting students' achievement in TIMSS 2015.

4.7 One-Sample t-test of the School Questionnaire

Factor 1: General School Resources

A one-sample test was calculated to examine the perceptions of the headmaster on items related to Factor 1: General School Resources. These items had four-point Likert-scale responses from A lot (coded 4) to Not at all (Coded 1), and the neutral value of 2.5 was used as the test value. The one-sample t-test shows that the headmaster had an overall significant negative perception toward Factor1: General School Resources (Mean=2.4165, SD=0.88074 and $p<0.05$) since it attained an overall mean of less than 2.5 with SD=1.302 and $p<0.05$. Their perceptions were negative toward school buildings and grounds, heating/cooling and lighting systems, and computer technology for teaching and learning (e.g., computers or tablets for student use). However, they expressed negative perceptions toward technologically competent staff (Mean=2.34, SD=1.064 and $p<0.05$), instructional materials (e.g., textbooks) (Mean=2.37, SD=1.199 and $p<0.05$), audio-visual resources for delivery of instruction (e.g., interactive whiteboards, digital projectors) (Mean=2.34, SD=1.063 and $p<0.05$), supplies (e.g., papers, pencils, materials) (Mean=2.15, SD=1.186 and $p<0.05$), concrete objects or materials to help students understand quantities or procedures (Mean=2.41, SD=0.936 ad $p<0.05$), Library resources relevant to mathematics instruction (Mean=2.37, SD=0.939 and $p<0.05$) and toward calculators for mathematics instruction (Mean=2.26, SD=1.140 and $p<0.05$). Overall, the headmaster had a negatively perception toward Factor 1: General School Resources (Mean=2.4165, SD=0.88074 and $p<0.05$) (Appendix A). This result aligns with the conceptual framework of this research; for example, the school applies public safety to all students equally, in addition to applying the rules of discipline within the classroom and the school, so that all students in the school are equity in all safety and discipline rules that are positively reflected in the students' achievement.

Factor 2: School Discipline and Safety

A one-sample t-test was conducted to examine the headmaster's perceptions on items related to Factor 2: School Discipline and safety. These items had four-point Likert-scale responses from Serious problem (coded 4) to Not a problem (coded 1), and the neutral value of 2.5 was used as a test value. All the rated items were less than neutral values. The highest-rated item was classroom disturbance (Mean=2.06, SD=0.745 and $p<0.05$) and the lowest rated item was physical injury to teachers or staff (Mean=1.10, SD= 0.403 and $p<0.05$). Overall, the headmaster had a positive perception toward Factor 2: School Discipline and Safety (Mean=1.6013, SD=0.49186 and $p<0.05$) (Table 7). This result aligns with the conceptual framework of this research. The school applies public safety to all students equally, in addition to applying the rules of discipline within the classroom and the school, so that all students in the school are equity in all safety and discipline rules that are positively reflected with the students' achievement. (Appendix A).

Factor 3: Parental Support

A one-sample t-test was conducted to examine the headmaster's perceptions of Factor 3: Parental Support items. These items had five-point Likert-scale responses from strongly disagree (coded 5) to strongly agree (coded 1), and the neutral value of 3.0 was used as the test value. The one-sample t-test shows that the headmaster had an overall significant positive perception toward Factor 3: Parental Support; the highest rated item was parental commitment to ensure that students are ready to learn (Mean=2.06, SD=0.745 and $p<0.05$) and the lowest rated item was students’ respect for classmates who excel in school (Mean=1.85, SD= 0.694 and $p<0.05$), However, the headmaster expressed negative perceptions toward parental involvement in school activities (Mean=3.11, SD=1.040 and $p<0.05$). Overall, the headmaster had a positive perception toward Factor 3: Parental Support (Mean=2.3159, SD=0.55927 and $p<0.05$) (Appendix A).

Factor 4: Principal Experience and Education

A one-sample t-test was conducted to examine the headmaster's perceptions of Factor 3: Parental Support items. These items had five-point Likert-scale responses from strongly disagree (coded 5) to strongly agree (coded 1), and the neutral value of 3.0 was used as the test value. The one-sample t-test shows that the headmaster had an overall significant positive perception toward Factor 3: Parental Support. The highest rated item was parental commitment to ensure that students are ready to learn (Mean=2.06, SD=0.745 and $p<0.05$) and the lowest rated item was students' respect for classmates who excel in school (Mean=1.85, SD= 0.694 and $p<0.05$), However, the headmaster expressed negative perceptions toward parental involvement in school activities (Mean=3.11, SD=1.040 and $p<0.05$). Overall, the headmaster had a positive perception toward Factor 3: Parental Support (Mean=2.3159, SD=0.55927 and $p<0.05$) (Appendix A).

Factor 5: Library and Instructional Resources

A one-Sample t-test was conducted to examine the principals' perceptions on items related to Factor 4: Principal Experience and Education. These items had Likert-scale responses, and the neutral value of 2.5 and 3.0 was used as test value. The one-sample t-test shows that the principal had a significantly positive perception toward approximately what percentage of students in your school have as their native language (Mean=3.71, SD=1.81 and $p<0.05$) and the highest level of formal education they have completed (Mean=2.65, SD=.675 and $p<0.05$). However, the principals expressed negative perceptions on degrees in educational leadership (Mean=1.75, SD= 0.435 and $p<0.05$), GEN\DEGREES IN EDUCATION LEADERSHIP\ISCED8 (Mean=1.93, SD= 0.252 and $p<0.05$). Overall, principal had a negative perception toward Factor 4: Principal Experience and Education (Mean=2.3159, SD=0.55927 and $p<0.05$) (Appendix A).

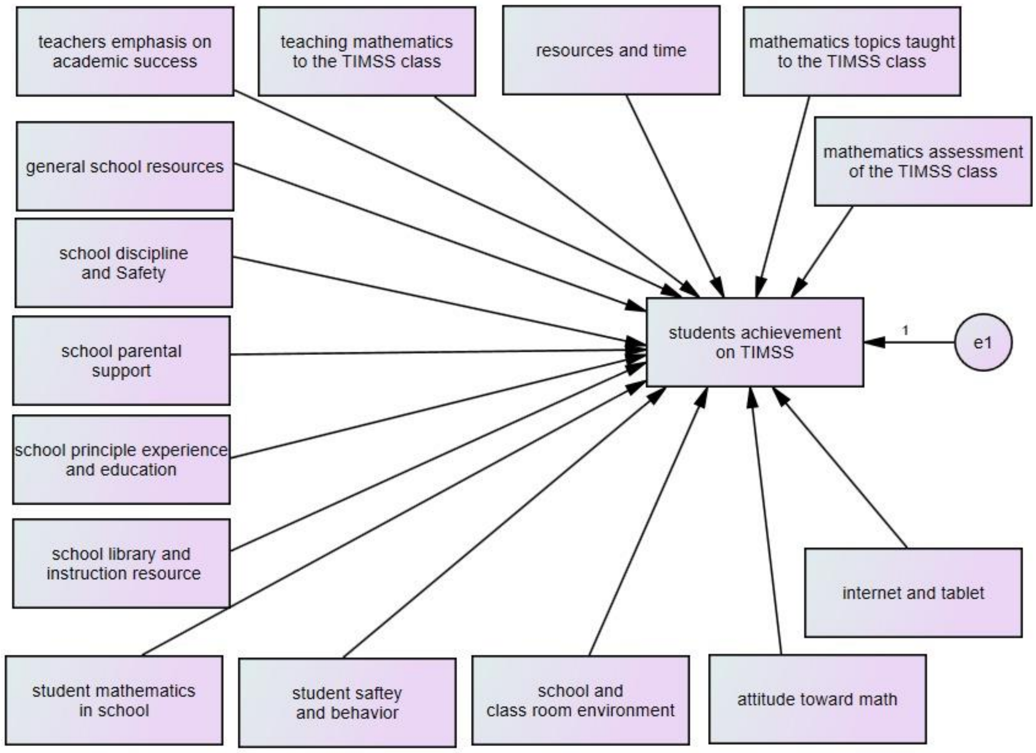

Figure 5: Exploratory Factor Analysis of the School, Students, and Math Teachers Questionnaires (Five School Factors, Five Students' Factors, and Five Math Teachers 'Factors).

4.8 Multiple Regression Models

The analysis in the current study involves multiple regression to investigate the influence of students, math teachers, and school factors on students' achievement in

TIMSS 2015. The student's achievement in TIMSS 2015 was set as the dependent variable, and 15 factors were selected as the independent variables. Those factors included five school factors, five student factors, and five math teacher factors. Multiple regression using the enter method was deemed a suitable analysis method (George & Mallery, 2020). Before conducting the analysis, the relevant assumptions of this statistical analysis were examined. Tests concluded that the data met the premises of no multicollinearity (Coakes, 2009; Hair et al., 2014) and there were no independent errors (Durbin-Watson=1.527).

Further analysis of standard residuals identified that the data obtained had no outliers (Std. Residual Min=-4.159 Std. Residual Max=3.360). Scatter plots demonstrated that the assumptions of linearity and homogeneity were all satisfied (Hair et al., 2014). As all the assumptions remained encountered, the multiple regression analysis with R^2 was commenced; through a fixed order of entry, the extent to which the predictor variables predicted the criterion was determined.

Table 18: One-Way ANOVA

Grades	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	16553.718	5	3310.744	0.361	0.876
Within Groups	266456192.100	29023	9180.863		
Total	266472745.900	29028			

A one-way ANOVA was conducted to determine differences between five plausible values and the average of five plausible values. Student achievement was classified into six groups: first plausible value, second plausible value, third plausible value, fourth plausible value, fifth plausible value, and the average of five plausible values. In that order, there were no outliers. Data were normally distributed for each group, as assessed by the Shapiro-Wilk test (p>.05), and variances were homogeneous, as assessed by Levene's test of homogeneity of variances. In that order, a one-way ANOVA indicated that the differences between all five plausible values and the average of the five plausible value groups were not statistically significant (Table 18).

4.8.1 Model A: Student Factors Multiple Regression

In this analysis, the effects of investigating the impact of student factors (Factor 1: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude toward Math, Factor 4: School and Classroom Environment, Factor 5: Internet and Tablet [Technology]) on students' achievement on TIMSS 2015, a five-stage Multiple Regression with the enter method was deemed a suitable for analysis (George & Mallery, 2020) to determine the level of impacts of these factors (independent variables) on students' achievement in mathematics (dependent variable).

The purpose of multiple regression is to ascertain the variation in the dependent variable by adding new independent variables. Still, multiple regression can also be utilized to calculate dependent variable values centered on new values of the independent variables and estimate the amount of change in the dependent variable when one unit of the independent variable varies. This unit focuses on clarifying the change in dependent while adding new independent variables step by step (Weisberg, 2014).

When explaining and stating findings from multiple regression, we recommend operating through three phases: (a) calculating the regression models that are meant for comparison; (b) deciding as to whether the multiple regression model is best for the information; and (c) comprehending the coefficients in the multiple regression model (Weisberg, 2014).

A separate five-stage multiple regression was conducted to investigate the effect of student factors on students' achievement in TIMSS 2015. Factor 1: Mathematics in School was entered at stage one of the regressions as the main predictors to observe its effects on students' mathematics achievement in TIMSS 2015. Next, Factor 2: Safety and Behavior was entered at stage two. Next, Factor 3: Attitude toward Math was entered at stage three. Next, Factor 4: School and Classroom Environment was entered at stage four, and Factor 5: Internet and Tablets (Technology) was entered at stage five. This order seemed plausible to investigate students' effects on students' achievement on TIMSS 2015 (Table 19).

Table 19: Multiple Regression Analysis Between the Five Factors on Student Achievement in TIMSS

Model	R	R^2	Adjusted R	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R^2 Change	F Change	df1	df2	Sig. F Change	
1	.271	.074	.073	89.04315	.274	.074	1	4751	.000	
2	.360	.130	.129	86.31248	.056	.130	1	4750	.000	
3	.425	.181	.180	83.73885	.051	.181	1	4749	.000	
4	.466	.217	.216	81.89306	.036	.217	1	4748	.000	
5	.478	.228	.228	81.29176	.012	.228	1	4747	.000	1.187

a. Predictors: (Constant), Factor 1: Mathematics in School

b. Predictors: (Constant), Factor 1: Mathematics in School, Factor 2: Safety and Behavior

c. Predictors: (Constant), Factor 1: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude toward Math

d. Predictors: (Constant), Factor 1: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude toward Math, and Factor 4: School and Classroom Environment

e. Predictors: (Constant), Factor 1: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude toward Math, Factor 4: School and Classroom Environment, Factor 5: Internet and Tablet

f. Dependent Variable: Achievement

Note: For step 1: $R= 0.271$ $R^2=0.074$ $\Delta R^2=0.274$, $p<0.01$; for step 2: $R=0.360$ $R^2=0.130$ $\Delta R^2= 0.056$, $p<0.01$; for step 3: $R=0.425$ $R^2=0.181$ $\Delta R^2= 0.051$, $p<0.01$; for step 4: $R=0.466$ $R^2=0.217$ $\Delta R^2= 0.036$, $p<0.01$; for step 5: $R=0.478$ $R^2=0.228$ $\Delta R^2= 0.012$, $p<0.01$.

Before conducting a multiple regression, the relevant assumptions of this statistical analysis were tested. Firstly, a sample size of 4,838 was deemed adequate given five independent variables to be included in the analysis, in which Green (1991) suggested the rule of thumb to determine the number of participants as appropriate via the formula: $N > 50 + 8m$ (where m is the number of independent variables). As per this formula, the minimum sample size required could be a number greater than 90 ($N > 50 + 8(5)$) for a moderate relationship among the one dependent and five independent variables. An examination of correlations revealed a statistically significant correlation between achievement and school factors. However, as the collinearity tests indicated, the data met no multicollinearity assumption (Coakes et al., 2009).

The Multiple Regression revealed that at Model 1, Factor 1: Mathematics in School contributed significantly to the regression model ($F (1, 4751) =377.193$, $p<0.01$) in the prediction of student's achievement on TIMSS 2015 (Model 1) ($R^2=0.074$) and accounted for approximately (7.4%) of the total variance in students' achievement on TIMSS 2015 (Table 19). Adding of Factor 2: Students’ Safety and Behavior to the prediction of achievement (Model 2) was an improvement over the earlier model, which led to a statistically significant increase in R^2 of 0.130, $F (2, 4750) =353.904$, $p<0.01$ since it could account for 13.0% of the total Variance. The addition of Factor 3: Attitude toward Math to the prediction of achievement (Model 3) led to a statistically significant increase in R^2 of 0.181, $F (3, 4749) =349.814$, $p<0.01$ and accounted for 18.1% of the total variance. The addition of Factor 4: Students Mathematics help for Job to the prediction of achievement (Model 4) led to a statistically significant increase in R^2 of 0.217, $F (4, 4748) =328.693$, $p<0.01$ and accounted for 21.7% of the total Variance. The fifth and final model, comprised of five predictor factors (Factor 1: General School Resources, Factor 2: Discipline and

Safety, Factor 3: Parental Support, Factor 4: Principal Experience and Education, and Factor 5: Internet and Tablet), with a prediction of students' achievement on TIMSS 2015 (Model 5) led to a statistically significant increase in R^2 of 0.228, F (5, 4747)=281.159, p<0.01 and accounted for 22.8% of the total variance (Table 20).

Table 20: ANOVA Results of the Five Student Factors - Model- Multiple Regression Analysis

Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
1	Regression	2990644.008	1	2990644.008	377.193	.000
	Residual	37669171.960	4751	7928.683		
	Total	40659815.970	4752			
2	Regression	5273054.696	2	2636527.348	353.904	.000
	Residual	35386761.280	4750	7449.844		
	Total	40659815.970	4752			
3	Regression	7358901.434	3	2452967.145	349.814	.000
	Residual	33300914.540	4749	7012.195		
	Total	40659815.970	4752			
4	Regression	8817484.044	4	2204371.011	328.693	.000
	Residual	31842331.930	4748	6706.473		
	Total	40659815.970	4752			
5	Regression	9289979.042	5	1857995.808	281.159	.000
	Residual	31369836.930	4747	6608.350		
	Total	40659815.970	4752	2990644.008	377.193	

a. Dependent Variable: Achievement

b. Predictors: (Constant), Factor 1: Mathematics in School

c. Predictors: (Constant), Factor 1: Mathematics in School, Factor 2: Safety and Behavior

d. Predictors: (Constant), Factor 1: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude toward Math

e. Predictors: (Constant), Factor 1: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude toward Math, students F4 mathematics help students to get job

f. Predictors: (Constant), Factor 1: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude toward Math, Factor 4: School and Classroom Environment, Factor 5: Internet and Tablet

The ANOVA result in Table 20 gave us the significance of each of the five models (one predictor, two predictors, three predictors, four predictors, and five predictors, respectively). It could be seen that all five models were significant ($p<0.01$). In particular, it was noted that the F value was higher in model 1 with one predictor. The F values were the overall predictive effects, which were different from the F for the amount of change in achievement when adding a variable. The p-value of $0.000<0.01$ for models 1, 2, 3, 4, and 5 implies that the regression model is statistically significant. They indicate a significant linear relationship between students' achievement and mathematics in school, safety and behavior, attitude toward math, school classroom environment, and internet and tablet.

Table 21: ANOVA Results of the Five Student Factors - Model- Multiple Regression Analysis

	Model	**Average of 5 plausible value**		**1ST PLAUSIBLE Value**		**2ND PLAUSIBLE Value**		**3RD PLAUSIBLE Value**		**4TH PLAUSIBLE Value**		**5TH PLAUSIBLE Value**	
		B	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**
	Square	228		212	.	210		207		211		208	.
1	(Constant)	509.511	.000	510.480	.000	509.522	.000	510.363	.000	505.678	.000	511.514	.000
	F1: Mathematics in School	-40.010	.000	-40.336	.000	-40.027	.000	-40.167	.000	-38.875	.000	-40.647	.000
	R Square	.074		.070		.067		.067		.063		.071	
2	(Constant)	398.239	.000	401.470	.000	395.414	.000	398.243	.000	390.434	.000	405.634	.000
	F1: Mathematics in School	-38.888	.000	-39.236	.000	-38.876	.000	-39.037	.000	-37.713	.000	-39.579	.000
	F2: Safety and Behavior	33.577	.000	32.894	.000	34.433	.000	33.833	.000	34.775	.000	31.950	.000
	R Square	.130		.121		.121		.118		.118		.118	
3	(Constant)	482.797	.000	486.775	.000	479.373	.000	482.178	.000	475.208	.000	490.450	.000
	F1: Mathematics in School	-30.068	.000	-30.338	.000	-30.118	.000	-30.281	.000	-28.870	.000	-30.731	.000
	F2: Safety and Behavior	25.548	.000	24.794	.000	26.460	.000	25.863	.000	26.726	.000	23.896	.000
	F3: Attitude toward Math	-32.272	.000	-32.557	.000	-32.043	.000	-32.034	.000	-32.354	.000	-32.370	.000
	R Square	.181		.170		.167		.163		.164		.166	
4	(Constant)	543.551	.000	546.841	.000	539.001	.000	543.882	.000	538.297	.000	549.734	.000
	F1: Mathematics in School	-20.835	.000	-21.209	.000	-21.056	.000	-20.904	.000	-19.282	.000	-21.722	.000
	F2: Safety and Behavior	24.956	.000	24.209	.000	25.879	.000	25.262	.000	26.111	.000	23.318	.000
	F3: Attitude toward Math	-35.327	.000	-35.577	.000	-35.041	.000	-35.137	.000	-35.527	.000	-35.351	.000

Table 21: ANOVA Results of the Five Student Factors - Model- Multiple Regression Analysis. (continued)

	Model	Average of 5 plausible value		1ST PLAUSIBLE Value		2ND PLAUSIBLE Value		3RD PLAUSIBLE Value		4TH PLAUSIBLE Value		5TH PLAUSIBLE Value	
		B	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**
	F4: School and Classroom Environment	-29.050	.000	-28.721	.000	-28.512	.000	-29.505	.000	-30.167	.000	-28.347	.000
	R Square	.217		.202		.198		.197		.200		.198	
5	(Constant)	478.081	.000	485.258	.000	471.245	.000	477.718	.000	469.730	.000	486.454	.000
	F1: Mathematics in School	-20.849	.000	-21.223	.000	-21.071	.000	-20.918	.000	-19.297	.000	-21.736	.000
	F2: Safety and Behavior	24.093	.000	23.398	.000	24.987	.000	24.390	.000	25.208	.000	22.485	.000
	F3: Attitude toward Math	-33.850	.000	-34.189	.000	-33.513	.000	-33.645	.000	-33.980	.000	-33.924	.000
	F4: School and Classroom Environment	-27.395	.000	-27.164	.000	-26.799	.000	-27.832	.000	-28.433	.000	-26.748	.000
	F5: Internet and Tablet	41.497	.000	39.034	.000	42.946	.000	41.937	.000	43.461	.000	40.109	.000
	R Square												

From Table 19, a one-way ANOVA indicates that the differences between all five plausible values and the average of the five plausible value groups were not statistically significant. The results showed that the coefficients for the constant and the five predictors of student achievement on TIMSS 2015 were as follows (based on the Model-5 with all independent variables with average of five plausible values at a time): Constant B=478.081, p=0.000: significant; Mathematics in School B= -20.849, p=0.000: significant; Safety and Behavior B=24.093, p=0.000: significant; Attitude toward Math B=-33.850, p=0.000: significant; School and Classroom Environment B= -27.395, p=0.000: significant ; Internet and Tablet B= 41.497, p=0.000: significant (Table 21). The best-fitting model for predicting students' achievement on TIMSS 2015 from the above analysis would be the linear combination of the constant, Factor 1: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude toward Math, Factor 4: School and Classroom Environment, Factor 5: The Internet and Tablets.

The coefficient estimate table for the Multiple Regression model is expressed as Average Achievement=478.081– 20.849 (Mathematics in School) + 24.093 (Safety and Behavior) – 33.850 (Attitude toward Math) -27.395 (School and Classroom Environment) + 41.497 (Internet and Tablet).

Similar models could be presented for each plausible value of students' achievement in mathematics. This may lead to generation of five parallel models while considering all five factors as independent variables and each plausible value as the dependent variable.

Increase in 1 unit in students' Mathematics in School means when their agreement level goes up by one unit (they disagree more by 1 unit about Mathematics in School), then it has negative effect on their achievement because coefficient (B=-

20.849) is negative and significant ($p<0.05$). Increase in 1 unit in Safety and Behavior means when their agreement level goes up by one unit (they disagree more by 1 unit about Safety and Behavior), then it has negative effect on their achievement because coefficient (B=24.093) is positive and significant ($p<0.05$). Increase in 1 unit in students' Attitude toward Math means when their agreement level goes up by one unit (they disagree more by 1 unit about Safety and Behavior), then it has positive effect on their achievement because coefficient (B=– 33.850) is negative and significant ($p<0.05$). Increase in 1 unit in Students School and Classroom Environment means when their agreement level goes up by one unit (they disagree more by 1 unit about School and Classroom Environment), then it has negative effect on their achievement because coefficient (B=-27.395) is negative and significant ($p<0.05$). Increase in 1 unit in Internet and Tablets means when their agreement level goes up by one unit (they disagree more by 1 unit about Internet and Tablets), then it has negative effect on their achievement because coefficient (B=-27.395) is negative and significant ($p<0.05$).

Besides, p-value=0.000<0.01 for students' Mathematics in School, Safety and Behavior, Attitude toward Math, School, and Classroom Environment, Internet and Tablet, respectively, which implies that factors F1(Mathematics in School) to F5 (Internet and Tablet) are statistically significant, and therefore have a significant impact on achievement. Meanwhile, the variance inflation factor for Factor 1: Mathematics in School to Factor 5: Internet and Tablets are less than 5. This shows no multicollinearity among the explanatory variables that satisfy the assumptions that there should not be multicollinearity.

The histogram and P-P Plot show that the data is approximately normally distributed as there is no perfect normality in practice, which satisfies the normality assumptions. The partial regression plot shows that the scatter points all diffuse out, and no clear pattern satisfies the assumption of constant variance (homoscedasticity). Therefore, there is no evidence of heteroscedasticity.

4.8.1.2 Summary

Multiple Regression was run to determine if the addition of Factor 2: Safety and Behavior, Factor 3: Attitude toward Math, Factor 4: School and Classroom Environment and Factor 5: Internet and Tablet improved the prediction of students' achievement on TIMSS 2015 over and above Factor1: Mathematics in School.

As assessed by partial regression plots and studentized residuals against the predicted values, there was linearity. Residuals were independent, as assessed by a Durbin-Watson statistic of 1.187. There was homoscedasticity as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1 or VIF less than 10. There were no studentized deleted residuals greater than ±3 standard deviations, no leverage values greater than 0.2, and values for Cook's distance above 1. Their assumption of normality was met, as assessed by Q-Q Plot.
The full model (Factors 1 to 5) was administered to predict students' achievement on TIMSS 2015 (Model 5), which was statistically significant, F (5, 4747) =281.159, $p<0.01$).

4.8.2 Model B: Math Teacher Factors Multiple Regression

In this study, to investigate the effects of math teacher-related factors (Factor 1: School Emphasis on Academic Success, Factor 2: Teaching Mathematics for TIMSS, Factor 3: Resources and Time, Factor 4: Mathematics for TIMSS, and Factor 5: Mathematics Assessment for TIMSS) on students' mathematics achievement in

TIMSS 2015, a five-stage multiple regression using the enter method was deemed a suitable method of analysis (George & Mallery, 2020).

The purpose of multiple regression is to ascertain the variation in the dependent variable, clarified by adding new independent variables. Still, multiple regression can also be utilized to calculate dependent variable values centered on the new values of the independent variables and estimate the amount of change in the dependent variable when one unit of the independent variable varies. This unit focuses on the most important objective of making clarifications regarding the dependent variable's proportion while adding new variables that are not dependent.

When explaining and stating findings from multiple regression, we recommend operating through three phases: (a) calculating the regression models that are meant for comparison, (b) deciding as to whether the multiple regression model is best for the information, and (c) comprehending the coefficients in the multiple regression model.

A separate five-stage Multiple Regression analysis was conducted to investigate math teachers' effects on students' achievement on TIMSS 2015. Factor 2: Teaching Mathematics for the TIMSS was entered at stage one of the regressions as the main predictors to observe their effects on students' achievement on the TIMSS 2015. Next, Factor 1: School Emphasis on Academic Success was entered into stage two. Next, Factor 3: Resources and Time, was entered at stage three. Next, Factor 4: Mathematics taught for the TIMSS was entered at stage four, and finally Factor 5: Mathematics Assessment of the TIMSS was entered at stage five. This order seemed plausible to investigate the effects math teachers' factors have on students' achievement on TIMSS 2015 (Table 22).

Table 22: Summary of the Multiple Regression Analysis Between Math Teachers Predictor Factors on Student's Achievement on TIMSS

					Change Statistics					
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**	**Durbin-Watson**
1	.099	.010	0.010	93.20503	0.010	40.667	1	4107	0.000	
2	.099	.010	0.009	90.21375	0.000	0.206	1	4106	0.000	
3	.139	.019	0.019	89.79187	0.009	39.674	1	4105	0.000	
4	.230	.053	0.052	88.24993	0.034	145.702	1	4104	0.000	
5	.315	.099	0.089	86.08377	0.046	210.140	1	4103	0.000	1.163

a. Predictors: (Constant), teachers F2 teaching mathematics to the TIMSS class
b. Predictors: (Constant), teachers F2 teaching mathematics to the TIMSS class, teachers F1 school emphasis on academic success
c. Predictors: (Constant), teachers F2 teaching mathematics to the TIMSS class, teachers F1 school emphasis on academic success, teachers F3 Resources and Time
d. Predictors: (Constant), teachers F2 teaching mathematics to the TIMSS class, teachers F1 school emphasis on academic success, teachers F3 Resources and Time, teachers F4 mathematics topics taught to the TIMSS class
e. Predictors: (Constant), teachers F2 teaching mathematics to the TIMSS class, teachers F1 school emphasis on academic success, teachers F3 Resources and Time, teachers F4 mathematics topics taught to the TIMSS class, teachers F5 mathematics assessment of the TIMSS class
f. Dependent Variable: Achievement

Note: For step 1: R= 0.099 R^2=0.010 ΔR^2=0.010, p<0.01; for step 2: R= 0.099 R^2=0.010 ΔR^2= 0.000, p<0.01; for step 3: R= 0.139 R^2=0.019 ΔR^2= 0.009, p<0.01; for step 4: R= 0.230 R^2=0.053 ΔR^2= 0.034, p<0.01; For step 5: R= 0.315 R^2=0.099 ΔR^2= 0.046, p<0.01.

Before conducting a multiple regression, the relevant assumptions of this statistical analysis were tested. Firstly, a sample size of 4,838 was deemed adequate given five independent variables to be included in the analysis, in which Green (1991) suggested the rule of thumb to determine the number of participants as appropriate via the formula: N > 50 + 8m (where m is the number of independent variables). As per this formula, the minimum sample size required could be a number greater than 90 (N > 50 + 8(5)) for a moderate relationship among the one dependent and five independent variables. An examination of correlations revealed a statistically significant correlation between achievement and school factors. However, as the collinearity tests indicated, the data met no multicollinearity assumption (Coakes et al.,2009).

The Multiple Regression revealed that in Model B, Factor 2: Teaching Mathematics for TIMSS was not significant to the regression model (F (1, 4107)

=0.306, $p>0.01$). The prediction of students' achievement in TIMSS 2015 (Model B) (R^2=0.000), the independent variable Teaching Mathematics for TIMSS did not account for the variance in students' achievement in TIMSS 2015. The addition of Factor 1: School Emphasis on Academic Success to the prediction of achievement (Model B) was an improvement over the earlier model, which led to a statistically significant increase in R^2 of 0.010, F (1, 4106) =34.704, $p<0.01$ since it could account for 1% of the total variance. The addition of Factor 3: Resources and Time to the prediction of achievement (Model 3) led to a statistically significant increase in R^2 of 0.019, F (1, 4105) =40.167, $p<0.01$, and it accounted for 1.9% of the total variance. The addition of factor 4: Mathematics Topics in TIMSS to the prediction of achievement (Model 4) led to a statistically significant increase in R^2 of 0.053, F (1, 4104) =131.698, $p<0.01$, and it accounted for 5.3% of the variance. The fifth and final model, comprised of five predictor factors (Factors 2,3,4,5) in the prediction of a student's achievement in TIMSS 2015 (Model 5), led to a statistically significant increase in R^2 of 0.099, F (1, 4103) =188.441, $p<0.01$ and accounted for 9.9% of the variance.

Table 23: ANOVA Results of the Five Math Teachers – Model- Multiple Regression Analysis

	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2705.806	1	2705.806	0.306	0.580
	Residual	36259783.900	4107	8828.776		
	Total	36262489.710	4108			
2	Regression	306602.156	2	153301.078	17.506	0.000
	Residual	35955887.550	4106	8756.914		
	Total	36262489.710	4108			
3	Regression	655019.033	3	218339.678	25.171	0.000
	Residual	35607470.680	4105	8674.171		
	Total	36262489.710	4108			
4	Regression	1762143.897	4	440535.974	52.404	0.000
	Residual	34500345.810	4104	8406.517		
	Total	36262489.710	4108			
5	Regression	3277083.689	5	655416.738	81.526	0.000
	Residual	32985406.020	4103	8039.339		
	Total	36262489.710	4108			

a. Dependent Variable: Achievement
b. Predictors: (Constant), teachers F2 teaching mathematics to the TIMSS CLASS
c. Predictors: (Constant), teachers F2 teaching mathematics to the TIMSS CLASS, teachers F1 school emphasis on academic success
d. Predictors: (Constant), teachers F2 teaching mathematics to the TIMSS CLASS, teachers F1 school emphasis on academic success, teachers F3 Resources and Time
e. Predictors: (Constant), teachers F2 teaching mathematics to the TIMSS CLASS, teachers F1 school emphasis on academic success, teachers F3 Resources and Time, teachers F4 mathematics topics taught to the TIMSS class
f. Predictors: (Constant), teachers F2 teaching mathematics to the TIMSS CLASS, teachers F1 school emphasis on academic success, teachers F3 Resources and Time, teachers F4 mathematics topics taught to the TIMSS class, teachers F5 mathematics assessment of the TIMSS class

The ANOVA result (Table 23) gave us the significance of each of the five models (one predictor, two predictors, three predictors, four predictors, and five predictors, respectively). It could be seen that all four models (2-5) were significant; ($p<0.01$) except Model 1 ($p>0.01$). In particular, it was noted that the F value was the smallest for the model with five predictors. The F values were the overall predictive effects, which were different from the F for the amount of change in achievement when adding a variable.

The p-value was $0.000 < 0.01$ for models 2, 3, 4, and 5, which implied that the regression model was statistically significant, indicating a significant linear relationship between students' mathematics achievement and F2, F3, F4, and F5 in the teacher-related variables.

Table 24: Summary of Multiple Regression Analysis for Five Math Teachers Predictor Factors on Student's Achievement on TIMSS.

Model	Average of 5 Plausible Value		1ST PLAUSIBLE Value		2ND PLAUSIBLE Value		3RD PLAUSIBLE Value		4TH PLAUSIBLE Value		5TH PLAUSIBLE Value	
	B	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**
(Constant)	426.701	.000	426.463	.000	425.358	.000	428.453	.000	426.308	.000	426.925	.000
F2: Teaching Mathematics for TIMSS	2.105	.609*	2.362	.580*	2.769	.522*	1.547	.721*	1.342	.757*	2.506	.558*
R Square	.000		.000		.000		.000		.000		.000	
(Constant)	470.228	.000	468.205	.000	468.335	.000	475.390	.000	471.378	.000	467.834	.000
F2: Teaching Mathematics for TIMSS	1.861	.650*	2.128	.617*	2.528	.557*	1.284	.766*	1.088	.801*	2.276	.593*
F1: School Emphasis on Academic Success	-23.053	.000	-22.108	.000	-22.761	.000	-24.859	.000	-23.870	.000	-21.666	.000
R Square	.010		.008		.009		.010		.009		.008	
(Constant)	488.892	.000	487.684	.000	488.045	.000	493.837	.000	488.597	.000	486.299	.000
F2: Teaching Mathematics for TIMSS	3.471	.396*	3.808	.369*	4.228	.325*	2.875	.504*	2.574	.551*	3.869	.362*
F1: School Emphasis on Academic Success	-9.591	.022*	-8.058	.064*	-8.545	.052*	-11.553	.009	-11.451	.010	-8.348	.055*
F3: Resources and Time	-21.976	.000	-22.935	.000	-23.207	.000	-21.721	.000	-20.274	.000	-21.741	.000
R Square	.019		.018		.018		.019		.017		.017	
(Constant)	545.899	.000	543.993	.000	544.918	.000	551.443	.000	546.394	.000	542.745	.000
F2: Teaching Mathematics for TIMSS	5.608	.163*	5.919	.156*	6.360	.133*	5.034	.235*	4.740	.264*	5.984	.153*
F1: School Emphasis on Academic Success	-5.185	.210*	-3.706	.388*	-4.149	.340*	-7.100	.103*	-6.983	.110*	-3.985	.354*
F3: Resources and Time	-27.176	.000	-28.072	.000	-28.395	.000	-26.976	.000	-25.546	.000	-26.890	.000
F4: Mathematics for TIMSS	-28.093	.000	-27.749	.000	-28.027	.000	-28.388	.000	-28.483	.000	-27.817	.000
R Square	.053		.049		.049		.050		.048		.047	

Table 24: Summary of Multiple Regression Analysis for Five Math Teachers Predictor Factors on Student's Achievement on TIMSS (continued)

Model	**Average of 5 Plausible Value**		**1ST PLAUSIBLE Value**		**2ND PLAUSIBLE Value**		**3RD PLAUSIBLE Value**		**4TH PLAUSIBLE Value**		**5TH PLAUSIBLE Value**	
	B	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**
(Constant)	625.910	.000	622.911	.000	628.259	.000	632.614	.000	626.155	.000	619.613	.000
F2: Teaching Mathematics for TIMSS	4.635	.237*	4.959	.225*	5.347	.195*	4.047	.328*	3.770	.364*	5.050	.218*
F1: School Emphasis on Academic Success	7.530	.068*	8.835	.040*	9.094	.036*	5.798	.183*	5.691	.193*	8.229	.056*
F3: Resources and Time	-20.494	.000	-21.481	.000	-21.435	.000	-20.197	.000	-18.885	.000	-20.470	.000
F4: Mathematics for TIMSS	-26.260	.000	-25.941	.000	-26.118	.000	-26.528	.000	-26.655	.000	-26.056	.000
F5: Mathematics Assessment for TIMSS	-51.721	.000	-51.014	.000	-53.874	.000	-52.471	.000	-51.559	.000	-49.689	.000
R Square	.099		.090		.094		.093		.089		.087	

*. B is not significant at the 0.01 level (2-tailed).
Dependent Variable: Achievement (5 plausible value mathematics)

From Table 24, the results of regression analysis showed that the coefficients for the constant and the five predictors of students' mathematics achievement in TIMSS 2015 for the average of five plausible values for the full model (model 5) were as follows: Constant B=625.910, p=0.000: significant; F2: Teaching Mathematics for TIMSS B= 4.635, p=.237*: Not significant; F1: School Emphasis on Academic Success B=7.530, p=.068*: Not significant; F3: Resources and Time B=-20.494, p=0.000: significant; F4: Mathematics for TIMSS B= -26.260, p=0.000: significant ; F5: Mathematics Assessment for TIMSS B= -51.721, p=0.000: significant. Likewise, the constants, coefficients, and p-values for the five plausible values are presented in the Table 24.

The best-fitting model for predicting student achievement in TIMSS 2015 from the analysis above would be the linear combination of the constant, Factor 1: School Emphasis on Academic Success, Factor 2: Teaching Mathematics for TIMSS, Factor 3: Resources and Time, Factor 4: Mathematics for TIMSS, Factor 5: Mathematics Assessment of the TIMSS. The coefficient estimate table for the Multiple Regression model is expressed as:

Achievement=625.910 + 7.530 (School Emphasis on Academic Success) + 4.635 (Teaching Mathematics for TIMSS) - 20.494 (Resources and Time) -26.260 (Mathematics for TIMSS) - 51.721 (Mathematics Assessment of the TIMSS).

Similar models could be presented for each plausible value of students' achievement in mathematics. This may lead to generation of five parallel models while considering all five factors as independent variables and each plausible value as the dependent variable.

Increase in 1 unit in School Emphasis on Academic Success means when their agreement level goes up by one unit (they disagree more by 1 unit about School

Emphasis on Academic Success), then it has negative effect on their achievement because coefficient (B=7.530) is negative and significant (p<0.05). Increase in 1 unit in Teaching Mathematics for TIMSS means when their agreement level goes up by one unit (they disagree more by 1 unit about Teaching Mathematics for TIMSS), then it has negative effect on their achievement because coefficient (B=4.635) is negative and significant (p<0.05). Increase in 1 unit in Resources and Time means when their agreement level goes up by one unit (they disagree more by 1 unit about Resources and Time), then it has positive effect on their achievement because coefficient (B=-20.494) is negative and significant (p<0.05). Increase in 1 unit in Students School and Classroom Environment means when their agreement level goes up by one unit (they disagree more by 1 unit about School and Classroom Environment), then it has negative effect on their achievement because coefficient (B=-26.260) is negative and significant (p<0.05). Increase in 1 unit in Internet and Tablets means when their agreement level goes up by one unit (they disagree more by 1 unit about Internet and Tablets), then it has negative effect on their achievement because coefficient (B=-51.721) is negative and significant (p<0.05).

Besides, p-value=.068*>0.01 significant level for teachers F1, p-value=0.237>0.01 significant level for teachers F2 and p-value=0.000<0.01 for teachers F3, teachers F4 and teachers F5 respectively, which implies that teachers F3, teachers F4, and teachers F5 are statistically significant and therefore have a significant impact on achievement while teacher F1 and teachers F2 are not statistically significant. Meanwhile, the variance inflation factor for teachers 1 to 5 is less than 5 (VIF < 5). This shows no multicollinearity among the explanatory variables that satisfy the assumptions that there should not be multicollinearity.

The histogram and P-P Plot show that the data points are well fitted along the regression line. This indicates that the data is approximately normally distributed, which satisfies the normality assumptions.

The partial regression plot shows that the spots are diffused based on the scatterplot output and do not form a clear, specific pattern. Therefore, it can be concluded that the regression model does not occur in the heteroscedasticity problem.

4.8.2.2 Summary

Multiple Regression was run to determine if the addition of Factor 1: School Emphasis on Academic Success, Factor 3: Resources and Time, Factor 4: Mathematics for TIMSS, and Factor 5: Mathematics Assessment for TIMSS improved the prediction of students' achievement on TIMSS 2015 over and above Factor 2: Teaching Mathematics for TIMSS. As assessed by partial regression plots and studentized residuals against the predicted values, there was linearity. Residuals were independent, as assessed by a Durbin-Watson statistic of 1.163. There was homoscedasticity as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater than ±3 standard deviations, no leverage values greater than 0.2, and values for Cook's distance above 1. Their assumption of normality was met, as assessed by the Q-Q Plot.

The full model of (Factor 2: Teaching Mathematics for TIMSS, Factor 1: School Emphasis on Academic Success, Factor 3: Resources and Time, Factor 4: Mathematics for TIMSS, and Factor 5: Mathematics Assessment for TIMSS) to predict students' achievement on TIMSS 2015 (Model 5) was statistically significant, (F (1, 4103) =188.441, $p<0.01$).

4.8.3 Model C: School Factors Multiple Regression

To investigate the effects of school factors (Factor 1: General School Resources, Factor 2: School Discipline and Safety, Factor 3: Parental Support, Factor 4: Principal Experience and Education, and Factor 5: Library and Instruction Resources) on students' achievement on TIMSS 2015, five-stage multiple regression using the enter method was deemed a suitable method of analysis (George & Mallery, 2020).

The purpose of multiple regression is to ascertain the variation in the dependent variable, clarified by the addition of new variables that are not dependent. Still, multiple regression can also be utilized to calculate dependent variable values centered on new values of the variables that are not dependent and estimate the amount of change in the dependent variable when one unit of the independent variable varies. This unit focuses on clarifying the dependent variable's proportion while adding new variables that are not dependent (Weisberg, 2014).

When explaining and stating findings from multiple regression, we recommend operating through three phases: (a) calculating the regression models that are meant for comparison; (b) deciding as to whether the multiple regression model is best for the information; and (c) comprehending the coefficients in the multiple regression model (Weisberg, 2014).

A separate five-stage multiple regression was conducted to investigate school factors' effects on students' achievement on TIMSS 2015. Factor 1: General School Resources was entered at stage one of the regression as the main predictor to observe their effects on students' achievement on TIMSS 2015. Next, Factor 2: Discipline and Safety were entered at stage two. Next, Factor 3: Parental Support, was entered at stage three. Next, Factor 4: Principal Experience and Education, was entered at stage four. Factor 5: Library and Instruction Resources were entered at stage five. This order seemed plausible to investigate school factors' effects on students' achievement on TIMSS 2015 (Table 25).

Table 25: Summary of the Multiple Regression Analysis Between the Five School Predictor Factors on Student' Achievement.

Model	**R**	**R square**	**Adjusted R Square**	**Std. Error of the Estimate**	**Change Statistics**					**Durbin-Watson**
					R Square Change	**F Change**	**df1**	**df2**	**Sig. F Change**	
1	.067	.005	.004	90.94611	.005	19.946	1	4374	.000	
2	.169	.029	.028	89.84590	.024	108.780	1	4373	.000	
3	.297	.088	.088	87.05131	.060	286.277	1	4372	.000	
4	.404	.163	.163	83.40089	.075	392.096	1	4371	.000	
5	.409	.168	.167	83.20074	.004	22.056	1	4370	.000	1.256

a. Predictors: (Constant), Factor 1: General School Resources
b. Predictors: (Constant), Factor 1: General School Resources, Factor 2: Discipline and Safety
c. Predictors: (Constant), Factor 1: General School Resources, Factor 2: School Discipline and Safety, Factor 3: Parental Support
d. Predictors: (Constant), Factor 1: General School Resources, Factor 2: Discipline and Safety, Factor 3: Parental Support, Factor 4: Principal Experience and Education
e. Predictors: (Constant), Factor 1: General School Resources, Factor 2: Discipline and Safety, Factor 3: Parental Support, Factor 4: Principal Experience and Education, Factor 5: Library and Instruction Resources
f. Dependent Variable: Students achievement on TIMSS 2015

Note: For step 1: $R= 0.067$ $R^2=0.005$ $\Delta R^2=0.005$, $p<0.01$; for step 2: $R= 0.169$ $R^2=0.029$ $\Delta R^2= 0.024$, $p<0.01$, for step 3: $R=0.297$ $R^2=0.088$ $\Delta R^2= 0.060$, $p<0.01$, for step 4: $R= 0.404$ $R^2=0.163$ $\Delta R^2= 0.075$, $p<0.01$, for step 5: $R= 0.409$ $R^2=0.168$ $\Delta R^2= 0.004$, $p<0.01$.

Before conducting a multiple regression, the relevant assumptions of this statistical analysis were tested. Firstly, a sample size of 4,838 was deemed adequate given five independent variables to be included in the analysis, in which Green (1991) suggested the rule of thumb to determine the number of participants as appropriate via the formula: $N > 50 + 8m$ (where m is the number of independent variables). As per this formula, the minimum sample size required could be a number greater than 90 ($N > 50 + 8(5)$) for a moderate relationship among the one dependent and five independent variables. An examination of correlations revealed a statistically significant correlation between achievement and school factors. However, as the collinearity tests indicated, the data met no multicollinearity assumption (Coakes et al., 2009).

The Multiple Regression revealed that in Model C, Factor 1: General School Resources contributed significantly to the regression model ($F(1, 4374) = 19.946$, $p<0.01$). The prediction of students' achievement on TIMSS 2015 (Model 1) ($R^2=0.005$) accounted for approximately 0.5% of the total variance in students' achievement on TIMSS 2015. Adding Factor 2: Discipline and Safety to the prediction of achievement (Model 2) was an improvement over the earlier model, which led to a statistically significant increase in R^2 of 0.029, $F(2, 4373) = 64.609$, $p<0.01$ since it could account for 2.9% of the total variance. The addition of Factor 3: Parental Support to the prediction of achievement (Model 3) led to a statistically significant increase in R^2 of 0.088, $F(3, 4372) = 141.308$, $p<0.01$ and accounted for 8.8% of the total variance. The addition of factor 4: Principal Experience and Education to the prediction of achievement (Model 4) led to a statistically significant increase in R^2 of 0.163, $F(4, 4371) = 213.486$, $p<0.01$ and accounted for 16.3% of the total variance. The fifth and final model, comprised of five predictor factors (Factor 1: General School Resources, Factor 2: Discipline and Safety, Factor 3: Parental Support, Factor 4:

Principal Experience and Education, and Factor 5 Library and Instruction Resources), in the prediction of student achievement on TIMSS 2015 (Model 5), led to a statistically significant increase in R^2 of 0.168, F (1, 4370) =176.022, $p<0.01$ and accounted for (16.8%) of the variance.

Table 26: ANOVA Results of the Five School Factors - Model- Multiple Regression Analysis.

Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
1	Regression	164974.787	1	164974.787	19.946	.000
	Residual	36178206.560	4374	8271.195		
	Total	36343181.350	4375			
2	Regression	1043077.960	2	521538.980	64.609	.000
	Residual	35300103.390	4373	8072.285		
	Total	36343181.350	4375			
3	Regression	3212467.878	3	1070822.626	141.308	.000
	Residual	33130713.470	4372	7577.931		
	Total	36343181.350	4375			
4	Regression	5939776.587	4	1484944.147	213.486	.000
	Residual	30403404.760	4371	6955.709		
	Total	36343181.350	4375			
5	Regression	6092453.549	5	1218490.710	176.022	.000
	Residual	30250727.800	4370	6922.363		
	Total	36343181.350	4375			

a. Dependent Variable: Achievement.

b. Predictors: (Constant), Factor 1: General School Resources

c. Predictors: (Constant), Factor 1: General School Resources, Factor 2: Discipline and Safety

d. Predictors: (Constant), Factor 1: General School Resources, Factor 2: Discipline and Safety, Factor 3: Parental Support.

e. Predictors: (Constant), Factor 1: General School Resources, Factor 2: Discipline and Safety, Factor 3: Parental Support, Factor 4: Principal Experience and Education

f. Predictors: (Constant), Factor 1: General School Resources, Factor 2: Discipline and Safety, Factor 3: Parental Support, Factor 4: Principal Experience and Education, Factor 5: Library and Instruction Resources

The ANOVA result (Table 26) gave us the significance of each of the five models (one predictor, two predictors, three predictors, four predictors, and five predictors, respectively). It could be seen that all five models were significant.

($P<0.01$). In particular, it was noted that the F value was the largest for the model with the fourth predictor. The F values were the overall predictive effects, which were different from the F for the amount of change in achievement when adding a variable.

The p-value $0.000 < 0.01$ for modes 1, 2, 3, 4 and 5 implies that the regression model is statistically significant, indicating a significant linear relationship between achievement and General School Resources, School Discipline and Safety, Parental Support, Principal Experience and Education, and Library and Instruction Resources.

Table 27: Summary of Multiple Regression Analysis for Five School Predictor Factors on Students Achievement on TIMSS

Model		**Average of 5 Plausible Value**		**1ST PLAUSIBLE Value**		**2ND PLAUSIBLE Value**		**3RD PLAUSIBLE Value**		**4TH PLAUSIBLE Value**		**5TH PLAUSIBLE Value**	
		B	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**
1	(Constant)	447.294	.000	447.93	0.000	446.021	.000	447.881	0.000	445.434	.000	449.198	.000
	General School Resources	-6.972	.000	-7.131	0.000	-6.431	.000	-6.992	.000	-6.878	.000	-7.429	000
	R Square	.005		.004		.004		.004		.004		.005	
2	(Constant)	488.188	.000	488.33	0.000	487.083	.000	488.564	.000	488.333	.000	488.623	000
	Factor 1: General School Resources	-4.733	.002	-4.918	0.002	-4.182	.010	-4.764	.004	-4.529	.006	-5.270	001
	Factor 2: Discipline and Safety	-28.959	.000	-28.61	0.000	-29.078	.000	-28.809	.000	-30.378	.000	-27.918	000
	R Square	.029		.026		.026		.026		.028		.026	
3	(Constant)	562.567	.000	560.84	0.000	562.200	.000	564.003	.000	562.381	.000	563.404	000
	Factor 1: General School Resources	-6.381	.000	-6.52	0.000	-5.847	.000	-6.436	.000	-6.170	.000	-6.927	000
	Factor 2: Discipline and Safety	-11.308	.000	-11.40	.000	-11.252	.000	-10.906	.000	-12.806	.000	-10.172	001
	Factor 3: Parental Support	-42.687	.000	-41.61	0.000	-43.110	.000	-43.295	.000	-42.497	.000	-42.917	000
	R Square	.088		.079		.081		.081		.081		.082	
4	(Constant)	669.083	.000	667.05	0.000	670.777	.000	671.683	.000	669.531	.000	666.375	000
	Factor 1: General School Resources	-1.376	.349*	-1.535	0.318*	-.745	.631*	-1.377	.379*	-1.135	.467*	-2.089	175*
	Factor 2: Discipline and Safety	-9.157	.001	-9.258	0.001	-9.060	.002	-8.733	.003	-10.642	.000	-8.093	005

Table 27: Summary of Multiple Regression Analysis for Five School Predictor Factors on Students Achievement on TIMSS (continued)

	Model	Average of 5 Plausible Value		1ST PLAUSIBLE Value		2ND PLAUSIBLE Value		3RD PLAUSIBLE Value		4TH PLAUSIBLE Value		5TH PLAUSIBLE Value	
		B	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**
	Factor 3: Parental Support	-43.128	.000	-42.05	0.000	-43.560	.000	-43.741	.000	-42.941	.000	-43.344	000
	F4: Principal Experience and Education	-47.144	.000	-47.00	0.000	-48.056	.000	-47.659	.000	-47.424	.000	-45.574	000
	R Square	.163		.149		.152		.149		.150		.147	
5 5	(Constant)	693.615	.000	692.79	0.000	695.514	.000	695.535	.000	691.471	.000	692.763	000
	Factor 1: General School Resources	-.225	.880*	-0.327	0.833*	.415	.791 *	-.258	.871*	-.106	.947*	-.851	585*
	Factor 2: Discipline and Safety	-9.947	.000	- 10.087	0.000	-9.857	.001	-9.501	.001	-11.349	.000	-8.943	002
	Factor 3: Parental Support	-40.998	.000	- 39.820	0.000	-41.412	.000	-41.670	.000	-41.036	.000	-41.052	000
	F4: Principal Experience and Education	-48.932	.000	- 48.882	0.000	-49.860	.000	-49.398	.000	-49.024	.000	-47.499	000
	F5: Library and Instruction Resources	-9.545	.000	- 10.016	0.000	-9.625	.000	-9.280	.000	-8.536	.000	-10.267	000
	R Square	.167		.153		.156		.153		.153		.151	

*. B is not significant at the 0.01 level (2-tailed).

Dependent Variable: Achievement (5 plausible value mathematics)

General School Resources, Tolerance=0.922, VIF=1.084; Factor 2: Discipline and Safety, Tolerance= 0.848, VIF=1.179; Factor 3: Parental Support, Tolerance=0.839, VIF=1.191; Factor 4: Principal Experience and Education, Tolerance=0.942, VIF=1.061; Factor 5 Library and Instruction, Tolerance=0.927, VIF=1.079. Furthermore, the data met the assumption of independent errors (Durbin-Watson=1.350). An analysis of standard residuals was carried out, which indicated that the data contained no outliers (Std. Residual Min=-3.757, Standard Residual Max=3.853). Residual and scatter plots indicated the assumptions of linearity and homogeneity were all satisfied (Hair et al., 2014).

From Table 19, a one-way ANOVA indicates that the differences between all five plausible values and the average of the five plausible value groups were not statistically significant.

The results showed that the coefficients for the constant and the five predictors of student achievement on TIMSS 2015 were as follows.

(1) Constant average score for B=693.615, p=0.000: significant.

(2) General School Resources B=-0.225, p=0.880*: not significant.

(3) School Discipline and Safety B=-9.947, p=0.000: significant.

(4) School Parental Support B=-40.998, p=0.000: significant.

(5) Principal Experience and Education B=-48.932, p=0.000: significant.

(6) School Library and Instruction Resources B=-9.545, p=0.000: significant.

The best-fitting model for predicting student achievement on TIMSS 2015 from the analysis above would be the linear combination of the constant, Factor 1: General School Resources, Factor 2: Discipline and Safety, Factor 3: Parental support, factor 4: Principal experience and education, and Factor 5: Library and Instruction Resources for instruction.

Achievement in Mathematics=693.615– 0.225 (General School Resources) – 9.947 (School Discipline and Safety) – 40.998 (School Parental Support) – 48.932 (School Principal Experience and Education) – 9.545 (School Library and Instruction Resources).

This model indicates that for every 1 unit increase in General School Resources, the achievement will decline by 0.225, for 1 unit increase in school discipline and safety, the achievement will decline by 9.947, and for 1 unit increase in school parental support, the achievement will decline by 40.998, for 1 unit increase in school principal experience and education, the achievement will decline by 48.932, and for 1 unit increase in the school library and instruction resources, the achievement will decline by 9.545.

Besides, p-value=0.880 > 0.01 is not a significant level for General School Resources, p-value=0.000<0.01 is a significant level for discipline and safety, and p-value=0.000<0.01 for parental support, school principal experience, and education, and school library and instruction resources respectively, which implies that school discipline and safety to the school library and instruction resources are statistically significant and therefore have a significant impact on achievement while General School Resources is not statistically significant. Meanwhile, the variance inflation factor for General School Re-sources to the school library and instruction resources is less than 5. This shows no multicollinearity among the explanatory variables that satisfy the assumptions that there should not be multicollinearity.

Increase in 1 unit in General School Resources means when their agreement level goes up by one unit (they disagree more by 1 unit about General School Resources), then it has negative effect on their achievement because coefficient (B=–0.225) is negative and significant (p<0.05). Increase in 1 unit in school discipline and safety means when their agreement level goes up by one unit (they disagree more by 1 unit about school discipline and safety), then it has negative effect on their achievement because coefficient (B=– 9.947) is negative and significant ($p<0.05$). Increase in 1 unit in school parental support means when their agreement level goes up by one unit (they disagree more by 1 unit about school parental support), then it has positive effect on their achievement because coefficient (B=– 40.998) is negative and significant ($p<0.05$). Increase in 1 unit in school principal experience and education means when their agreement level goes up by one unit (they disagree more by 1 unit about school principal experience and education), then it has negative effect on their achievement because coefficient (B=– 48.932) is negative and significant ($p<0.05$). Increase in 1 unit in school library and instruction resources means when their agreement level goes up by one unit (they disagree more by 1 unit about school library and instruction resources), then it has negative effect on their achievement because coefficient (B=9.545) is negative and significant ($p<0.05$).

Besides, p-value=0.880 > 0.01 not significant level for General School Resources, p-value=0.000<0.01 significant level for discipline and safety and p-value=0.000<0.01 for parental support, school principal experience and education, and school library and instruction resources respectively, which implies that school discipline and safety to the school library and instruction resources are statistically significant and therefore have a significant impact on achievement while General School Resources is not statistically significant. Meanwhile, the Variance inflation factor for General School Resources to the school library and instruction resources is less than 5. This shows no multicollinearity among the explanatory variables that satisfy the assumptions that there should not be multicollinearity.

The histogram and P-P Plots also show that the data points are well fitted along the regression line. This indicates that the data is approximately normally distributed, which satisfies the normality assumptions.

4.8.3.1 Summary

Multiple Regression was run to determine if Factor 2: Discipline and Safety, Factor 3: Parental Support, Factor 4: Principal Experience and Education, and Factor 5 Library and Instruction Resources improved the students' achievement on TIMSS 2015 over above Factor 1: General School Resources.

As assessed by partial regression plots and studentized residuals against the predicted values, there was linearity. Residuals were independent, as evaluated by a Durbin-Watson statistic of 1.256. There was homoscedasticity as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was no evidence of multicollinearity, as evaluated by tolerance values greater than 0.1. There were no studentized deleted residuals greater than ±3 standard deviations, no leverage values greater than 0.2, and values for Cook's distance above 1. Their assumption of normality was met, as assessed by Q-Q Plot.

The full model of (Factor 1: General School Resources, Factor 2: Discipline and Safety, Factor 3: Parental Support, Factor 4: Principal Experience and Education and Factor 5 Library and Instruction Resources) to predict students' achievement on TIMSS 2015 (Model 5) was statistically significant, (F (5, 4370) =176.022, $p<0.01$).

Adding Factor 1: General School Resources contributed significantly to the regression model, (F (1, 4374) =19.446, $p<0.01$) the prediction of student achievement on TIMSS 2015 (Model 1) (R^2=0.004) accounted for approximately (0.4%) of the variance in student achievement on TIMSS 2015.

4.8.4 Model D: School, Students, and Math Teachers Factor in Multiple Regression

To investigate the students, math teachers, and school factors on students' achievement on TIMSS 2015, a separate three-stage Multiple Regression was conducted on their achievement on TIMSS 2015. Three-stages multiple regression using the enter method was deemed a suitable analysis method (George & Mallery, 2020).

Multiple regression aims to ascertain the variation in the dependent variable, which is clarified by adding new variables that are not dependent. Still, multiple regression can also be utilized to calculate dependent variable values centered on new values of the variables that are not dependent and estimate the amount of change in the dependent variable when one unit of the independent variable varies. This unit focuses on the most important aim objective of clarifying the dependent variable's proportion while adding new variables that are not dependent.

When explaining and stating findings from multiple regression, we recommend operating through three phases: (a) calculating the regression models that are meant for comparison, (b) deciding whether the multiple regression model is best for the information, and (c) comprehending the coefficients in the multiple regression model.

A separate three-stage multiple regression analysis was carried out to investigate the effect of school, student, and math teacher factors on TIMSS 2015 student achievement. School factors were entered at stage one of the regressions as the main predictors to observe their effects on students' achievement on TIMSS 2015. Next, the students' factors were entered at stage two. Following that, math teacher related factors were entered at stage three, and this order seemed plausible to investigate the effect of school, student, and math teacher factors on TIMSS 2015 student achievement. [Normally, the order should start from student factors, then teacher factors and school factors. If possible, I would like to encourage you to do this in this order].

Table 28: Summary of the Multiple Regression Analysis Between Three Model School on Students Achievement on TIMSS

Model		Square	R	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	0.375	0.141		0.139	87.00143	0.141	123.985	5	3790	0.000	
2	0.533	0.284		0.283	79.43782	0.143	152.217	5	3785	0.000	
3	0.552	0.305		0.302	78.34155	0.021	22.334	5	3780	0.000	1.388

a. Predictors: (Constant), school F5 library and instruction resources, Factor 2: Discipline and Safety, Factor 4: Principal Experience and Education, Factor 1: General School Resources, Factor 3: Parental Support
b. Predictors: (Constant), school F5 library and instruction resources, Factor 2: Discipline and Safety, Factor 4: Principal Experience and Education, Factor 1: General School Resources, Factor 3: Parental Support, Factor 3: Attitude toward Math, Factor 5: Internet and Tablet, Factor 2: Safety and Behavior, Factor 1: Mathematics in School, students F4 mathematics help students to get job
c. Predictors: (Constant), school F5 library and instruction resources, Factor 2: Discipline and Safety, Factor 4: Principal Experience and Education, Factor 1: General School Resources, Factor 3: Parental Support, Factor 3: Attitude toward Math, Factor 5: Internet and Tablet, Factor 2: Safety and Behavior, Factor 1: Mathematics in School, students F4 mathematics help students to get a job, teachers F2 teaching mathematics to the TIMSS CLASS, teachers F4 mathematics topics taught to the TIMSS class, teachers F1 school emphasis on academic success, teachers F3 Resources and Time, teachers F5 mathematics assessment of the TIMSS class
d. Dependent Variable: Achievement

Before conducting a multiple regression, the relevant assumptions of this statistical analysis were tested. Firstly, a sample size of 4,838 was deemed adequate given five independent variables to be included in the analysis, in which Green (1999) suggested the rule of thumb to determine the number of participants as appropriate via the formula: N > 50 + 8m (where m is the number of independent variables). As per this formula, the minimum sample size required could be a number greater than 90 (N > 50 + 8(5)) for a moderate relationship among the one dependent and five independent variables. An examination of correlations revealed a statistically significant correlation between achievement and school factors. However, as the collinearity tests indicated, the data met no multicollinearity assumption (Coakes et al.,2009).

The Multiple Regression revealed that in Model 1, School Factors (Factor 1: Technology, Factor 2: Discipline and Safety, Factor 3: Parental Support, Factor 4: Principal Experience and Education, and Factor 5: Library and Instruction Resources) contributed significantly to the regression model ($F (5, 3790)=123.985$, $p<0.01$). The prediction of students' achievement on TIMSS 2015 (Model 1) ($R^2=0.141$) accounted for approximately (14.1%) of the variance in students' achievement on TIMSS 2015. Adding of student factors (Factor 1: Mathematics in School, Factor 2: Students' Safety and Behavior, Factor 3: Attitude toward Math, Factor 4: School and Classroom Environment, and Factor 5: Internet and Tablet) to the prediction of achievement (Model 2) was an improvement over the earlier model, which led to a statistically significant increase in R^2 of 0.284, $F (5, 3785)=152.217$, $p<0.01$ since it could account for 28.4% of the total variance. The final statistically significant model comprised three predictor factors (school factors, students' factors, and math teacher factors). Whose prediction of student achievement on TIMSS 2015 (Model 3) led to a statistically significant increase in R^2 of 0.305, $F (5, 3780) =22.334$, $p<0.01$ and accounted for 30.5% of the total variance.

Table 29: ANOVA Results of the Three Model School, Students, and Math Teachers Multiple Regression Analysis

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4692378.094	5	938475.619	123.985	0.000
	Residual	28687450.920	3790	7569.248		
	Total	33379829.020	3795			
2	Regression	9495090.454	10	949509.045	150.468	0.000
	Residual	23884738.560	3785	6310.367		
	Total	33379829.020	3795			
3	Regression	10180463.980	15	678697.599	110.584	0.000
	Residual	23199365.040	3780	6137.398		
	Total	33379829.020	3795			

a. Dependent Variable: Achievement

b. Predictors: (Constant), school F5 library and instruction resources, Factor 2: Discipline and Safety, Factor 4: Principal Experience and Education, Factor 1: General School Resources, Factor 3: Parental Support

c. Predictors: (Constant), school F5 library and instruction resources, Factor 2: Discipline and Safety, Factor 4: Principal Experience and Education, Factor 1: General School Resources, Factor 3: Parental Support, Factor 3: Attitude toward Math, Factor 5: Internet and Tablet, Factor 2: Safety and Behavior, Factor 1: Mathematics in School, students F4 mathematics help students to get a job.

d. Predictors: (Constant), school F5 library and instruction resources, Factor 2: Discipline and Safety, Factor 4: Principal Experience and Education, Factor 1: General School Resources, Factor 3: Parental Support, Factor 3: Attitude toward Math, Factor 5: Internet and Tablet, Factor 2: Safety and Behavior, Factor 1: Mathematics in School, students F4 mathematics help students to get a job, teachers F2 teaching mathematics to the TIMSS CLASS, teachers F4 mathematics topics taught to the TIMSS class, teachers F1 school emphasis on academic success, teachers F3 Resources and Time, teachers F5 mathematics assessment of the TIMSS class

The ANOVA result (Table 29) gave us the significance of each of the three models (one group of predictors, two groups of predictors, and three predictors, respectively). It could be seen that all three models were significant: ($p<0.01$). In particular, it was noted that the F value was the largest for model 2 with five predictors. The F values were the overall predictive effects, which were different from the F for the amount of change in achievement when adding a variable. From the ANOVA test, we can see those models 1, 2, and 3 ($p<0.001$) imply that they are statistically significant and indicate a significant relationship between achievement and school factors, achievement and teacher factors, and achievement and student factors.

Table 30: Summary of Multiple Regression Analysis for Three Model Predictor Factors on Student's Achievement on TIMSS

	Average of 5 Plausible Value		**1ST PLAUSIBLE Value**		**2ND PLAUSIBLE Value**		**3RD PLAUSIBLE Value**		**4TH PLAUSIBLE Value**		**5TH PLAUSIBLE Value**	
Model	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**sig**
(Constant)	678.170	.000	678.630	.000	679.859	.000	680.253	.000	676.364	.000	675.743	.000
School Factor 1: General School Resources	-.179	.910*	-.140	.933*	.387	.817*	-.269	.873*	-.250	.882*	-.623	.708*
School Factor 2: Discipline and Safety	-9.555	.001	-9.506	.002	-9.388	.002	-9.465	.002	-11.070	.000	-8.347	.006
School Factor 3: Parental Support	-39.560	.000	-38.883	.000	-40.572	.000	-39.831	.000	-39.579	.000	-38.934	.000
School F4: Principal Experience and Education	-45.792	.000	-45.613	.000	-46.169	.000	-46.953	.000	-46.100	.000	-44.122	.000
School F5: Library and Instruction Resources	-8.574	.000	-9.433	.000	-8.543	.000	-7.798	.001	-7.365	.002	-9.731	.000
R Square	.153		.141		.143		.142		.140		.135	
(Constant)	676.406	.000	686.209	.000	674.709	.000	674.696	.000	661.452	.000	684.963	.000
School Factor 1: General School Resources	-3.883	.008	-3.770	.014	-3.454	.026	-3.985	.011	-3.968	.011	-4.240	.006
School Factor 2: Discipline and Safety	-6.433	.014*	-6.564	.018*	-6.218	.026*	-6.290	.026*	-7.670	.007*	-5.422	.051*
School Factor 3: Parental Support	-34.878	.000	-34.263	.000	-35.983	.000	-35.155	.000	-34.595	.000	-34.393	.000
School F4: Principal Experience and Education	-41.754	.000	-41.713	.000	-42.769	.000	-42.863	.000	-41.111	.000	-40.313	.000
School F5: Library and Instruction Resources	-8.404	.000	-9.220	.000	-8.589	.000	-7.644	.000	-6.995	.001	-9.572	.000
Students F1: Mathematics in School	-20.379	.000	-21.456	.000	-20.559	.000	-20.063	.000	-19.080	.000	-20.736	.000
Students F2: Safety and Behavior	20.025	.000	19.185	.000	21.194	.000	20.245	.000	21.446	.000	18.055	.000
Students F3: Attitude toward Math	-33.801	.000	-33.945	.000	-33.520	.000	-33.411	.000	-33.558	.000	-34.570	.000
Students F4: School and Classroom Environment	2.058	.403*	2.081	.423*	3.209	.221*	2.063	.435*	.686	.796*	2.253	.388*
Students F5: Internet and Tablet	22.796	.000	20.232	.000	22.259	.000	23.755	.000	25.963	.000	21.769	.000
R Square	.308		.284		.286		.280		.280		.278	

Table 30: Summary of Multiple Regression analysis for three model school, Students and Math Teachers predictor factors on student's achievement on TIMSS 2015 (continued)

	Average of 5 Plausible Value		**1ST PLAUSIBLE Value**		**2ND PLAUSIBLE Value**		**3RD PLAUSIBLE Value**		**4TH PLAUSIBLE Value**		**5TH PLAUSIBLE Value**	
Model	B	**Sig**	B	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**
(Constant)	742.553	.000	750.125	.000	742.520	.000	743.441	.000	728.237	.000	748.442	.000
School Factor 1: General School Resources	-3.282	.029*	-3.127	.048*	-2.602	.103*	-3.541	.028*	-3.391	.036*	-3.750	.019*
School Factor 2: Discipline and Safety	-8.188	.003	-8.329	.004	-8.302	.004	-7.773	.008	-9.533	.001	-7.004	.015
School Factor 3: Parental Support	-32.404	.000	-31.846	.000	-33.097	.000	-32.702	.000	-32.184	.000	-32.193	.000
School F4: Principal Experience and Education	-30.191	.000	-30.126	.000	-30.674	.000	-31.354	.000	-29.864	.000	-28.939	.000
School F5: Library and Instruction Resources	-9.038	.000	-9.784	.000	-9.152	.000	-8.339	.000	-7.734	.000	-10.180	.000
Students F1: Mathematics in School	-21.693	.000	-22.817	.000	-21.942	.000	-21.238	.000	-20.413	.000	-22.058	.000
Students F2: Safety and Behavior	17.712	.000	16.845	.000	18.879	.000	18.008	.000	19.129	.000	15.697	.000
Students F3: Attitude toward Math	-33.299	.000	-33.420	.000	-33.055	.000	-32.906	.000	-33.091	.000	-34.022	.000
Students F4: School and Classroom Environment	5.719	.020*	5.743	.028*	7.137	.007*	5.662	.033*	4.273	.109*	5.783	.027*
Students F5: Internet and Tablet	21.627	.000	19.208	.000	20.810	.000	22.527	.000	24.713	.000	20.878	.000
Teachers F1: School Emphasis on Academic Success	7.343	.058*	8.842	.031*	9.001	.029*	4.989	.232*	6.190	.139*	7.694	.062*
Teachers F2: Teaching Mathematics for TIMSS	3.469	.322*	3.997	.280*	3.320	.374*	2.913	.440*	2.904	.443*	4.209	.258*
Teachers F3: Resources and Time	-12.053	.000	-13.021	.000	-12.632	.000	-11.459	.001	-10.541	.002	-12.613	.000
Teachers F4: Mathematics for TIMSS	-19.917	.000	-20.011	.000	-19.735	.000	-19.638	.000	-19.971	.000	-20.231	.000
Teachers F5: Mathematics Assessment for TIMSS	-21.536	.000	-21.378	.000	-24.209	.000	-21.100	.000	-20.927	.000	-20.066	.000
R Square	.330		.305		.307		.300		.299		.298	

*. B is not significant at the 0.01 level (2-tailed).
Dependent Variable: Achievement (5 plausible value mathematics)

From Table 19, a one-way ANOVA indicates that the differences between all five plausible values and the average of the five plausible value groups were not statistically significant. The results show that the coefficients for the constant and the five predictors of student achievement on TIMSS 2015 were as follows; first, the constant B=742.553, p=.000, significant; school F1: General School Resources B=-3.282, p=0.029: not significant; factor 3: Parental Support B=-32.404, p=0.000: significant; Factor 4: Principal Experience and Education B=5.719, p=0.000: significant; school F5: library and instruction resources B=-9.038, p=0.000: significant.

Secondly, the Factor 1: Mathematics in School B=-21.693, p=0.000: significant; Factor 2: Safety and Behavior B=17.712, p=0.000; significant; Factor 3: Attitude toward Math B=-33.299, p=0.000: significant; Factor 4: School and Classroom Environment B=5.719, p=0.020; not significant; Factor 5: Internet and Tablet B=21.627, p=0.000: significant.

Thirdly, Teachers F1: School Emphasis on Academic Success B=7.343, p=.058: Not significant; Teachers F2: TIMSS Mathematics Teaching B=3.469, p=.322: Not significant; Teachers F3: Resources and Time B=-12.053, p=0.000: significant; Teachers F4: TIMSS Mathematics B=-19.917, p=0.000: significant; Teachers F5: TIMSS Mathematics Assessment B=-21.536, p=0.000: significant.

The best-fitting model for predicting students' achievement on TIMSS 2015 from the analysis above would be the linear combination of the constant, School Model (Factor 1: General School Resources, Factor 2: Discipline and Safety, Factor 3: Parental support, Factor 4: Principal experience and education, Factor 5: library and instruction resources). The Students Model (Factor 1: mathematics in school, Factor 2: Safety and Behavior, Factor 3: Attitude toward Math, factor 4: School and

Classroom Environment, and Factor 5: Internet and Tablet are also fitting to predict Students Achievement on TIMSS 2015 from the analysis. Additionally, the Math Teachers Model (Factor 1: School Emphasis on Academic Success, Factor 2: Teaching Mathematics for TIMSS, Factor 3: Resources and Time, Factor 4: Mathematics for TIMSS, and Factor 5: Mathematics Assessment for TIMSS.

The Model is:

Ŷ (Students' Achievement TIMSS 2015)=B0 + B1 (Factor 1: General School Resources) + B2 (Factor 2: Discipline and Safety) + B3 (Factor 3: Parental support) + B4 (factor 4: Principal experience and education) + B5 (Factor 5: library and instruction resources) +B6 (Factor 1: mathematics in school) + B7 (Factor 2: Students Safety and Behavior) + B8 (Factor 3: Attitude toward Math) + B9 (Factor 4: School and Classroom Environment) + B10 (factor 5 Internet and Tablet) + B11 (Factor 1: School Emphasis on Academic Success) + B12 (Factor 2: Teaching Mathematics for TIMSS) + B13 (Factor 3: Resources and Time) + B14 (Factor 4: Mathematics for TIMSS) + B15 (Factor 5 Mathematics Assessment for TIMSS).

From the coefficient estimate Table 16, the multiple regression model can be written as Students' Achievement TIMSS 2015=742.553 - 3.282 (Factor 1: General School Resources) -8.188 (school F2) - 32.404 (school F3) +5.719 (school F4) -9.038 (school F5) - 21.693 (students F1) + 17.712 (students F2) - 33.299 (students F3) + 5.719 (students F4) - 21.536 (studentsF5) +7.343 (teachers F1) + 3.469 (teachers F2) - 12.053 (teachers F3) - 19.917 (teachers F4) - 21.536 (teachers F5).

Similar models could be presented for each plausible value of students' achievement in mathematics. This may lead to generation of five parallel models while considering all five factors as independent variables and each plausible value as the dependent variable.

More so, students' F1 to F3 and students' F5 p-values are less than 0.05 significant level. Teachers' F3 to F5 p-values are less than 0.05 significant level, and Factor 1: General School Resources to School F5 p-value is less than 0.05 significant level. In contrast, students' F4, teachers' F1, and F2 p-values are greater than the 0.05 significant level. Students F1 to F3 and F5, teachers F3 to F5, and Factor 1: General School Resources to school F5 are statistically significant and significantly impact achievement. In contrast, students F4, teachers F1, and F2 are not statistically significant. The VIF for Factor 1: General School Resources to school F5, students F1 to students F5, and teachers F1 to teachers F5 is less than 5. This implies no multicollinearity problem, which satisfies the assumption that there should be no multicollinearity between two or more independent variables.

However, the histogram and P-P plot of regression standardized residuals show that the residual error is approximately normally distributed, which satisfies the assumption that residual error should be approximately normally distributed. The partial regression plot of achievement against schools, students, and teachers shows that the spots are diffused and do not form a clear, specific pattern. Therefore, it can be deduced that the regression model does not possess a heteroscedasticity problem.

4.8.4.1 Summary

Multiple regression was used to see if adding student factors, followed by math teacher factors, would improve the prediction of student achievement in TIMSS 2015 over and above school factors.

As assessed by partial regression plots and studentized residuals against the predicted values, there was linearity. Residuals were independent, as assessed by a Durbin-Watson statistic of 1.388. There was homoscedasticity as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater than ±3 standard deviations, no leverage values greater than 0.2, and values for Cook's distance above 1. The assumption of normality was met, as assessed by the Q-Q Plot.

The full model of school, students, and math teachers' factors to predict students' achievement on TIMSS 2015 (Model 3) was statistically significant, (Model 1) $R^2=0.141$, ($F (5, 3790) =123.985$, $p<0.01$). The addition of students' factors to the prediction of a student's achievement on TIMSS 2015 (Model 2) led to a statistically significant increase in $R^2=0.284$, $F (5, 3785) =152.217$, $p<0.01$. The addition of Math Teachers factors to the prediction of students' achievement on TIMSS 2015 (Model 3) also led to a statistically significant increase in $R^2=0.305$, $F (5, 3780) =22.334$, $p<0.01$.

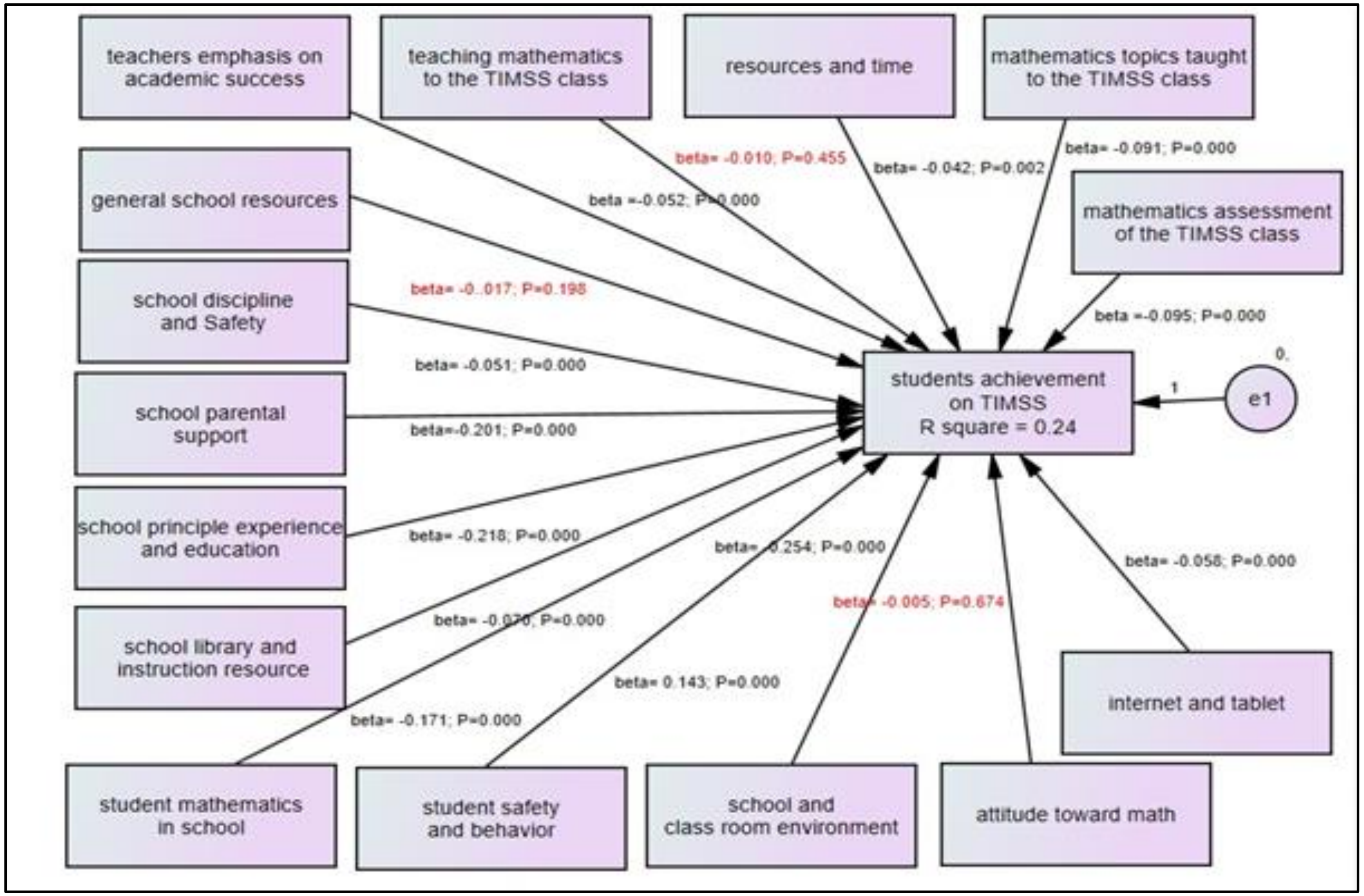

Figure 6: Hierarchical Multiple Regression Results for School Factors, Student Factors, and Math Teacher Factors on TIMSS 2015.

4.9 Mathematics Teacher' Perception of TIMSS in Abu Dhabi Emirate Schools

The study used a quantitative approach to measure mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools. The data was collected using a questionnaire consisting of 30 statements on a 5-point Likert scale. This cross-section survey was used to study math teachers’ perceptions, attitudes, and opinions on TIMSS.

4.9.1 Research Tool

A questionnaire was developed by the authors after a thorough review of the existing literature on teachers’ perceptions of math education in the context of TIMSS. A pilot study with an exploratory sample of sixteen teachers (none of whom participated in the main study) was carried out in order to establish the psychometric properties of the survey. To ensure the survey’s validity, six faculty members specializing in mathematics education and familiar with the conceptual framework of TIMSS were asked to check the instrument’s relevance to the study. Further modifications were performed, such as item rewording, deleting, and reframing. Using Cronbach’s Alpha, the survey’s reliability was found to be 0.93, indicating high reliability and a high internal consistency level. The final draft consisted of demographic information about the respondents’ gender, years of teaching experience, level of education (Bachelor’s degree, Master’s degree, or PhD), and whether the teacher was teaching math in an Abu Dhabi Emirate school. Teachers’ perceptions were measured using a four-dimensional scale (Dimension 1: Mathematics Teachers Practices and TIMSS, eight items; Dimension 2: Mathematics and Instruction, eight items; Dimension 3: Readiness of Students for TIMSS, eight items; and Dimension 4: School and Classroom Environment, six items). The questionnaire was based on a 5 point-Likert scale from Strongly Disagree (coded as 1), Disagree (coded as 2), Neutral (coded as 3), Agree (coded as 4), and Strongly Agree (coded as 5) (Altakhaineh & Alnamer, 2018).

4.9.2 Procedure

The researcher applied for ethical approval from the Research Ethics Committee of the United Arab Emirates University to conduct the study. Following receipt of the ethical approval to conduct the study, the questionnaire was converted into an online survey using Google Forms. The Abu Dhabi mathematics teachers' network was used to circulate the questionnaire as there was no possibility of visiting the schools because of restrictions related to the COVID-19 pandemic. The online questionnaire included a brief introduction of the study, its purpose, and informed consent notifying the participants of their rights regarding voluntary participation in the study. The potential respondents were provided with a reminder after a week requesting, they respond to the survey. Within a two-week period, a total of 522 teachers responded to the online questionnaire.

4.9.3 Population and Sampling

The population of mathematics teachers consisted of the total number of the full-time Mathematics teachers teaching mathematics at the grade 8 level in Abu Dhabi in the academic year 2020–2021. A total sample of 522 mathematics teachers (244 male and 278 female) voluntarily participated in this study out of 3297 (female 2391 and 906 male) mathematics teachers from about 449 schools in Abu Dhabi (El Afi, 2019; Ministry of Education, 2020). These numbers were estimated from the Ministry of Education data of mathematics teachers in Abu Dhabi and Government of Abu

Dhabi data insights. This makes the sample proportion of about 15.83% of the population of mathematics teachers (although we have no information about how many mathematics teachers might have received the online questionnaire, as it was distributed through the private emails and social media groups of mathematics teachers (Altakhaineh & Alnamer, 2018).

4.9.4 Data Analysis

Descriptive statistic data was utilized to address the first question. The last five research questions were explored by comparing the differences between subsamples. They used a one-sample t-test, an independent sample test, and a one-way ANOVA. Teachers' perceptions in different groups were categorized by gender, teaching experience, and educational background. In this section, participants' background information is initially presented by gender, teacher's qualification, teacher's experience, school type, and region, as illustrated in Table 31. This section summarizes the findings according to the research questions.

Table 31: The Distribution of Teachers Demographics.

Demographic Information		**Frequency**	**Percent %**
Gender	Male	244	46.7
	Female	278	53.3
	Total	522	100
Teacher's qualification	Bachelor's degree	298	57.1
	Master's degree	208	39.8
	Ph.D. degree	16	3.1
	Total	522	100
Teacher's experience	Less than 5 years	40	7.7
	Between 6 to 10 years	40	7.7
	Between 11 to 15 years	226	43.3
	16 years and above	216	41.4
	Total	522	100
School Type	Public	284	22.3
	Private	238	18.7
The Region	Abu Dhabi	198	37.9
	Alain	275	52.7
	Al Dhafrah	49	9.4
	Total	522	100

The demographic information shows that male respondents represented 46.7%, while females represented 53.3%. Teacher qualifications shows that respondents with a Bachelor’s degree represented 57.1%, those with a Master’s degree represented 39.8%, and those with a Ph.D. degree represented 3.1%. Meanwhile, teacher experience shows that respondents with less than 5 years’ experience represented 7.7%, respondents with between 6 to 10 years’ experience accounted for 7.7%, respondents with between 11 to 15 years’ experience represented 43.3%, and those with 16 years’ experience and above represented 41.4%. The school type shows that public school respondents represented 22.3%, while private school respondents represented 18.7%. The region reveals that respondents in Abu Dhabi represented 37.9%, respondents in Alain represented 52.7%, and respondents in Al Dhafrah represented 9.4%.

Research Questions: What are the mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?

The means of four domains were calculated to interpret the overall perceptions of mathematics teachers concerning their practices, instruction, classroom environment, and student readiness on TIMSS in Abu Dhabi Emirate schools (Table 32).

Table 32: The Means and Standard Deviations of the Mathematics Teachers Perception.

NO	Rank	Domain	Frequency	Mean	Standard deviation
1	3	Dimension 1: Mathematics Teachers Practices and TIMSS	522	2.8563	0.57635
2	1	Dimension 2: Mathematics and Instruction	522	3.1655	0.41772
3	4	Dimension 3: Readiness of Students for TIMSS	522	2.7160	0.43479
4	2	Dimension 4: School and Classroom Environment	522	2.9633	0.58994

The teacher’s perception of "Mathematics and Instruction" has the highest mean of 3.1655 and the least standard deviation of 0.41772, meaning that the respondent’s perception of "Mathematics and Instruction" has the highest perception with the least variability. In contrast, teachers’ perception of the "readiness of students for TIMSS" has the lowest mean value of 2.716. Teachers’ perception of "school and classroom environment" has the highest standard deviation of 0.58994, which means that respondents to a level of teacher's perception of school and classroom environment (Dimension 4) have high variability or dispersion from the mean. The higher the standard deviation, the higher the variability, and the lower the standard deviation, the lower the variability. We can say that Dimension 2, being the level of the teacher's perception of mathematics and instruction, is the best, based on its highest mean value and least standard deviation.

Research Questions: Are there positive or negative mathematics teachers' perceptions about TIMSS in Abu Dhabi Emirate Schools?

To examine whether there are positive or negative perceptions in mathematics teachers about TIMSS in Abu Dhabi Emirate Schools, a one-sample t-test was conducted for each item's dimensions, illustrated in Table 36, Table 37, Table 38, and Table 39. Figure 7 shows the distribution of average item scores.

Dimension 1: Mathematics Teachers' Practices and TIMSS

A one-sample t-test was conducted to examine teachers' perceptions of Dimensions 1: Mathematics Teacher Practices for TIMSS (Table 33).

Table 33: One-Sample T-Test Mathematics Perception of TIMSS Based on Dimension 1.

S.N	Items	Mean	Standard deviation	Mean Difference	t	df	Sig. (2-tailed)	Significant Positive or Negative Perception
1	I have sufficient experience with TIMSS.	3.52	1.190	0.525	10.07	521	0.000	SP
2	I assign sample questions that align with TIMSS to my students.	2.99	1.073	-0.008	-0.16	521	0.870	N
3	I set the class tests as per the format of TIMSS.	1.75	1.074	-1.245	-26.49	521	0.000	SN
4	I encourage my grade 8 students to practice TIMSS questions.	3.05	1.046	0.052	1.13	521	0.259	N
5	I am interested in TIMSS for the benefit of my students.	3.70	.794	0.705	20.28	521	0.000	SP
6	I focus on mathematical skills that align with the skills in TIMSS.	2.31	1.497	-0.693	-10.58	521	0.000	SN
7	Mathematics tests in schools are compatible with TIMSS.	2.91	1.293	-0.090	-1.59	521	0.112	N
8	I follow TIMSS together with standards followed by the school to teach mathematics to grade 8 students.	2.61	1.189	-0.395	-7.58	521	0.000	SN
	Dimension 1: Mathematics Teachers Practices and TIMSS	2.856	.57635	-0.143	-5.69	521	0.000	SN

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], $p<0.05$ Confident, $p>0.05$ Not Confident.

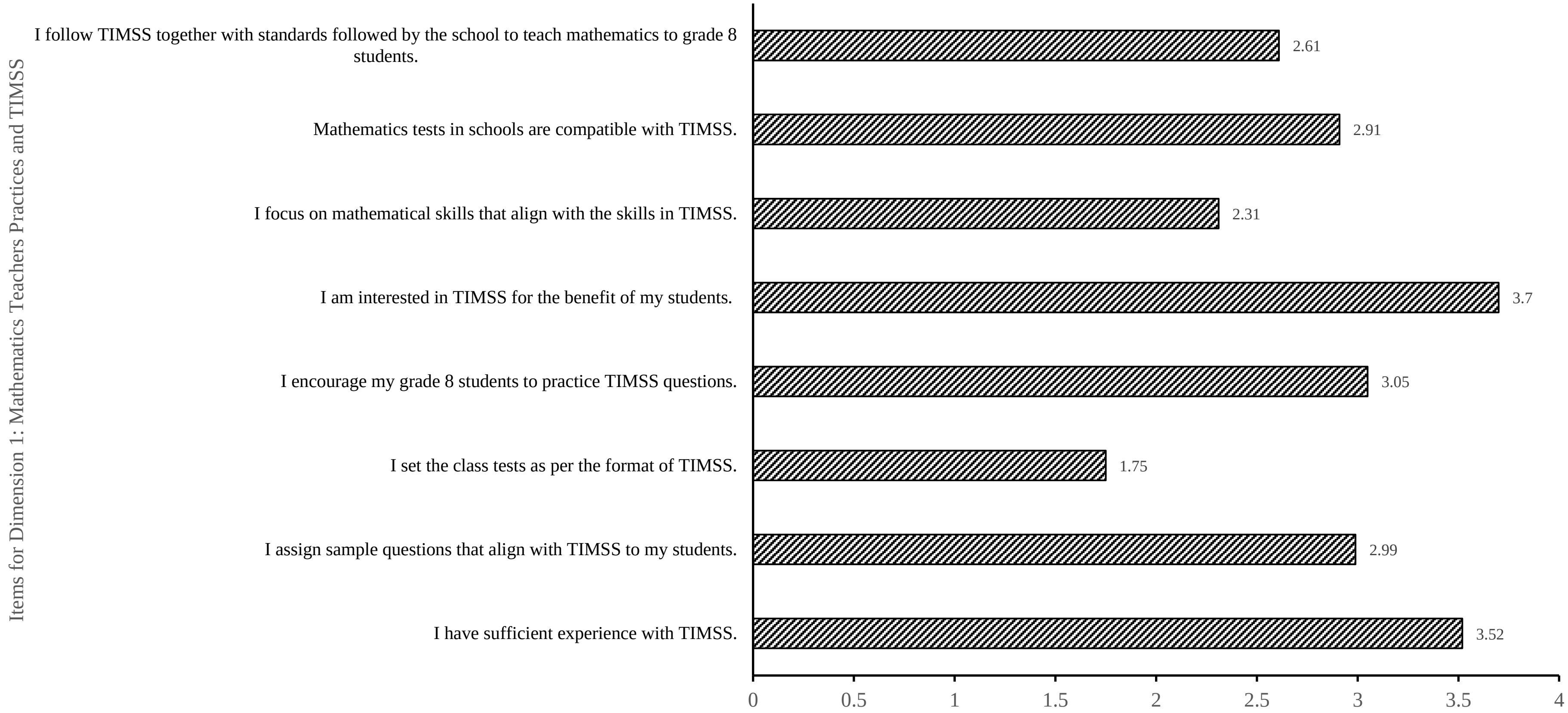

Figure 7: Average Scores of the Components of Dimension 1: Mathematics Teachers Practices and TIMSS.

The one-sample t-test above (Table 33) shows that the teachers had a positive perception toward having sufficient experience with TIMSS) (Mean=3.52, SD= 1.190, $p<0.05$) teaching perception was greater than the test value of 3.0. That means teachers believed that they had sufficient experience with TIMSS. Similarly, they had significantly positive perception toward benefits of TIMSS for students (Mean=3.70, SD=0.794, and $p<0.05$). However, they expressed negative perceptions on the items related to the class tests as per the format of TIMSS (Mean=1.75, SD=1.074, and $p<0.05$), focus on mathematical skills that align with the skills in TIMSS (Mean=2.31, SD=1.497, and $p<0.05$), and following TIMSS together with standards followed by the school to teach mathematics to grade 8 students (Mean=2.61, SD=1.189, and $p<0.05$). Their perceptions were neutral toward assigning sample questions that align with TIMSS to their students, encouraging grade 8 students to practice TIMSS questions, and mathematics tests in schools are compatible with TIMSS ($p>0.05$). Overall, teachers had a negative perception toward Dimension 1: Mathematics Teachers’ Practices for TIMSS (Mean=2.8563, SD=.57635 and $p<0.05$) (Table 33, Figure 7).

Dimension 2: Classroom Mathematics and Instruction

A one-sample t-test was conducted to examine teachers' perceptions of Dimension 2: Mathematics and Instruction for TIMSS (Table 34).

Table 34: One-Sample T-Test Mathematics Perception of TIMSS Based on Dimension 2

S.N.	**Items**	**Mean**	**Standard deviation**	**Mean Difference**		**df**	**Sig. (2-tailed)**	**Significant Positive or Negative Perception**
1	I have sufficient experience with TIMSS.	3.52	1.190	0.525	10.07	521	0.000	SP
2	I assign sample questions that align with TIMSS to my students.	2.99	1.073	-0.008	-0.16	521	0.870	N
3	I set the class tests as per the format of TIMSS.	1.75	1.074	-1.245	-26.49	521	0.000	SN
4	I encourage my grade 8 students to practice TIMSS questions.	3.05	1.046	0.052	1.13	521	0.259	N
5	I am interested in TIMSS for the benefit of my students.	3.70	.794	0.705	20.28	521	0.000	SP
6	I focus on mathematical skills that align with the skills in TIMSS.	2.31	1.497	-0.693	-10.58	521	0.000	SN
7	Mathematics tests in schools are compatible with TIMSS.	2.91	1.293	-0.090	-1.59	521	0.112	N
8	I follow TIMSS together with standards followed by the school to teach mathematics to grade 8 students.	2.61	1.189	-0.395	-7.58	521	0.000	SN
	Dimension 1: Mathematics Teachers Practices and TIMSS	2.856	.57635	-0.143	-5.69	521	0.000	SN

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident.

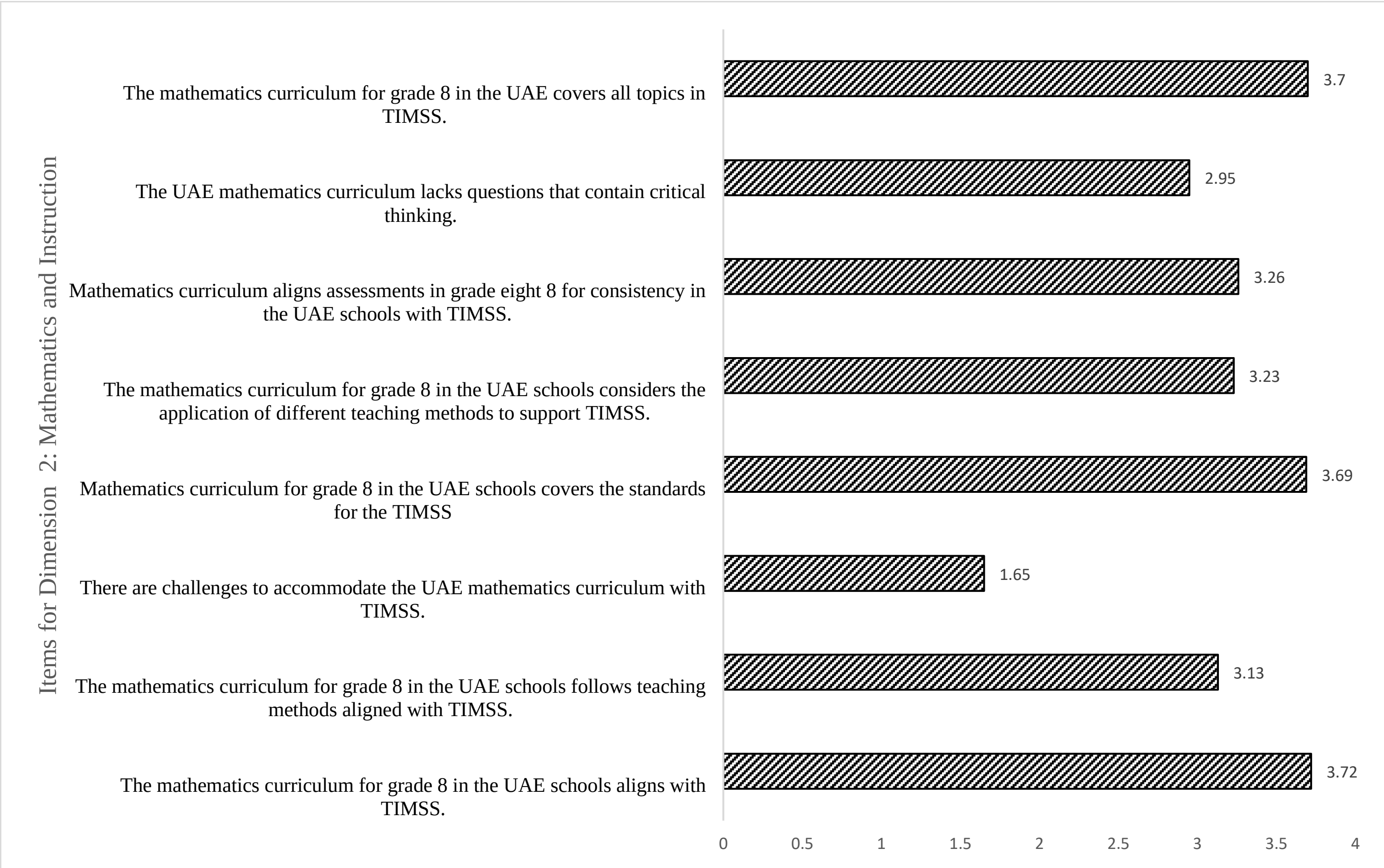

Figure 8: Average Scores of the Components of Dimension 2: Mathematics and Instruction.

The one-sample t-test above (Table 34) shows that the mathematics curriculum for grade 8 in the UAE schools aligns with TIMSS (Mean=3.72, SD= 0.788, $p<0.05$). That means teachers believe the mathematics curriculum for grade 8 in the UAE positively aligns with the TIMSS. Similarly, they had a significantly positive perception of whether the UAE school's grade 8 mathematics curriculum covers the TIMSS standards (Mean=3.69, SD=0.830, and p 0.05). This means that the mathematics curriculum for grade 8 introduces, explains, and implements the TIMSS standards. Additionally, the mathematics curriculum for grade 8 in the UAE schools positively considers the application of different teaching methods to support TIMSS (Mean= 3.23, SD= 1.162 and $p<0.05$). However, they expressed negative perceptions about the challenges of accommodating the UAE mathematics curriculum with TIMSS (Mean=1.65, SD=0.753, and $p<0.05$). The UAE mathematics curriculum lacks questions that require critical thinking ($p>0.05$), the perceptions were neutral. Overall, teachers had a positive perception toward Dimension 2: Mathematics and Instructions (Mean=3.165, SD=0.41772, $p<0.05$) (Table 34, Figure 8).

Dimension 3: Readiness of Students for TIMSS

A one-sample t-test was conducted to examine the teachers' perceptions of Dimension 3: Readiness of Students for TIMSS. These items had five-point Likert-scale responses from strongly disagree (coded 5) to strongly agree (coded 1), and the neutral value of 3 was used as a test value.

Table 35: One-Sample T-Test Mathematics Perception of TIMSS Based on Dimension 3

S.N	Items	Mean	Standard deviation	Mean Difference	t	df	Sig. (2-tailed)	Significant Positive or Negative Perception
1	Grade 8 students in the UAE schools practice problem solving to improve results in TIMSS	2.11	1.375	-.887	-14.743	521	.000	SN
2	Grade 8 students in the UAE schools practice reasoning skills to perform well in TIMSS.	3.52	0.892	.515	13.202	521	.000	SP
3	Grade 8 students in the UAE schools are often found unaware of the questions in TIMSS.	3.42	0.875	.418	10.904	521	.000	SP
4	Grade 8 students in the UAE schools persevere in learning mathematics for good results in TIMSS.	3.04	1.028	.042	.936	521	.350	NC
5	Parents are interested in helping their children to perform well in TIMSS.	2.23	1.186	-.774	-14.904	521	.000	SN
6	Parents are aware of the importance of urging students to get good	2.05	1.199	-.946	-18.039	521	.000	SN
7	Grade 8 students are motivated to achieve good results in TIMSS.	3.89	0.824	.893	24.744	521	.000	SP
8	Grade 8 students are usually evaluated through pretests to prepare them for TIMSS.	1.47	0.938	-1.533	-37.348	521	.000	SN
	Dimension 3: Readiness of Students for TIMSS:	2.7160	.4348	-0.28400	-14.924	521	0.000	SN

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident.

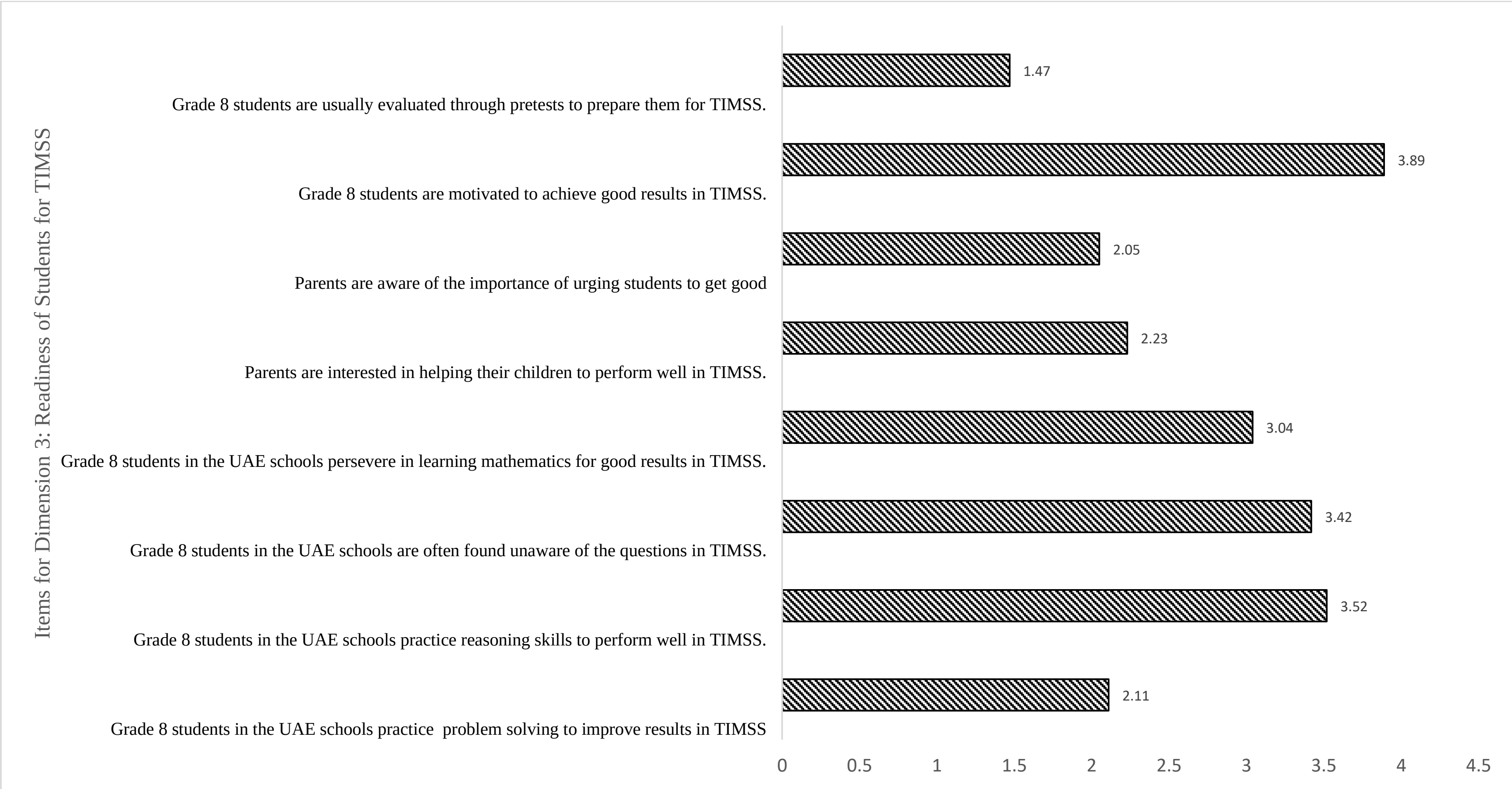

Figure 9: Average Scores of the Components of Dimension 3: Readiness of Students for TIMS.

Figure 9 shows the distribution of average item scores for the readiness of students for TIMSS from the teachers' viewpoint. The one-sample t-test above (Table 5) shows that students' readiness for TIMSS was significantly negative due to the output realized (Mean=2.11, SD= 1.375, $p > 0.05$). Students' readiness for TIMSS was poor since it attained a test value of less than 3.0. Though some items highlighted by table 3 above, such as, student motivation to attain better results (mean=3.89, SD= 0.824, $p > 0.05$) and students practicing reasoning skills to achieve better results (mean= 3.52, SD= 0.82, $p > 0.05$), had a greater test value than 3.0. Some of the negative items that lead to poor student readiness are that grade 8 students in the UAE schools practice problem solving to improve results in TIMSS (mean= 2.11, SD= 1.375, $p > 0.05$), that parents are interested in helping their children to perform well in TIMSS (mean= 2.23, SD= 1.186, $p > 0.05$), it shows that the negative significant of parents' awareness of the importance of urging students to get good (mean= 2.05, SD= 1.199, $p > 0.05$) and that grade 8 students are usually evaluated through pretests to prepare them for TIMSS (mean= 1.47, SD= 0.938, $p > 0.05$). This clearly shows a negative impact that students' readiness has on TIMSS. Nonetheless, the grade 8 students in the UAE schools who practice reasoning skills positively perform well in TIMSS (mean= 3.52, SD= 0.892, $p < 0.05$), and the grade 8 students in the UAE schools are often found unaware of the questions in TIMSS (mean=3.42 SD= 0.875 $p < 0.05$) (Table 35, Figure 9).

Dimension 4: School and Classroom Environment

A one-sample t-test was conducted to examine teachers' perceptions of items related to dimension 4: school and classroom environment. These items had five-point Likert-scale responses from strongly disagree (coded 5) to strongly agree (coded 1), and the neutral value of 3 was used as a test value.

Table 36: One-Sample T-Test Mathematics Perception of TIMSS Based on Dimension 4

NO	Items	Mean	Standard deviation	Mean Difference	t	df	Sig. (2-tailed)	Significant Positive or Negative Perception
1	Schools create a suitable environment to help students with TIMSS.	2.20	1.402	-.799	-13.020	521	.000	SN
2	Teachers have the required skills to maintain a classroom environment to help their students succeed in TIMSS.	3.99	.770	.987	29.274	521	.000	SP
3	Teachers use interactive sessions to increase student participation in the class.	3.39	1.150	.393	7.805	521	.000	SP
4	Teachers manage their classes to encourage students to perform better in TIMSS.	3.77	.712	.772	24.785	521	.000	SP
5	The classroom environment encourages students to be ready for TIMSS.	1.71	1.144	-1.293	-25.819	521	.000	SN
6	The school environment promotes healthy competitions to motivate students to achieve good results in TIMSS.	2.72	1.335	-.280	-4.785	521	.000	SN
	Dimension 4: School and Classroom Environment:	2.963	.5899	-.0367	-1.422	521	.156	SN

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident.

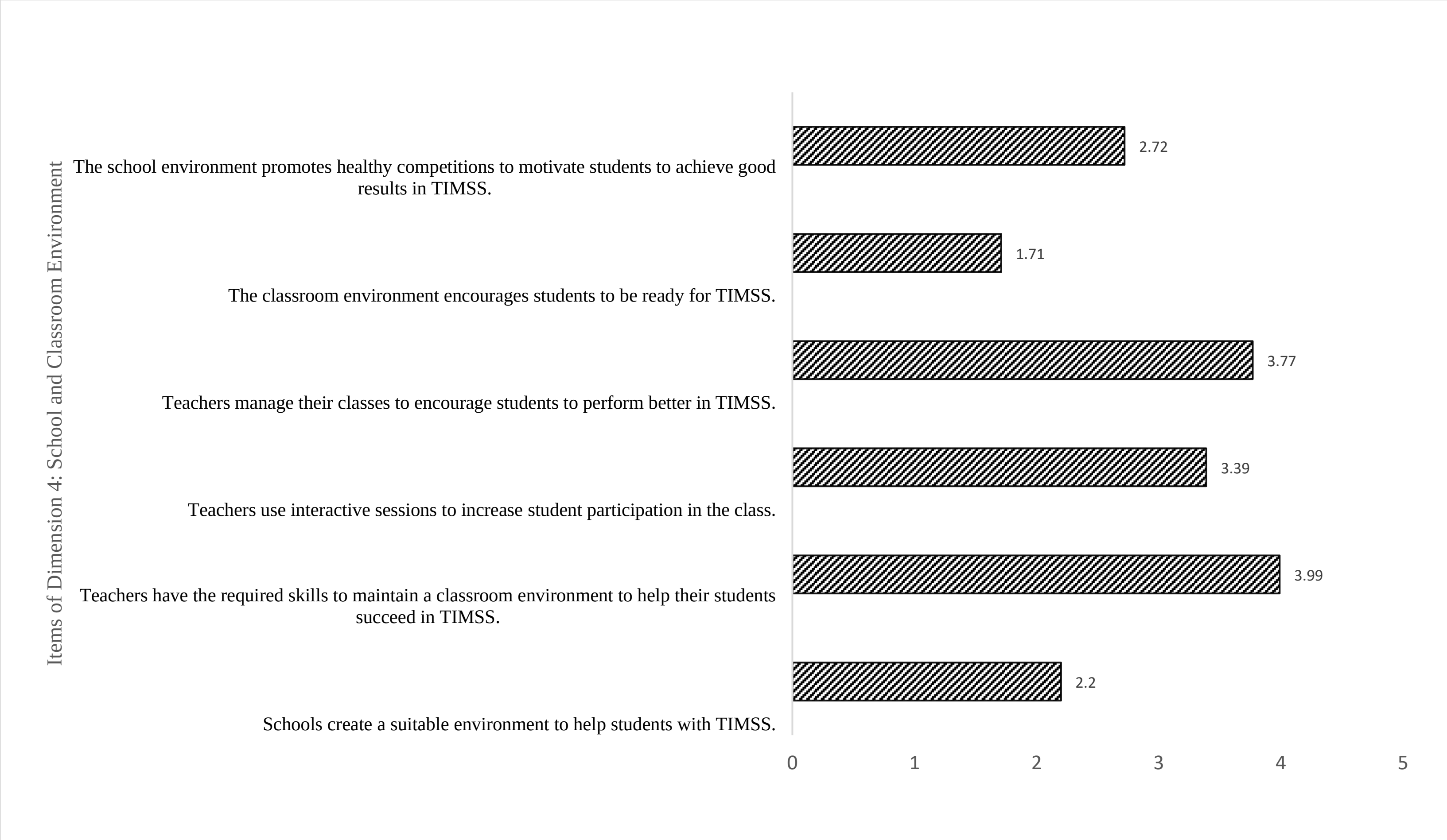

Figure 10: Average Scores of the Components of Dimension 4: School and Classroom Environment for TIMSS.

Figure 10 shows the distribution of average item scores for school and classroom environments for TIMSS from teachers' view. The one-sample t-test above (Table 39) shows that the teachers had a negative perception toward dimension 4: school and classroom environment school and classroom environment was significantly negative since it attained an overall mean less than 3.0. the test expressed negative perceptions on whether the classroom environment encourages students to be ready for TIMSS (Mean=1.71, SD=1.144, and $p<0.05$), emphasis on schools create a suitable environment to help students with TIMSS (Mean=2.20, SD=1.402, and $p<0.05$), and if the school environment promotes healthy competitions to motivate students achieve good results in TIMSS (Mean=2.72, SD=1.335, and $p<0.05$). Nevertheless, the test shows that the teachers have the required skills to maintain a classroom environment to help their students succeed in TIMSS (Mean=3.99, SD= 0.770, $p<0.05$). This means that teachers have the required skills to maintain a classroom environment to help their students succeed in TIMSS. Equally, teachers use interactive sessions to increase student's participation in the class (Mean=3.39, SD=1.150, and $p<0.05$), also teachers positively manage their classes to encourage students to perform better in TIMSS (Mean= 3.77, SD= 0.712 and $p<0.05$) (Table 36, Figure 10).

Research Question: Is there a (statistically) significant difference between males and females with respect to mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?

An independent sample t-test was utilized to examine whether there is any difference between males' and females' perceptions of TIMSS in Abu Dhabi Emirate schools. The mean (M) and standard deviation (SD) of each group are illustrated in Table 37.

Table 37: Mathematics Teachers' Perceptions of TIMSS Based on Gender

Dimension	Gender	N	Mean	Mean Difference	Std. Deviation	Sig. (2-tailed)
Math teachers' overall perception	Male	244	2.98	.11	.31	.000
	Female	278	2.87		.28	
Dimension 1: Mathematics Teachers Practices and TIMSS	Male	244	2.88	.04	.64	.465
	Female	278	2.84		.52	
Dimension 2: Mathematics and Instruction	Male	244	3.20	.06	.45	.109
	Female	278	3.14		.39	
Dimension 3: Readiness of Students for TIMSS	Male	244	2.75	.06	.45	.134
	Female	278	2.69		.42	
Dimension 4: School and Classroom Environment	Male	244	3.14	.33	.56	.000
	Female	278	2.81		.58	

Independent samples t-test for mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools based on gender showed that there was a statistically significant difference between male and female teachers in overall perception of TIMSS (Male: Mean=2.98, SD=0.31; Female: Mean=2.87, SD=0.28, and p-value=0.000 < 0.01). In addition, independent samples t- test shows there was no statistically significant difference between male and female teachers in Dimension 1: Mathematics Teachers' Practices and TIMSS (Male: Mean=2.88, SD=0.64; Female: Mean=2.84, SD=0.52, and p-value=0.465 > 0.01). Both male and female have different opinions towards a teacher's perception of "Mathematics Teachers' Practices and TIMSS". Similarly, an independent t-test indicated that there was no statistically significant difference between male and female teachers in Dimension 2: Mathematics and Instruction (Male: Mean=3.20, SD=0.45; Female: Mean=3.14, SD=0.39, and p-value=0.109 > 0.01), meaning that male and female have a similar opinion towards Dimension 2: Mathematics and Instruction. The independent t-test indicated that there was no statistically significant difference between male and female teachers in Dimension 3: Readiness of Students for TIMSS (Male: Mean=2.75, SD=0.44; Female: Mean=2.69, SD=0.42, and p-value=0.134 > 0.01), meaning that male and female have a similar opinion towards Dimension 3: Readiness of Students for TIMSS. In the same vein, an independent t-test indicated that there was a statistically significant difference between male and female teachers in Dimension 4: School and Classroom Environment (Male: Mean=3.14, SD=0.56; Female: Mean=2.81, SD=0.58, and p-value=0.000 < 0.01) meaning that males and females have a different opinion towards Dimension 4: School and Classroom Environment**.**

Research Question: Is there a (statistically) significant difference between public and private schools with respect to mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?

An independent sample t-test was utilized to examine whether there is any difference between public and private school teachers' perceptions of TIMSS in Abu Dhabi Emirate schools. The mean (M) and standard deviation (SD) of each group are illustrated in Table 38.

Table 38: Mathematics Teachers' Perceptions of TIMSS Based on School Type

Dimension	**School type**	**N**	**Mean**	**Std. Deviation**	**Sig. (2-tailed)**	**Mean Difference**
Math teachers' perception	Public	284	2.95	.30	.018	.06
	Private	238	2.89	.30		.06
Dimension 1: Mathematics Teachers Practices and TIMSS	Public	284	2.87	.59	.524	.03
	Private	238	2.84	.56		.03
Dimension 2: Mathematics and Instruction	Public	284	3.15	.45	.512	-.02
	Private	238	3.18	.37		-.02
Dimension 3: Readiness of Students for TIMSS	Public	284	2.66	.49	.000	-.13
	Private	238	2.79	.34		-.13
Dimension 4: School and Classroom Environment	Public	284	3.18	.58	.000	.48
	Private	238	2.70	.49		.48

The independent samples t-test for mathematics teachers' perceptions of TIMSS on Abu Dhabi Emirate schools based on school type revealed no statistically significant difference in overall teacher perception of TIMSS between public and private schools (public: mean=2.95, SD=0.30; private: mean=2.89, SD=0.30, and p-value=0.018 > 0.01).In addition, independent sample t- test shows there was no statistically significant difference between public and private schools in teacher perception of Dimension 1: Mathematics Teachers' Practices and TIMSS (public: Mean=2.87, SD=0.59; private: Mean=2.84, SD=0.56, and p-value=0.524 > 0.01). Similarly, an independent t test indicated that there was no statistically significant difference between public and private schools in teacher perception in Dimension 2: Mathematics and Instruction (public: Mean=3.15, SD=0.45; private: Mean=3.18, SD=0.37, and p-value=0.512 > 0.01). A similarly independent t test indicated there is a statistically significant difference between public and private schools in teachers' perception of Dimension 3: Readiness of Students for TIMSS (public: Mean=2.66, SD=0.49; private: Mean=2.78, SD=0.34, and p-value=0.000 < 0.01).in the same vein, independent t test indicated there is a statistically significant difference between public and private schools in teachers' perception of Dimension 4: School and Classroom Environment (public: Mean=3.18, SD=0.58; private: Mean=2.70, SD=0.49, and p-value=0.000 < 0.01).

Research Question: Is there a (statistically) significant difference in mathematics teachers' perceptions of teaching experience?

A one-way ANOVA and post hoc comparisons were utilized to examine whether there is any difference in teachers' perceptions of TIMSS in Abu Dhabi Emirate Schools based on maths teaching experience. The mean (M) and standard deviation (SD) of each group are illustrated in Table 34. The post hoc comparisons are shown in Table 39.

Table 39: Differences in Mathematics Teachers' Perceptions of TIMSS Based on Teaching Experience

Dimension	**Teacher's experience**	**N**	**Mean**	**Std. Deviation**
Math teachers' perceptions (Overall)	Less than 5 years	40	3.01	0.29
	Between 6 to 10 years	40	2.91	0.45
	Between 11 to 15 years	226	2.88	0.25
	16 years and above	216	2.96	0.30
	Total	522	2.92	0.30
Dimension 1: Mathematics Teachers Practices and TIMSS	Less than 5 years	40	3.15	0.34
	Between 6 to 10 years	40	2.88	0.85
	Between 11 to 15 years	226	2.79	0.44
	16 years and above	216	2.87	0.66
	Total	522	2.86	0.58
Dimension 2: Mathematics and Instruction	Less than 5 years	40	3.04	0.55
	Between 6 to 10 years	40	3.08	0.63
	Between 11 to 15 years	226	3.21	0.30
	16 years and above	216	3.15	0.44
	Total	522	3.17	0.42
Dimension 3: Readiness of Students for TIMSS	Less than 5 years	40	2.76	0.48
	Between 6 to 10 years	40	2.82	0.39
	Between 11 to 15 years	226	2.74	0.40
	16 years and above	216	2.67	0.47
	Total	522	2.72	0.43
Dimension 4: School and Classroom Environment	Less than 5 years	40	3.10	0.54
	Between 6 to 10 years	40	2.82	0.42
	Between 11 to 15 years	226	2.72	0.51
	16 years and above	216	3.22	0.60
	Total	522	2.96	0.59

The one-way ANOVA test was used to determine if the differences in the mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirates schools were significant at the significance level (at $\alpha \leq 0.05$), as shown in Table 40.

Table 40: One-Way ANOVA Test of Mathematics Teachers' Perceptions of TIMSS Based on Teaching Experience

		Sum of Squares	df	Mean Square	F	Sig.
Math teachers' perception	Between Groups	1.09	3	.36	4.12	0.007
	Within Groups	45.54	518	.09		
	Total	46.63	521			
Dimension 1: Mathematics Teachers Practices and TIMSS	Between Groups	4.44	3	1.48	4.54	0.004
	Within Groups	168.63	518	.33		
	Total	173.07	521			
Dimension 2: Mathematics and Instruction	Between Groups	1.47	3	.49	2.84	0.037
	Within Groups	89.44	518	.17		
	Total	90.91	521			
Dimension 3: Readiness of Students for TIMSS	Between Groups	1.068	3	0.356	1.89	0.130
	Within Groups	97.422	518	.188		
	Total	98.490	521			
Dimension 4: School and Classroom Environment	Between Groups	28.343	3	9.448	31.99	.000
	Within Groups	152.981	518	.295		
	Total	181.324	521			

Table 41: Experience Multiple Comparisons

		Tukey HSD				**95% Confidence Interval**	
Dependent Variable	**(I) 2. Teacher's professional experience**	**(J) 2. Teacher's professional experience**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**Lower Bound**	**Upper Bound**
Math teachers' perception	Less than 5 years	Between 6 to 10 years	.10	.07	.441	-.0717	.2701
		Between 11 to 15 years	.13	.0	.052	-.0008	.2614
		16 years and above	.05	.05	.803	-.0854	.1777
	Between 6 to 10 years	Less than 5 years	-.10	.07	.441	-.2701	.0717
		Between 11 to 15 years	.03	.05	.928	-.0999	.1622
		16 years and above	-.05	.05	.726	-.1846	.0785
	Between 11 to 15 years	Less than 5 years	-.13	.05	.052	-.2614	.0008
		Between 6 to 10 years	-.03	.05	.928	-.1622	.0999
		16 years and above	-.08*	.02	.016	-.1569	-.0115
	16 years and above	Less than 5 years	-.05	.05	.803	-.1777	.0854
		Between 6 to 10 years	.05	.05	.726	-.0785	.1846
		Between 11 to 15 years	.08*	.02	.016	.0115	.1569
Dimension 1: Mathematics Teachers Practices and TIMSS	Less than 5 years	Between 6 to 10 years	.27	.12	.145	-.0570	.6007
		Between 11 to 15 years	.36*	.09	.002	.1063	.6108
		16 years and above	.28*	.09	.021	.0311	.5374
	Between 6 to 10 years	Less than 5 years	-.27	.13	.145	-.6007	.0570
		Between 11 to 15 years	.09	.10	.813	-.1656	.3389
		16 years and above	.01	.10	.999	-.2407	.2655
	Between 11 to 15 years	Less than 5 years	-.32*	.10	.002	-.6108	-.1063
		Between 6 to 10 years	-.09	.10	.813	-.3389	.1656
		16 years and above	-.07	.05	.520	-.2142	.0657
	16 years and above	Less than 5 years	-.28*	.10	.021	-.5374	-.0311
		Between 6 to 10 years	-.01	.10	.999	-.2655	.2407
		Between 11 to 15 years	.07	.05	.520	-.0657	.2142

Table 41: Experience Multiple Comparisons (continued)

Tukey HSD						95% Confidence Interval	
Dependent Variable	**(I) 2. Teacher's professional experience**	**(J) 2. Teacher's professional experience**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**Lower Bound**	**Upper Bound**
Dimension 2: Mathematics and Instruction	Less than 5 years	Between 6 to 10 years	-.04	.09	.972	-.2801	.1989
		Between 11 to 15 years	-.17	.07	.072	-.3571	.0103
		16 years and above	-.11	.07	.393	-.2971	.0716
	Between 6 to 10 years	Less than 5 years	.04	.09	.972	-.1989	.2801
		Between 11 to 15 years	-.13	.07	.245	-.3165	.0509
		16 years and above	-.07	.07	.745	-.2565	.1122
	Between 11 to 15 years	Less than 5 years	.17	.07	.072	-.0103	.3571
		Between 6 to 10 years	.13	.07	.245	-.0509	.3165
		16 years and above	.06	.04	.417	-.0412	.1626
	16 years and above	Less than 5 years	.11	.07	.393	-.0716	.2971
		Between 6 to 10 years	.07	.07	.745	-.1122	.2565
		Between 11 to 15 years	-.06	.04	.417	-.1626	.0412
Dimension 3: Readiness of Students for TIMSS	Less than 5 years	Between 6 to 10 years	-.06	.10	.917	-.3124	.1874
		Between 11 to 15 years	.02	.07	.993	-.1717	.2118
		16 years and above	.09	.07	.642	-.1046	.2802
	Between 6 to 10 years	Less than 5 years	.06	.09	.917	-.1874	.3124
		Between 11 to 15 years	.08	.07	.684	-.1092	.2743
		16 years and above	.15	.07	.184	-.0421	.3427
	Between 11 to 15 years	Less than 5 years	-.02	.07	.993	-.2118	.1717
		Between 6 to 10 years	-.08	.07	.684	-.2743	.1092
		16 years and above	.07	.04	.356	-.0386	.1741
	16 years and above	Less than 5 years	-.09	.07	.642	-.2802	.1046
		Between 6 to 10 years	-.15	.07	0.184	-.3427	.0421
		Between 11 to 15 years	-.07	.04	0.356	-.1741	.0386

Table 41: Experience Multiple Comparisons (continued)

		Tukey HSD				95% Confidence Interval	
Dependent Variable	**(I) 2. Teacher's professional experience**	**(J) 2. Teacher's professional experience**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**Lower Bound**	**Upper Bound**
Dimension 4: School and Classroom Environment	Less than 5 years	Between 6 to 10 years	.27	.12	0.117	-.0424	.5840
		Between 11 to 15 years	.38*	.09	0.000	.1378	.6183
		16 years and above	-.12	.09	.607	-.3564	.1258
	Between 6 to 10 years	Less than 5 years	-.27	.12	.117	-.5840	.0424
		Between 11 to 15 years	.11	.09	.659	-.1331	.3475
		16 years and above	-.39*	.09	.000	-.6272	-.1450
	Between 11 to 15 years	Less than 5 years	-.38*	.09	.000	-.6183	-.1378
		Between 6 to 10 years	-.11	.09	.659	-.3475	.1331
		16 years and above	-.49*	.05	.000	-.6266	-.3600
	16 years and above	Less than 5 years	.12	.09	.607	-.1258	.3564
		Between 6 to 10 years	.39*	.09	.000	.1450	.6272
		Between 11 to 15 years	.49*	.05	.000	.3600	.6266

*. The mean difference is significant at the 0.05 level.

A one-way ANOVA was conducted to determine if there were differences in overall teachers' perception of TIMSS, Dimension 1: Mathematics Teachers' Practices and TIMSS, Dimension 2: Mathematics and Instruction, Dimension 3: Readiness of Students for TIMSS, and Dimension 4: School and Classroom Environment based on teaching experiences. Participants were classified into four groups: Less than 5 years (n=40), between 6 to 10 years (n=40), between 11 to 15 years (n=226), 16 years and above (n=216). There were no outliers, as assessed by boxplot; data was normally distributed for each group, as assessed by the Shapiro-Wilk test ($p>0.05$); and variances were homogeneous, as assessed by Levine's test of homogeneity of variances (p=0.053). Data are presented as mean and standard deviation math. Teachers' perception scores were significantly different between different experience groups, $F(3, 218) = 4.117$, $p<0.05$. Teachers' perception of TIMSS score increased from the 11 to 15-year (M=2.8755, SD=0.26), to 16 years and above (M=2.96, SD=0.30) teaching experience groups, in that order. The results of the Tukey post hoc analysis revealed that the increase from the group (between 11 and 15 years) to the group (16 years and above) was statistically significant (p=0.016). Still, no other group differences were statistically significant.

Similarly, data are presented as mean and standard deviation. Dimension 1: Mathematics Teachers' Practices and TIMSS Score was statistically significantly different between different experience groups, $F(3, 218) = 4.544$, $p<0.05$. Dimension 1: Mathematics Teachers' Practices and TIMSS score increased from the less than 5-year (M=2.76, SD=.48), to the 11-to-15-year (M=2.73, SD=.40) teaching experience groups, in that order. The results of the Tukey post hoc analysis revealed that the increase from a group (less than 5 years) to a group (between 11 and 15 years) was statistically significant (p=0.002). Dimension 1: Mathematics Teachers' Practices and

TIMSS score increased from the less than 5-year (M=2.76, SD=.48) to the 16 year and above (M=2.96, SD=0.30) teaching experience groups, in that order. A Tukey post hoc analysis revealed that the increase from a group (less than 5 years) to a group (16 years and above) was statistically significant (p=0.021). Still, no other group differences were statistically significant.

The data revealed that Dimension 2: Mathematics and Instruction score was statistically significantly different between different teachers' experience groups, F (3, 218) =2.842, p<0.05. Dimension 2: Mathematics and Instruction score increased from the less than 5 years (M=3.04, SD=0.55) to between 6 to 10 years (M=3.08, SD=0.63) to between 11 to 15 years (M=3.21, SD=0.30) to 16 years and above (M=3.15, SD=0.44) teaching experiences groups, in that order. Tukey's post hoc analysis revealed that the increase among all experience groups was not statistically significant.

Similarly, a one-way ANOVA result indicated that Dimension 3: Readiness of Students for TIMSS score was statistically not significant among different teachers' experience groups, F (3, 218) =1.894, p>0.05. A one-way ANOVA results are presented as mean and standard deviation Dimension 4: School and classroom environment scores were statistically significantly different among different teachers' experience groups, F (3, 218) =31.990, p<0.05. Dimension 4: School and Classroom Environment score increased from the less than 5 years (M=3.10, SD=0.54) to between 11 to 15 years (M=2.74, SD=0.40) teaching experiences groups, in that order. A Tukey post hoc analysis revealed that the increase from a group (less than 5 years) to a group (between 11 and 15 years) was statistically significant (p<0.001). Furthermore, there is an increase from 6 to 10 years (M=2.72, SD=0.51) to 16 years and above (M=3.21, SD=0.60). The increase in teaching experience groups was indicated by Tukey post hoc analysis, which revealed that; the increase from a group (between 6 to 10 years) to a group (16 years and above) was statistically significant (p<0.001).

Research Question: Is there a (statistically) significant difference in mathematics teachers' perceptions among different teachers' qualifications?

A one-way ANOVA and post hoc comparisons were utilized to examine whether there was any difference in teachers' perceptions of TIMSS in Abu Dhabi Emirate School based on Math Teachers' Qualifications. The mean (M) and standard deviation (SD) of each group are illustrated in Table 42. The one-way ANOVA test of each group are illustrated in table 43. The post hoc comparisons are shown in Table 44.

Table 42: Differences in Teachers' Perceptions of TIMSS on Abu Dhabi Emirates Schools Based on Teachers Qualifications

Dimensions	**Teacher's experience**	**N**	**Mean**	**Std. Deviation**
Math teachers' perception	Bachelor's degree	298	2.91	.29
	Master's degree	208	2.93	.31
	Ph.D. degree	16	3.06	.24
	Total	522	2.92	.30
Dimension 1: Mathematics Teachers Practices and TIMSS	Bachelor's degree	298	2.85	.47
	Master's degree	208	2.85	.71
	Ph.D. degree	16	3.05	.31
	Total	522	2.86	.58
Dimension 2: Mathematics and Instruction	Bachelor's degree	298	3.20	.41
	Master's degree	208	3.12	.44
	Ph.D. degree	16	3.16	.25
	Total	522	3.17	.42
Dimension 3: Readiness of Students for TIMSS	Bachelor's degree	298	2.71	.40
	Master's degree	208	2.70	.49
	Ph.D. degree	16	3.00	.34
	Total	522	2.72	.43
Dimension 4: School and Classroom Environment	Bachelor's degree	298	2.85	.58
	Master's degree	208	3.12	.57
	Ph.D. degree	16	3.01	.64
	Total	522	2.96	.59

Table 43: One-Way ANOVA Test of Mathematics Teachers' Perceptions of TIMSS Based on Teachers Qualification

		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Math teachers' perception	Between Groups	.390	2	.195	2.191	0.113
	Within Groups	46.240	519	.089		
	Total	46.630	521			
Dimension 1: Mathematics Teachers Practices and TIMSS	Between Groups	.655	2	.327	0.986	0.374
	Within Groups	172.413	519	.332		
	Total	173.068	521			
Dimension 2: Mathematics and Instruction	Between Groups	.855	2	.428	2.465	0.086
	Within Groups	90.055	519	.174		
	Total	90.911	521			
Dimension 3: Readiness of Students for TIMSS	Between Groups	1.335	2	.668	3.566	0.029
	Within Groups	97.155	519	.187		
	Total	98.490	521			
Dimension 4: School and Classroom Environment	Between Groups	8.368	2	4.184	12.556	0.000
	Within Groups	172.956	519	.333		
	Total	181.324	521			

Table 44: Qualifications Multiple Comparisons

Dependent Variable	**(I) 3. Teacher's academic qualification**	**(J) 3. Teacher's academic qualification**	**Mean Difference (I-J)**	**Sig.**
Math teachers' perception	Bachelor's degree	Master's degree	-.03	.585
		Ph.D. degree	-.15	.121
	Master's degree	Bachelor's degree	.03	.585
		Ph.D. degree	-.12	.245
	Ph.D. degree	Bachelor's degree	.15	.121
		Master's degree	.12	.245
Dimension 1: Mathematics Teachers Practices and TIMSS	Bachelor's degree	Master's degree	.01	.991
		Ph.D. degree	-.20	.360
	Master's degree	Bachelor's degree	-.01	.991
		Ph.D. degree	-.21	.344
	Ph.D. degree	Bachelor's degree	.20	.360
		Master's degree	.21	.344
Dimension 2: Mathematics and Instruction	Bachelor's degree	Master's degree	.08	.069
		Ph.D. degree	.04	.912
	Master's degree	Bachelor's degree	-.08	.069

Table 44: Qualifications Multiple Comparisons. (continued)

Dependent Variable	(I) 3. Teacher's academic qualification	(J) 3. Teacher's academic qualification	Mean Difference (I-J)	Sig.
		Ph.D. degree	-.04	.928
	Ph.D. degree	Bachelor’s degree	-.04	.912
		Master’s degree	.04	.928
Dimension 3: Readiness of Students for TIMSS	Bachelor's degree	Master’s degree	.01	.989
		Ph.D. degree	-.29*	.025
	Master's degree	Bachelor’s degree	-.01	.989
		Ph.D. degree	-.30*	.023
	Ph.D. degree	Bachelor’s degree	.30*	.025
		Master’s degree	.30*	.023
Dimension 4: School and Classroom Environment	Bachelor's degree	Master’s degree	-.30*	.000
		Ph.D. degree	-.16	.544
	Master's degree	Bachelor’s degree	.30*	.000
		Ph.D. degree	.10	.763
	Ph.D. degree	Bachelor’s degree	.16	.544
		Master’s degree	-.10	.763

A one-way ANOVA was conducted to determine if there are differences in overall teachers' perception of TIMSS, Dimension 1: Mathematics Teachers' Practices and TIMSS, Dimension 2: Mathematics and Instruction, Dimension 3: Readiness of Students for TIMSS, and Dimension 4: School and Classroom Environment based on Math Teachers' Qualification. Participants were classified into three groups: bachelor’s degree (n=298), master’s degree (n=208), and Ph.D. degree (n=16). There were no outliers, as assessed by boxplot; data was normally distributed for each group, as assessed by the Shapiro-Wilk test ($p>0.05$); and variances were homogeneous, as assessed by Levine's test of homogeneity of variances ($p=0.053$). For math teachers' perception scores, one-way ANOVA results indicated no statistically significant differences among different teachers' qualification groups, $F(2, 519)=2.191$, $p>0.05$.

Similarly, for Dimension 1: Mathematics Teachers' Practices and TIMSS scores, one-way ANOVA results indicated no statistically significant differences among teachers with different qualifications, $F(2, 519) = 0.986$, $p > 0.05$. In the same vein, a one-way ANOVA result indicated that Dimension 3: Readiness of Students for TIMSS score was not statistically significant among different teachers' qualifications, $F(2, 519) = 2.465$, $p > 0.05$.

The mean and standard deviation are used to represent the data. Dimension 3: Readiness of students for TIMSS score was statistically significantly different between different teachers' experience groups, $F(2, 519) = 3.566$, $p < 0.05$. Dimension 3: Readiness of Students for TIMSS score increased from the Bachelor’s degree (M=2.70, SD=.40) to Ph.D. degree (M=0.34, SD=.40) teacher qualifications groups, in that order. The results from the Tukey post hoc analysis revealed that the increase from the Bachelor’s degree group to the Ph.D. degree group was statistically significant (p=0.025); also, Dimension 3: Readiness of Students for TIMSS score increased from the Master’s degree (M=0.49, SD=0.03) to Ph.D. degree (M=0.34, SD=.40) teacher qualification groups, in that order. The Tukey post hoc analysis revealed that the increase from the Master's degree group to the Ph.D. degree group was statistically significant (p=0.023). Still, no other group differences were statistically significant.

A one-way ANOVA result indicated that Dimension 4: School and Classroom Environment scores were statistically significant among different qualification groups, $F(2, 519) = 12.556$, $p < 0.05$. Dimension 4: School and Classroom Environment score increased from the Bachelor’s degree M=2.85, SD=0.58 to the Master’s degree M=0.57, SD=0.04 for teachers' qualifications groups, in that order. The Tukey post hoc analysis revealed that the increase from the (Bachelor's degree) group to the (Master's degree) group was statistically significant ($p=0.000$).

4.10 Chapter Summary

A Principal Components Analysis (PCA) was run on a 90 items questionnaire that asked students in Abu Dhabi public and private schools to provide information about aspects of their home and school lives, their home environment, school climate for learning, and self-perception and attitudes toward learning mathematics. PCA revealed five factors (Factor 1: Mathematics in School, Factor 2: Students Safety and Behavior, Factor 3: Attitude toward Math, the Factor 4: School and Classroom Environment and Factor 5: Internet and Tablet).

One-Sample t-test was calculated to examine the perceptions of the students on items related to Factor 1: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude toward Math, Factor 4: School and Classroom Environment, Factor 5: Internet and Tablet on students' achievement on TIMSS 2015.

The One-Sample t-test shows that the Students had a positive perception toward Factor1: Mathematics in School (Mean=1.9552, SD=.62760 and $p<0.05$), Students had a negative perception toward Factor2: Safety and Behavior (Mean=3.2490, SD=0.65445 and $p<0.05$), Students had a positive perception toward Factor 3: Attitude toward Math (Mean=2.3458, SD=0.69183and $p<0.05$), Students had a positive perception toward Factor4: School and Classroom Environment (Mean=2.4005, SD=.63389 and $p<0.05$), and Students had a positive perception toward Factor5: Internet and Tablet (Mean=1.4664, SD=0.24359and $p<0.05$) .

To investigate the effects of student's factors (Factor 1: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude toward Math, Factor 4: School and

Classroom Environment, Factor 5: Internet and Tablet) on Student's achievement on TIMSS 2015, five-stages Multiple Regression using the enter method was deemed a suitable method of analysis (Darren & Paul, 2012).

The full model of student factors Multiple Regression revealed that all the school factors are statistically significant predictors of student achievement in TIMSS 2015. This implies that Mathematics in School, Safety and Behavior, Attitude toward Math, School and Classroom Environment, and Internet and Tablet significantly impact students' achievement in TIMSS 2015.

A Principal Components Analysis (PCA) was run on a 166 questions questionnaire that measured responses of math teachers in Abu Dhabi public and private schools to provide information about teachers of eighth-grade students and sought information about teachers' academic and professional backgrounds, classroom resources, instructional practices, and attitudes toward teaching, PCA revealed five factors(Factor 1 : School Emphasis on Academic Success, Factor 2: Teaching Mathematics to the TIMSS Class, Factor 3 : Recourses and Time, Factor 4 : Mathematics Topics Taught to the TIMSS Class, and Factor 5 : Mathematics Assessment of the TIMSS Class).

One-Sample t-test was calculated to examine the perceptions of the Math Teachers on items related to Factor 1: Factor 1: School Emphasis on Academic Success, Factor 2: Teaching Mathematics to the TIMSS CLASS, Factor 3: Resources and Time, Factor 4: Mathematics topics taught to the TIMSS class, Factor 5: Mathematics Assessment for the TIMSS on students' achievement on TIMSS 2015.

The one-sample T -test shows that the Math Teachers had a positive perception toward Factor 1: Teachers school emphasis on academic success (Mean=1.8726, SD=.38976 and $p<0.01$), Math Teachers had a positive perception toward Factor 2:

Teaching Mathematics to the TIMSS Class (Mean=1.9438, SD=.34356 and $p<0.05$), Math Teachers had a positive perception toward Factor 3: Resources and Time (Mean=2.1362, SD=0.46501 and $p<0.01$), Math Teachers had a positive perception toward Factor 4: Mathematics Topics Taught to the TIMSS Class \ Math Teachers Factors (Mean=2.4165, SD=0.88074 and $p<0.05$), and Math Teachers had a positive perception toward Factor 5: Mathematics Assessment of the TIMSS Class (Mean=2.4165, SD=0.88074 and $p<0.05$) .

To investigate the effects of Math Teachers related factors (Factor 1: School Emphasis on Academic Success, Factor 2: Teaching Mathematics to the TIMSS CLASS, Factor 3: Resources and Time, Factor 4: Mathematics topics taught to the TIMSS class, Factor 5: Mathematics Assessment for the TIMSS) on students' achievement on TIMSS 2015, five-stages Multiple Regression using the enter method was deemed a suitable method of analysis (Darren & Paul, 2012).

The full model of Math Teachers factors on Multiple Regression revealed that all the five factors are statistically significant except Teaching Mathematics to the TIMSS class, and this tells us that School Emphasis on Academic Success, Resources and Time, Mathematics topic taught to the TIMSS class and Mathematics Assessment for the TIMSS had a significant impact on students' achievement on TIMSS have significant impacts on student's achievement in TIMSS 2015.

Finally, Descriptive statistic, one-sample t-test , Independent Samples Test, a one-way ANOVA and post hoc comparisons were utilized to address Mathematics Teachers' Perceptions of TIMSS in Abu Dhabi Emirate Schools Results as primary data ,So Descriptive statistic data were utilized to address the first question (Research Questions1: What is the mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?), one-sample t-test were utilized to address the second question(

Research Questions2: Is there a positive or negative Perceptions of mathematics Teachers' about TIMSS on Abu Dhabi Emirate Schools?), Independent Samples Test were utilized to address (Research Question 3: Is there a (statistically) significant difference between males and females with respect to mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?), an Independent samples t-test was utilized to address the (Research Question 4: Is there a (statistically) significant difference between public and private schools with respect to mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?), and a one-way ANOVA and post hoc comparisons were utilized to address the Research Question 5: Is there a (statistically) significant difference in mathematics teachers' perceptions with teaching experience?

Descriptive analysis, One-Sample t-test, an Independent Sample t-test, and one-way ANOVA were also carried out on mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate school's data. The one-way ANOVA showed a statistically significant difference in overall teachers' perception of TIMSS, which led to testing further using the Tukey HSD test for multiple comparisons to know where the group difference lies. The independent t-test showed that both males and females had an equal perception of classroom practices and TIMSS, Mathematics and Instruction, Readiness of students for TIMSS, and different perceptions of school and classroom environment. More so, the independent sample t-test also showed us that both public and private schools had an equal opinion or perception towards mathematics teacher practices and TIMSS, Mathematics, and Instruction but different opinions towards students' Readiness for TIMSS as school and classroom environment.

Chapter 5: Discussion and Conclusion

5.1 Introduction

This chapter is divided into seven sections. The first section provides an overview of the current study, the research questions, and a summary of the methods employed to address the research questions. The results for TIMSS 2015 and the results for the Mathematics Teacher's perception of TIMSS in Abu Dhabi Emirate schools are provided in Section 2. Section 3 provides a discussion of the current study results in terms of the literature reviewed. The limitations of this study are presented in Section 4. The conclusions are contained in Section 5. Implications for practice and recommendations for future research are provided in the last two sections.

5.2 Research Purpose and Methods

This study aimed to identify the factors affecting the mathematics achievement of Abu Dhabi 8th grade students in the Trends in International Mathematics and Science Study (TIMSS, 2015) and also to determine mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools.

The first part of this study is a secondary data analysis of the Trends of International Mathematics and Science Study (TIMSS) 2015. The second part includes primary data from the teacher's perception questionnaire. The study sample for TIMSS 2015 consisted of 4838 students in 8th grade; 2172 girls, 2666 boys, and 220 teachers from Abu Dhabi Emirate schools. Overall, three domains were taken into consideration for this project viz. a school questionnaire, a student questionnaire and a teacher questionnaire. Mathematics test scores were also taken into consideration. A total of 522 mathematics teachers from the Abu Dhabi Emirate schools participated in the completion of the sample study of the mathematics teachers' perception questionnaire in TIMSS in the academic years between 2020 and 2021.

5.3 Summary of Results

The results were presented in two parts. The first part included TIMSS 2015 results while the second part dealt with mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools.

5.3.1 TIMSS 2015 Results

TIMSS 2015 results were focused on students, mathematics teachers, and school questionnaires and their effects on student achievement.

A Principal Components Analysis (PCA) was run on a 90-item questionnaire that asked students in Abu Dhabi public and private schools to provide information about aspects of their home and school lives, home environment, school climate for learning, self-perception and attitudes toward learning mathematics. The PCA revealed the following five factors: (Factor 1: Mathematics in School, Factor 2: Students' Safety and Behavior, Factor 3: Attitude towards Mathematics, Factor 4: School and Classroom Environment, and Factor 5: Internet and Tablet usage).

A one-sample t-test was calculated to examine the perceptions of students on items related to Factor 1 namely: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude towards Mathematics, Factor 4: School and Classroom Environment, Factor 5: Internet and Tablets usage and effects on students' achievement in TIMSS 2015.

The one-sample t-test revealed that students had a positive perception towards Factor 1: Mathematics in School (Mean=1.9552, SD=.62760 and $p<0.05$), Students had a negative perception towards Factor 2: Safety and Behavior (Mean=3.2490, SD=0.65445 and p<0.05), Students had a positive perception towards Factor 3: Attitude towards Mathematics (Mean=2.3458, SD=0.69183and p<0.05), Students had a positive perception towards Factor 4: School and Classroom Environment (Mean=2.4005, SD=.63389 and p<0.05), and students had a positive perception towards Factor 5: Internet and Tablet (Mean=1.4664, SD=0.24359and p<0.05) (Appendix B).

To investigate the effects of students' factors (Factor 1: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude towards Mathematics, Factor 4: School and Classroom Environment, Factor 5: Internet and Tablet) on students' achievement in TIMSS 2015, a five-stage multiple regression using the enter method was deemed a suitable method of analysis (Darren & Paul, 2012).

The full model of student factors' Multiple Regression revealed that all the school factors were statistically significant predictors of student achievement in TIMSS 2015. This implies that Mathematics in School, Safety and Behavior, Attitude towards Mathematics, School, Classroom Environment, and Internet and Tablet usage, significantly impacted students' achievement in TIMSS 2015.

A Principal Components Analysis (PCA) was run on a 174-item questionnaire that measured the responses of mathematics teachers in Abu Dhabi public and private schools to provide information about their academic and professional backgrounds, classroom resources, instructional practices, and attitudes toward teaching. The PCA revealed five factors (Factor 1: School Emphasis on Academic Success, Factor 2: Teaching Mathematics to the TIMSS Class, Factor 3: Resources and Time, Factor 4: Mathematics Topics Taught to the TIMSS Class, and Factor 5: Mathematics Assessment of the TIMSS Class).

A one-sample t-test was calculated to examine the perceptions of mathematics teachers on items related to Factor 1: Factor 1: School Emphasis on Academic Success, Factor 2: Teaching Mathematics to the TIMSS class, Factor 3: Resources and Time, Factor 4: Mathematics topics taught to the TIMSS class, Factor 5: Mathematics Assessment for TIMSS on students' achievement in TIMSS 2015.

The one-sample t-test showed that mathematics teachers had a positive perception towards Factor 1: Teachers' school emphasis on academic success (Mean=1.8726, SD=.38976 and $p<0.01$), mathematics teachers had a positive perception towards Factor 2: Teaching Mathematics to the TIMSS Class (Mean=1.9438, SD=.34356, and $p<0.05$), Math Teachers had a positive perception toward Factor 3: Resources and Time (Mean=2.1362, SD=0.46501 and $p<0.01$), mathematics teachers had a positive perception towards Factor 4: Mathematics Topics Taught to the TIMSS Class \ Math Teachers Factors (Mean=2.4165, SD=0.88074 and $p<0.05$), and they had a positive perception towards Factor 5: Mathematics Assessment of the TIMSS Class (Mean=2.4165, SD=0.88074 and $p<0.05$) (Appendix C).

To investigate the effects of mathematics teachers' related factors (Factor 1: School Emphasis on Academic Success, Factor 2: Teaching Mathematics to the TIMSS class, Factor 3: Resources and Time, Factor 4: Mathematics Topics Taught to the TIMSS Class, and Factor 5: Mathematics Assessment for TIMSS) on students' achievement on TIMSS 2015, a five-stage multiple regression using the enter method was deemed a suitable method of analysis (Darren & Paul, 2012).

The full model of mathematics teachers' factors on multiple regression revealed that all the five factors were statistically significant except teaching mathematics to the TIMSS class, and this tells us that school emphasis on academic success, resources and time, mathematics topic taught to the TIMSS class, and mathematics assessment for TIMSS had a significant impact on students’ achievement in TIMSS 2015.

A Principal Components Analysis (PCA) was run on a 77-item questionnaire administered to school principals or head teachers to provide information about the school contexts for teaching and learning, The five factors from the school questionnaire were General School Resources, School Discipline and Safety, Parental Support, Principal Experience and Education, and Library and Instruction Resources.

A one-sample test was calculated to examine the perceptions of the headmaster on items related to Factor 1: General School Resources. the headmaster had a negatively perception toward Factor 1: General School Resources (Mean=2.4165, SD=0.88074 and $p<0.05$), headmaster had a positive perception toward Factor 2: School Discipline and Safety (Mean=1.6013, SD=0.49186 and $p<0.05$), the headmaster had a positive perception toward Factor 3: Parental Support (Mean=2.3159, SD=0.55927 and $p<0.05$), the headmaster had a positive perception toward Factor 3: Parental Support (Mean=2.3159, SD=0.55927 and $p<0.05$), principal had a negative perception toward Factor 4: Principal Experience and Education (Mean=2.3159, SD=0.55927 and $p<0.05$) .

To investigate the effects of school factors (Factor 1: General School Resources, Factor 2: School Discipline and Safety, Factor 3: Parental Support, Factor 4: Principal Experience and Education, and Factor 5: Library and Instruction Resources) on students' achievement on TIMSS 2015, five-stage multiple regression using the enter method was deemed a suitable method of analysis (George & Mallery, 2020).the full model of school factors multiple regression revealed that all the school factors are statistically significant except Factor1: General School Resources.

5.3.2 Mathematics Teachers' Perceptions of TIMSS in Abu Dhabi Emirate Schools Results

Descriptive statistics, a one-sample t-test, an Independent Samples Test, a one-way ANOVA, and post hoc comparisons were utilized to address mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools. A one-sample t-test was utilized to address the first question; [Research Questions 1: What are the mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?]. A one-sample t-test was utilized to address the second question: [Research Questions 2: Is there a positive or negative perception of mathematics teachers' about TIMSS in Abu Dhabi Emirate schools?]. An Independent sample t-test was utilized to address the third question: [Research Question 3: Is there a (statistically) significant difference between males and females with respect to mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?]. An Independent sample t-test was utilized to address the fourth question: [Research Question 4: Is there a (statistically) significant difference between public and private schools with respect to mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?]. A one-way ANOVA and post hoc comparisons were utilized to address the fifth question: [Research Question 5: Is there a (statistically) significant difference in mathematics teachers' perceptions with teaching experience?].

Descriptive analysis, a one-sample t-test, an independent sample t-test, and one-way ANOVA were also carried out on mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate school's data. The one-way AN2OVA showed a statistically significant difference in overall teachers' perception of TIMSS, which further tested the Tukey HSD for multiple comparisons to determine where the group difference was. The independent t-test revealed that males and females had similar perceptions of classroom practices and TIMSS, mathematics and instruction, and student readiness for TIMSS, but different perceptions of school and the classroom environment. The independent sample t-test also showed that both public and private schools had an equal opinion or perception towards mathematics teacher practices and TIMSS, mathematics, and instruction but different opinions towards students' readiness for TIMSS, school, and the classroom environment.

5.4 Discussion of Results

The current study's results are consistent with the "Input-Process-Output" of students, math teachers, school factors, and mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools' results. The discussion of TIMSS 2015 results is presented first, followed by a discussion of mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools' results.

5.4.1 The Discussion of TIMSS 2015 Results

Student Factors Affecting 8th-Grade Students' Math Achievement on TIMSS 2015

Factor 1: Mathematics in School

Mathematics in school significantly impacted students' achievement in TIMSS 2015 (B= -22.817, p (0.000) < 0.01). Furthermore, a one-sample t-test revealed that students positively perceived Factor 1: Mathematics in School (Mean=1.9552, SD=.62760, and p 0.05) (Appendix B).

This finding is consistent with the study by Goodall et al. (2017), who reported that many students in 8th grade usually do not have many opportunities to learn mathematics at home. Consequently, mathematics in school is essential because students can learn in a more organized manner. Teachers have already set out syllabuses to ensure students understand mathematics more effectively. Learning in school positively impacted students' achievement on TIMSS 2015, mainly because they had qualified teachers to guide them.

Peer learning in 8th-grade mathematics also helps students to learn with their peers in teams. Any student who fails to understand any particular concept can get the necessary assistance from fellow students. This makes the school the ideal place for students to learn (Eldeeb, 2012).

Similarly, Montague et al. (2014) showed that school provides the necessary facilities for an 8th-grade student to learn effectively. Young students might require components such as counting aids, which are an integral part of mathematics learning (Afari, 2012) but which are hardly available. Afari (2012) conducted a Z-test to determine whether counting aids assist 8th-grade students in performing better in mathematics. The results showed that the aids positively impacted the students' understanding of mathematics which was evident since they achieved an average mean of 2.78, which is > 2.5). This result was confined to a school environment as in any other setting the same result could not be achieved. Therefore, 8th-grade students learn mathematics more effectively when they learn in school where all the components and amenities required for proper learning are readily available (Cuenca-Carlino et al., 2016).

It becomes evident from the preceding assertions about mathematics that the importance of mathematics in any society cannot be overemphasized. Von Suchodoletz et al (2020) stated: "In today's increasingly technological society, a strong background in mathematics is crucial in many career and job opportunities, like in the United Arab Emirates." In his attempt to show how essential mathematics is, Abu-Hilal and Bahri (2000) asserted that mathematics is called the "queen of all sciences" since it has promoted the growth of many cultures. It is not only this but also the art of all arts. Wagie and Fox (2006) stated that math is regarded as the mirror of civilization and the whole academic world's emperor. Opinions from various schools of thought have described mathematics as the cornerstone upon which all other subjects, chemistry, physics, biology, and economics, can be built (Alharbi et al., 2020).

Factor 2: Student Safety and Behavior

Students' feelings of safety and behavior significantly impacted their achievement in TIMSS 2015 (B=-16.845, p (0.000) < 0.01). A one-sample t-test indicated that students had a negative perception towards Factor 2: Safety and Behavior (Mean=3.2490, SD=0.65445, and p<0.05) (Appendix B).

This study showed that pride and safety are essential components for effective learning to take place. Every student needs to feel confident and safe to comprehend what they are being taught. When any student suffers from one or other form of psychological or mental inferiority, it reflects in their learning because their pride has been dented so therefore their rate of learning stagnates significantly. Pride, when accompanied by safety, enables harmony which ultimately leads the student to perform at optimal level enabling achievement in the education process. This finding is consistent with Yaşaroğlu (2016), which shows that pride mainly results from students' ability to solve academic issues that they could not previously solve. The 8th-grade students are primarily concerned with what they can achieve. According to Cordero et al. (2018), solving a simple problem derives a high sense of pride, which plays an essential role in the student's achievement in TIMSS. For teachers and ordinary people not having any relationship with the education process, this could be regarded as insignificant, but for 8th grade students, this is an achievement that plays a significant role in boosting the student's self-esteem (Khamis et al., 2008). In Abu Dhabi, the Emirate school's pride and safety combination further encourages students to learn even more. A student with satisfaction and safety will not mind working extra hard to understand different things. Consequently, every student in the 8th grade can benefit much more through pride and safety (Baifakh, 2003).

Achtziger and Gollwitzer (2008) found that safe learning environments can be threatened by internal threats, such as bullying, corporal punishment, gang recruitment as well as external threats, such as school attacks, and environmental threats, such as natural disasters. All these threats have the potential to decrease students' academic performance significantly. Daleure et al. (2014) found a growing body of research which points to a connection between school environments and student outcomes, and much remains unknown about the effect of perceived school safety on learning. Most of the evidence originates from middle and high-income countries and focuses on educational outputs, such as attendance and retention, rather than academic achievement (Ashour, 2020). Ridge (2010) found a more quantitative analysis of the relationship between school safety and student performance in developed countries. Ridge (2010) concluded that students' performance increases when they feel safe in school.

Factor 3: Attitude towards Math

Attitude towards math is a crucial student factor that plays an integral role in determining students' performance in 8th-grade mathematics. Attitude towards mathematics significantly impacted students' achievement in TIMSS 2015 ($B= -33.420$, $p (0.000) < 0.01$). A one-sample t-test indicated that students had a positive perception towards Factor 3: Attitude toward Math (Mean=2.3458, SD=0.69183, $p<0.05$) (Appendix B).

Farooq and Shah (2008) concluded that there is a significant impact on a student's confidence towards mathematics. They used the Urdu translated Fennema and Sherman (1977) Mathematics Attitude Scale to conduct a t-test with a $p<0.05$. The results had an average mean of 1.276. They concluded that teachers and parents should focus mainly on boosting students' confidence to improve their performance in mathematics. The study corresponds to a study by Di Martino and Zan (2011), which explains that a student's emotions and beliefs impact the overall performance of the student's performance in mathematics. They concluded that students' emotions and anxiety levels determine whether they will perform better in mathematics or not. Beliefs in mathematics are what students accept as being hard without even attempting a trial. The students' beliefs should change to believe that mathematics is not hard and complicated, thereby improving their performance (Di Martino & Zan, 2011).

Abu-Al-Aish and Love (2013) stated that every student's achievement in TIMSS is greatly affected by their attitude towards mathematics. The most critical period for homework is when the students have to be away from school for a prolonged period of time (Abdelfattah & Lam, 2018). This can occur over weekends or extended holiday breaks. Such times provide students with opportunities to engage in activities that can easily erase what they had learnt in school (Tucker, 2012).

Research by Hannula (2014) indicated that the attitude towards mathematics by students changes as they grow. Hannula explained that the progression of students from the elementary to secondary stages of school, negatively impacts their mathematics learning. The study further explains that the general attitude towards mathematics is highly related to the quality of the socio-psychological climate and the teachings from the class (Hannula, 2002). They conducted a simple t-test to clarify the claim. The results were as follows (Mean=2.2615, SD=0.6743, and p<0.05). This shows that the socio-psychological climate negatively impacts students' attitude towards mathematics.

Factor 4: School and Classroom Environment

Student's questionnaire results revealed that Factor 4: School and Classroom Environment significantly impacted students' achievement in TIMSS 2015 (B=5.743, p=0.028 > 0.01). This finding is consistent with Goodall et al. (2017). Furthermore, a one-sample t-test reveals that students positively perceived Factor 4: School and Classroom Environment (Mean=2.4005, SD=.63389, and (p< 0.05) (Appendix B).

A student who understands this has a higher chance of working harder in mathematics to get a job after school (Eriksson et al., 2019). Teachers and other stakeholders have an essential role in ensuring they understand the importance of mathematics in getting jobs (Davis & Carlo, 2018). A student in the 8th grade might not fully comprehend this due to their immature nature. But according to the previous chapters of this dissertation, students who understand the job market have a greater opportunity in understanding mathematics better. Some students might come from backgrounds where they do not need jobs to get the lives they want. Even such students should understand that jobs provide a unique opportunity to interact with other people, leading to happier lives (Gentilucci & Muto, 2007). Therefore, helping students to understand that mathematics might enable them to advance their careers by making job opportunities readily available is among the most effective ways to help students learn more efficiently (Baifakh, 2003). Daleure (2014) found that student achievement in mathematics is inextricably linked to future career opportunities, plays an essential role in the student's general learning acquisitions, and is a reliable criterion to divide students into scientific or literary streams. Pauceanu et al. (2018) also found that mathematics achievement can be a gateway to well-rewarded and high-status positions.

Factor 5: Internet and Tablet

The Internet and tablets significantly impacted students' achievement in TIMSS 2015 (B= -33.420, p (0.000) < 0.01). A one-sample t-test showed that students had a positive perception towards Factor 5: Internet and Tablet usage (Mean=1.4664, SD=0.24359 and p<0.05) (Appendix B). TIMSS 2015 showed that the Internet and tablets play an essential role in determining students' performance (Burroughs et al., 2019). Burroughs et al. conducted a study to assess the effect of tablets on student achievement. They determined that tablet support improves students' overall performance; the result showed a mean of 2.61 >2.5.

This finding is consistent with Goodall et al. (2017) study. Most technology resources support students' achievement. According to Goodall et al. (2017), the tablets and technology resources encourage children to study mathematics and other subjects, giving them more confidence (Dukmak & Ishtaiwa, 2015). Dukmak and Ishtaiwa (2015) conducted a study to determine the impact of technological devices on students' overall performance. The Z-test showed that technology devices support mathematics in the students' overall performance. Factor 5: Internet and Tablets align with the Deficit Model in the conceptual framework of this study; for example, the shortage of internet, computers, tablets, and different school resources has a negative impact on students' achievement.

Mathematics Teachers' Factors Affecting 8th-Grade Students' Math Achievement on TIMSS 2015

Factor 1: School Emphasis on Academic Success

Factor 1: School Emphasis on Academic Success did not significantly impact students' achievement in TIMSS 2015 (B= 8.842, p (0.031) > 0.01). A one-sample t-test indicated that mathematics teachers had a positive perception toward Factor 1: Teachers school emphasis on academic success (Mean=1.8726, SD=.38976 and p<0.01) (Appendix C). This finding is consistent with Cruz et al. (2019). Students rely on the guidance provided by the teacher to learn other subjects. The direction controls the students' achievement in TIMSS (Morris & Hiebert, 2017).

Ashour (2020) stated that academic success comes almost naturally to some students who understand the mathematical concepts taught within the school milieu more readily. Such students have an easier time understanding mathematics, making them seem brighter than the other students in a class (Ridge, 2010). Students who do not have natural academic success need their teachers' guidance (Harb & El-shaarawi, 2007). Most teachers are appropriately trained to know the techniques to help students understand different subjects (Daleure et al., 2014). This is why parents send their children to school to be handled by professional teachers (Gentilucci & Muto, 2007).

Wagie and Fox (2006) also noted that academic success is dependent on the diligence displayed by every student. This is a concept which is emphasized by most academic places. A student in 8th grade requires help from all the involved stakeholders to have meaningful academic success. Therefore, academic success means that students have a higher chance of understanding math more easily (Tucker, 2012).

Studies have shown that academic optimism has significantly influenced students' performance (Alghizzawi et al., 2019). Academic optimism mostly mirrors the needs of parents, teachers, and students to attain academic success. (Alghizzawi et al., 2019). Schools' prominent role in influencing the students to achieve success academically has also been briefly discussed. For instance, Alhashmi et al. (2019) studied the part played by instructional quality as a possible intermediary between schools' environments and instilling interest in students. He focused on three features of the school environment (prominence on academic accomplishment, security, and discipline in schools) and three features related to encouragement for attaining success (self-concept, intrinsic value, and extrinsic value). Abdel-Khalek (2012) purports a substantial, optimistic relationship between the quality of instruction and the stimulation given to motivate students in the mathematics classroom. Alloghani (2015), states that by employing multilevel structural equation models, a significant positive outcome of the awareness of pedagogical content on learning improvement becomes realized. Alloghani (2015) has also presented a unique research synthesis to analyze the relationship between teachers' quality and their effects on students.

Factor 2: Teaching Mathematics for the TIMSS

Factor 2: Teaching in preparation for TIMSS did not significantly impact students' achievement in the TIMSS 2015 (B= 3.997, p (0.280) > 0.01). A one-sample t-test indicated that mathematics teachers had a positive perception towards Factor 2: Teaching Mathematics to the TIMSS Class (Mean=1.9438, SD=.34356 and $p<0.05$) (Appendix C).

Mathematics is pivotal in enabling students to understand the subject effectively. Findings from this study showed that teaching TIMSS classes played a meaningful role in students understanding questions more readily. Mathematics teaching expertise has proven to be the key element in unlocking students' understanding of complex mathematical formulae as many of the values as taught, are completely new to students who participate in the TIMSS class.

Teaching mathematics to prepare students for TIMSS paves the way for the teacher to rectify any misunderstandings that may arise which is related to their testing. Saragih and Surya (2017) showed that being corrected in mathematics plays a vital role in making students learn faster. Through correction, students can avoid the mistakes that might be preventing them from understanding mathematics more effectively. According to Eldeeb (2012), teachers can correct students politely and helpfully. The teacher uses language and approaches that are likely to make an 8th-grade student understand the corrections (Bdeir, 2019).

Consequently, teaching the same content for TIMSS for understanding mathematics is challenging. Ashour (2020) found a significant relationship between the teachers' use of the different instructional strategies and their student's performance in mathematics. For example, Vally et al. (2019) explained that the students involved in problem-solving, self-practice, teachers demonstrating, and students contributing to the teaching sessions, perform positively in mathematics.

Factor 3: Resources and Time

Resources and time significantly impacted students' achievement in TIMSS 2015 ($B= -13.021$, $p\ (0.000) < 0.01$). A one-sample t-test indicated that mathematics teachers had a positive perception towards Factor 3: Resources and Time ($Mean=2.1362$, $SD=0.46501$ and $p<0.05$) (Appendix C). Findings from TIMSS 2015 showed that resources and time played an essential role in determining students' performance. Resources and time are essential components in promoting effective student learning. When a healthy learning mood gets cultivated within the school setting, mathematics learning takes place more effectively (Zaharna, 1995). Zaharna (1995) used a simple Z-test that sought to determine the effect of the school's learning mood on a student’s performance in TIMSS and derived an average mean of 2.56, which is > 2.5.

Jarrah and Alkhazaleh (2020) found that that in a school environment where resources and time were put to effective use, the result was a positive effect on the learners’ psyche. Whenever a student enters a school compound, the student's mind is configured to learn and understand more easily. Jarrah and Alkhazaleh (2020) conducted a one-sample T-test to determine whether resources affected students' minds. The results expressed an average mean of 2.83 which proved to be more significant than the average of 2.5 indicating that improved resources impacted and enhanced students' thinking and perceptions. This is unlike any other resource because most school environments are disruptive (Abu-Hilal & Bahri, 2000). While in school, students also interact with other students. Sulisworo and Toifur (2016) showed that interacting with other students in school helps students feel the urge to learn. Sulisworo and Toifur (2016) conducted research to determine the effect of students’ interactions on increasing the urge of students to learn. They conducted a binomial test and determined that students’ interactions positively impacted their urge to learn resulting in an average mean of 2.84, which is >2.5).

Students enjoy resources where they are free to play without the limits imposed on them due to overly strict parental restrictions. They are guided by their teachers and other stakeholders and follow rules set by the school. Resources therefore provide a platform for students, including 8th-grade students, to learn mathematics more effectively (Cordero et al., 2018). Salloum (2018) found that resources and time encompass physical environments such as classrooms and teachers' houses, classroom size, how dark or light it is, temperature, the arrangement of chairs, and the noise, affecting teachers and students' attention. Abu-Al-Aish and Love (2013) found that it can assist pre-professional mathematics teachers in exploring the advantages of e-learning to learn the new methods of teaching mathematics and designing various strategies that promote learning effectiveness.

Abu-Al-Aish and Love (2013) used a one-sample t-test and determined that e-learning assists students to understand mathematics better. The results showed an average mean of 2.55, which is > 2.5. It is hoped that the readers and stakeholders in education and those who believe that the availability of resources can promote teaching effectiveness will find this study beneficial as it assists in maintaining factors that encourage cultural effectiveness in dealing with students. The results in Factor 3: Resources and Time confirm and reflect the theoretical framework of this study. The deficit and shortage of educational resources (books, computers and tablets) have negative effects on students' achievement.

Factor 4: Mathematics Topics Taught to the TIMSS Class

The mathematics topics taught in preparation for the TIMSS assessment, significantly impacted students' achievement in TIMSS 2015 (B= -20.011, p (0.000) < 0.01). A one-sample t-test indicated that mathematics teachers had a positive perception towards Factor 4: Mathematics Topics Taught to the TIMSS Class: Math Teachers Factors (Mean=2.4165, SD=0.88074 and p<0.05) (Appendix C).

Eighth-grade students mostly learn mathematics through relatively easy topics first (Senk & Thompson, 2020). This is important because the more specific topics make them better prepared for more sophisticated topics (Darren & Paul, 2012). The syllabus guides teachers on the topics they should teach. Morris & Hiebert (2017) explained that the syllabus is prepared by professionals who understand teaching mathematics concepts to young minds. The teachers are required to teach different topics in friendly and straightforward ways (Fauth et al., 2014). These teachers are trained in the most effective techniques of ensuring the students can understand the various topics without struggle (Alhashmi et al., 2019).

Mathematics topics taught to make students familiar with TIMSS testing, serve as a determinant for student performance according to data from chapter 4 of this dissertation. Some topics require considerably more time, depending on their complexity. The teacher determines the amount of time required allocated to teach every TIMSS related topic. These topics also determine the mood of the class since there are some topics with more enjoyable concepts (Oddone, 2016). Such topics keep the students interested, and as a result, they can learn faster. Therefore, mathematics topics and concepts taught with a view to TIMSS preparation and mastery, is one of the primary factors determining performance (Khamis et al., 2008).

Vracheva et al. (2019) found that educational leaders must be prepared for the elements and change processes when implementing an innovative and controversial new mathematics curriculum. Often, implementing a new curriculum requires teachers, parents, and students to alter how they think about mathematics, what they hold to be true about mathematics, and how they have traditionally done mathematics (Vracheva et al., 2019). A transformation of this magnitude can lead to frustration, confusion, and anger among teachers, parents, students, and other community members (Afari, 2012). It should be understood that curriculum reform initiates resistance factors because reform brings about change, breaking away from tradition. A break from tradition always stirs animosity and fear of change (Afari, 2012).

Factor 5: Mathematics Assessment for TIMSS

The mathematics assessment for TIMSS significantly impacts students' achievement in TIMSS 2015 (B=-21.378, p (0.000) < 0.01). And, according to the one-sample t-test, mathematics teachers had a favorable attitude towards Factor 5: Mathematics Assessment of the TIMSS Class (Mean=2.4165, SD=0.88074, p 0.05) (Appendix C).

In every TIMSS class, there are students with different abilities. According to Cruz et al. (2019), students have different levels of understanding. Consequently, it is paramount for a proper assessment for every class to be conducted. Teachers are responsible for establishing whether the students understand what is being taught (Kartal, 2020). This includes ensuring that the slow learners in the class are not left behind. The mathematical assessment ensures that each student in the class understands all the aspects taught at any particular time (Cruz et al., 2019). Cruz et al. (2019) concluded that mathematical assessment positively impacted the student's level of understanding of mathematics with an average mean of 2.62, which is >2.5).

Assessment of mathematics skills can be done in different ways, including asking random questions to different students. The teacher can also provide simple random tests after every topic (Goodall et al., 2017). Such tests reflect how well the students have understood the topic in question. Furthermore, the assessment allows the teacher to identify students struggling with specific concepts. Accurate assessment enables the teacher to understand the most effective ways to help struggling students. In this way the teacher modifies instruction for teaching TIMSS related concepts. This is important because 8th-grade students might require specialized techniques to understand specific topics. Consequently, mathematics assessment is among the essential components of mathematics performance in the TIMSS class.

Such tests reflect how well the students have comprehended the topic in question. Furthermore, the assessment allows the teacher to identify the students struggling with specific details (Ashour, 2020). An effective assessment helps the teacher to identify problem areas of learning so in this way can implement the most effective ways of helping a student who might be struggling (Stronge & Tucker, 2000). The teacher will also know whether to change the approach used to teach for TIMSS. This is important because 8th-grade students might require specialized techniques to understand specific topics.

Consequently, mathematics assessment is among the essential components of mathematics performance in TIMSS. The results in Factor 5: Mathematics Assessment for TIMSS is a real example that reflects the equity model in the theoretical framework in this study. All students have the right to participate in education. Local and international tests improve and increase students’ mathematical skills.

School Factors Affecting 8th-grade Students' Math Achievement on TIMSS 2015

Factor 1: General School Resources

School questionnaire results revealed that Factor 1: General School Resources doesn’t significantly impact students' achievement on TIMSS 20152015 (B= -3.127, p (0.048) > 0.01). And the One-Sample t-test shows that the principal had a negative perception of Factor 1: General School Resources (Mean=2.4165, SD=0.88074, and p<0.05) (Appendix A).

This finding is in contrast to the results of previous studies. Alenezi (2017) found that General School Resources are defined as facilities and services to achieve engaging and effective learning experiences. The technology of instruction has played a significant role in helping students understand what is required of them and effectively approach problem-solving. Similarly, Alenezi (2017) also found that instruction technology has significantly improved students' learning experience.

In Abu Dhabi Emirate School, the school teachers require support and time to use re-cent technologies and strategies to improve their work before learning to use them in the teaching process (Hamad et al., 2022). It's essential to understand the significance of instructional technology in helping 8th-grade students perform well in mathematics in the TIMISS. Also, Abed (2001) has spotted the significance of understanding students’ level of math anxiety in the UAE students. Technology may help in reducing such math anxiety with flexible and multiple learning tools. They are more able to use them than those of the previous generations. Technological developments have produced a novel and advanced techniques to present and instruct students, and it also has a demand for integrating instructional technology in teaching mathematics.

In a study of 8th-Grade students, it was shown that it is possible to guide students to perform well on mathematics assessments through the use of educational technology (Najm, 2015). The students were given training for the Virginia Standards of Learning Mathematics tests by using computer technology and software related to the subject by providing them access to various websites. Properly used, technology helps teachers present concepts to students more efficiently and helps students learn with more convenience (Alotaibi et al., 2021). Technology has also allowed students to learn math in a more dynamic way (Harb & El-shaarawi, 2007). Nowadays, students are getting many opportunities to connect with technology, as they can have access to it at both schools and homes. Most of them are attracted to it by using their iPod, cell phone, or laptops, and they always remain in contact with some form of it. Applying technology in teaching to intensify students' yearning to study and comprehend mathematics indeed nourishes their cravings to remain in close contact with technology, which positively affects their learning and performance in standardized tests (Viberg et al., 2020; Wardat et al., 2022).

Factor 2: Discipline and Safety

School discipline and safety were significantly impacting students' achievement in TIMSS 2015 (B= -8.329, p (0.004) < 0.01). One-Sample t-test results showed that principals had a positive perception of Factor 2: School Discipline and Safety (Mean=1.6013, SD=0.49186 and p<0.05 (Appendix A).

This finding is consistent with the findings of Huguley et al. (2020). which show that an 8th-grade student needs to be optimally disciplined and, at the same time, feel safe to per-form well. The school administration and the teachers are responsible for coming up with rules to be followed in school. They also have the responsibility of providing the students with the necessary safety. When discipline and safety are enhanced, a better learning environment is created, which directly translates to improved performance (Bdeir, 2019).

Young students in the 8th grade might not fully understand the importance of discipline. These students have a lot of energy, and they want to experiment in different ways. This leads to indiscipline and can easily result in a lack of safety (Booren et al., 2011). If discipline is in-stilled correctly and the necessary safety is provided, they will perform better. Indiscipline is cited as one of the primary factors that lead to distractions and, therefore, results in poor performance (Mullis et al., 2020). Safety also plays an integral role where students feel safer being able to contrite and perform well (Kutsyuruba et al., 2015). Kibriya et al. (2018) found out that safety positively impacted the performance of students in some African countries. There was a negative effect of potentially an unsafe classroom and school environment on achievement in math and other disciplines among Rwandan and Tanzanian students (Kibriya et al., 2018).

The most critical factors appeared to be students' concerns about school discipline, their relationships with teachers, and their concerns about classroom disruption (Whisman & Hammer, 2014). Past studies have linked safety issues in schools with low performance of students in mathematics (Zhang et al., 2019). According to this structure, the traditional way of dealing with indiscipline, mainly in the classroom, seems insufficient. It suspects that the school-level indiscipline, such as vandalism and illegal use of drugs, may provide shelters or excuses for classroom misbehavior. Classroom disruption can also be a natural reflection of the conflict or tension between teachers and students and affects mathematics achievements (Bodovski et al., 2018).

In other words, if the disciplinary climate is unhealthy at the school level, it may well be problematic at the classroom level. These results of Discipline and Safety align with the conceptual framework of this research. The school applies public safety to all students equally, in addition to using the rules of discipline within the classroom and the school, so that all students in the school are equity in all safety and discipline rules that are positively reflected with the student's achievement. The results of Factor 2: Discipline and Safety align with the conceptual framework. The school applies public safety to all students equally and uses the rules of discipline within the classroom and the school. Equity in respect of safety and discipline rules for all students, positively reflects in their achievement.

Factor 3: Parental Support

Parental support significantly impacted students' achievement in TIMSS 2015 (B= -31.846, p (0.000) < 0.01). One-Sample t-test shows that principals had a positive perception toward Factor 3: Parental Support (Mean=2.3159, SD=0.55927 and p<0.05) (Appendix A).

This finding is somewhat consistent with the results of Davis and Carlo (2018), who reported that parents play a significant role in students' education to data collection and analysis, parents are an integral part of a student's performance, and approximately 60% offered a valid response to parental influence on mathematics performance. Davis and Carlo (2018) used a simple t-test to determine whether Parental Support impacted the overall performance of the students in TIMSS. They acquired an overall mean of 2.245, which is <2.5; these results show that parental support had a negative impact on the average performance of the students). Eldeeb (2012) reported a high level of parental involvement in the children's educational outcomes in the same vein. For 60% of the parents (48.6% of whom are highly educated), parental time use with children varies from 3 to 5 hours daily. Yet, 57.2% of these parents were aware that they were partly responsible for their children's educational outcomes, with 52.3% deflecting their low academic achievement in schools (Wagie & Fox, 2006).

Abu Dhabi Emirates' parents played a significant role in supporting their children in mathematics performance in 8th-grade because parents' support involves certain attributes such as monitoring their kids and motivating them in mathematics content, counseling in relation to mathematics, and providing resources (Alhashmi et al., 2019). It is crucial to understand that students with supportive parents tend to perform better in mathematics and develop a positive attitude (Ersan & Rodriguez, 2020). Ridge (2010) explained that students with non-supportive parents are likely to develop negative attitudes towards mathematics, hence perform poorly in mathematics. Students with parents who are motivators, resource providers, and good monitors of their children were better in their mathematics performance. Therefore, parents may have a significant role in ensuring their kids achieve better performance when it comes to mathematics just by being supportive, motivators, resource providers, good advisors, and counselors. Khamis et al. (2008) stated that parental expectations could be connected to parental pressure, which could have different results, depending on whether it is positive or negative. Research shows that a significant positive predictor of student math achievement is how much parents restrict out-of-school activities (Dukmak & Ishtaiwa, 2015).

Factor 4: Principal Experience and Education

School principals with experience and high education qualification significantly impacted students' achievement in TIMSS 2015 ($B= -30.126$, $p (0.000) < 0.01$). One-Sample t-test showed that the principal had a positive perception of Factor 4: Principal Experience and Education ($Mean=2.3159$, $SD=0.55927$, and $p<0.05$) (Appendix A).

This finding is consistent with Huguley et al.'s (2020) results, who reported that principals with 20 years or above have a positive perception and awareness of students' achievement. Lubienski et al. (2008) reported similar findings, and they observed that principals with higher qualifications who portray the school climate as positive, obtain higher achievement scores. Similarly, Gentilucci and Muto (2007) suggest that students identify direct and highly influential instructional leadership behaviors. Among these were principal approachability, interactive classroom observation/visitation, and instructional leadership behaviors that firmly establish administrators as the "principal teachers" in their respective schools (Fauth et al. ,2014). Fauth et al. (2014) reported that the above factors positively impacted the students, such as principal approachability. According to Incikabi et al. (2020), the principal's experience is vital in determining and influencing teachers' professional development. That reflects teachers' helping their students achieve better performance in their education (Tucker, 2012).

Vale et al. (2010) reported that principals significantly affect students' math outcomes. Much of the effect is likely related to the match between the principal and the school; a principal's education also plays a small role in improving students' scores. Principals with high value-added increased test scores have low value-added or new reduced scores (Zaharna, 1995). Despite examining a variety of school inputs and outcomes, we could find only part of the puzzle to help us disentangle the contributions that high- and low-value-added principals make to their schools and students (Vally et al., 2019).

Factor 5: Library and Instructional Resources

Library and instruction resources significantly affected students' achievement in TIMSS 2015 ($B = -9.784$, $p\ (0.000) < 0.01$); and One-Sample t-test shows that principal had a negative perception toward Factor 5: Library and Instruction Resources ($Mean = 2.7595$, $SD = 0.64013$ and $p < 0.05$) Appendix A.

This finding is consistent with Oddone's (2016) study that shows that students get an insight of only about 20% of their learning through teaching. The student's responsibility is to research and find more details regarding what is taught in class. Oddone (2016) conducted an ANOVA test where they examined the students and deter-mined that student get 80% insight from the library and only 20% from class teaching. Therefore, library and instructional resources need to be provided for a student to learn mathematics more effectively.

Some of the most critical components that affect performance in a TIMSS class include library and instruction resources. So, in Abu Dhabi schools, students need resources that can provide more insight in addition to what is taught in the class. The resources are also helpful because they can be used at almost any time. This study showed that students with access to these resources tend to perform better. The schools have the responsibility of providing these resources. A student can also decide to acquire these resources independently to better his or her education. Library resources complement the education pro-vided in class.

A student can use these resources to practice what was taught in class. The student needs to choose the appropriate resources that resonate with the lessons learned in class (Lubienski et al., 2008). Firstly, Kutsyuruba et al. (2015) reported library services as one of the services needed to upgrade students' knowledge. It is a place for self-development. The finding is similar to studies that have been done in the past to understand the concept of library services in the school setting. Most of the studies described library ser-vices in different versions Alghizzawi et al. (2019). A library is a place where necessary materials (print and non-print materials) are put in place for self-development. Library as the collection of newspapers, books, tapes, television, etc., which are kept for students and staff to use during and after school hours. The library is essential in the learning process. The books control the learning process. The academic library aims to enhance users' knowledge for their betterment Daleure et al. (2014). The five factors related to school and classroom environment together with leader-ship quality of school principals seemed to have a significant role in students' achievement in mathematics in TIMSS 2015 and possibly, other years too. While considering school planning and educational polies, other factors such as mathematics teachers' perceptions of TIMSS (Wardat et al.,2022) and interdisciplinary approach to collaboration, communication, and creative educational practices could be enhanced with a greater prospect, decentralized priorities, and STEM/STEAM movement as a process (Belbase et al., 2021) to improve students' achievement in mathematics and science in TIMSS, PISA and PIRLS. Therefore, these five school factors should be studied in conjunction with other factors related to teachers, students, parents, and interdisciplinary activities.

5.4.2 The Discussion of Mathematics Teachers' Perceptions of TIMSS in Abu Dhabi Emirate Schools Results

A one-Sample t-test was conducted to examine the perceptions of teachers on items related to mathematics teachers' practices for TIMSS. The results of the One-Sample t-test indicated that teachers had negative views towards practices for TIMSS (Mean=2.86, SD=0.58 and $p<0.05$), indicating that their perception of classroom practices were not aligned with TIMSS. A One-Sample t-test was conducted to examine teachers' perceptions of items related to mathematics teachers' perceptions of TIMSS. The results of the One-Sample t-test indicated that teachers had a positive perception toward TIMSS (Mean=3.17, SD=0.41 and $p<0.05$). In addition, a One-Sample t-test was conducted to examine the teachers' perceptions of student readiness for TIMSS. The One-Sample t-test clearly shows a negative assessment of the readiness of the students for TIMSS (Mean=2.71, SD=0.43 and $p<0.05$). Similarly, a One-Sample t-test was conducted to examine the mathematics teachers' perceptions of the school and classroom environment for TIMSS. The results of the One-Sample t-test indicated that teachers had negative perceptions as to whether the classroom environment encourages students to be ready for TIMSS (Mean=1.71, SD=1.14, and $p<0.05$).

Quite a few research studies have been conducted concerning mathematics teaching practices and TIMSS. This study concludes that creating a suitable environment for students, conducting interactive academic sessions, encouraging classroom environments, and promoting healthy and competitive school settings all play a significant role in student performance in mathematics, and lead to remarkable results in TIMSS. According to Güven and Akçay (2019), teachers should have sufficient experience and knowledge to deliver lessons to students efficiently. Alharbi et al. (2020) highlight teacher quality as among the critical determinants of the student learning process. A similar study by Berger et al. (2020) concluded that this attribute plays an essential role in mathematics performance. Several studies have been performed in relation to mathematics and instruction. In these studies, the efforts of Clavel et al. (2016) are comprehensive and lucid. These studies have led their study to conclude that activities such as a suitable environment for students, active involvement of skilled teaching staff, collaborative academic sessions, a motivational attitude of teachers, and ideal distribution of resources and time were helpful in improving students' performance in mathematics in TIMMS in 2015. Incikabi et al. (2020) clearly show that teachers need to use simplified instruction when teaching mathematics. Mathematics teaching and learning can be simplified by achieving higher student engagement using flipped classes Incikabi et al. (2021). This is most applicable when introducing new topic that students might not be conversant in. Another study carried out by Cuenca-Carlino et al. (2016) concluded that mathematics and instructions were pivotal in determining mathematics performance in TIMSS. The results of the present study suggest the same, especially considering that mathematics and instruction are at the center of mathematics teaching in alignment with TIMSS.

Davis and Carlo (2018) performed different studies on students' readiness for TIMSS in order to understand the environmental impact on learning. The results led their research to confirm that an exceptional school environment, proficient instructors, communicative class sittings, better classroom management, overall classroom ambiance, and competing milieu in schools all considerably affected mathematics performance in 2015. Furthermore, Ersan and Rodriguez (2020) revealed that most students employed different tactics to study for mathematics examinations. Teachers may see this preparation as inadequate, and as a result can guide students on what to do and what to avoid (Ersan & Rodriguez, 2020). Another similar study by Provasnik et al. (2019) showed that students' readiness for TIMSS is an integral part of their performance. The findings of this study support this view and helping to recognize that the readiness of students for TIMSS is among the primary determinants of performance in TIMSS. The school and classroom environment have been explored extensively by Eriksson et al. (2019) in their studies. Their results explain that well-prepared teaching staff and their cordial efforts to customize the school environment and classroom setup played a pivotal part in determining how 2015 TIMMS students performed in mathematics.

An ingenious study by Kartianom and Retnawati (2018) showed that schools are ideal places for students to learn, as they contain all of the necessary amenities. The teachers are well trained to handle even those students who have challenges in understanding certain concepts (Akyuz & Berberoglu, 2010). Despite the independent t-test showing no statistically significant differences between male and female teachers in their opinions on teacher perceptions and practices regarding TIMSS, mathematics instruction, and readiness of students for TIMSS, Dimension 4 revealed a critical issue in teacher perceptions towards the school and classroom environment. Kartal (2020) highlighted that despite the initiatives taken globally to ensure equality in performance and participation, the TIMMS performance in mathematics for 8th-grade females was very low in 2015.

Another study by Burroughs et al. (2019) indicated that various initiatives should be undertaken to address female teacher perceptions and classroom environment to ensure equity of outcome performance, not only equity in terms of accessing educational opportunities in mathematics. These studies show that the results of the present study are concrete and legitimate. In addition, teachers and critical players in the classroom and school environment should make efforts to counter gender stereotypes. Even though the independent t-test showed no statistically significant differences between private and public schools in teachers' perceptions of practices for TIMSS, mathematics, and instruction or of the readiness of their students for TIMSS, Dimension 4 introduces an essential issue regarding teachers' perceptions towards school and the class environment. Cordero et al. (2018) elaborate on this by explaining efforts towards ensuring 8thgrade students in public schools perform better. Despite this, their performance in TIMSS 2015 was significantly low. A different though related study by Bdeir (2019) further supports this, pointing out that more effective measures should be put in place to support students' performance in public schools, particularly in mathematics. Students in public schools need to be provided with all the essentials, including being taught using the most updated syllabi used in private schools (Alenezi, 2017). These studies support the findings of the current study. Furthermore, the disparities between private schools and public schools should be dealt with by all stakeholders, including teachers and principals. Our One-way ANOVA analysis indicated statistically significant differences in mathematics teaching experience regarding mathematics teaching practices for TIMSS, mathematics, instruction, and school and class environment. On the other hand, readiness for TIMSS did not significantly differ when considering teaching experience. This result is consistent with Burroughs et al. (2019), who showed that a teacher's experience has a role in determining an 8th-grade student's understanding. A more experienced teacher is use different and friendlier teaching strategies to teach mathematics to students. These findings are similar to another study by Alharbi et al. (2020) which confirmed that students' readiness for mathematics exams is not necessarily affected by their teacher's experience. Even teachers who have fewer than five years' experience can affect the performance of 8th-grade students in TIMSS mathematics (Abdelfattah & Lam, 2018).Teachers who used modern teaching methods proved that experience only plays a role in allowing teachers to understand their students better (Davis & Carlo, 2018) which offers further confirmation that the results of the present study are viable and provide a real picture of how experience can affect performance without depending on school and class environment. Our ANOVA results showed no statistically significant disparities in teacher qualifications based on teachers' perceptions of the school and class environment or students' readiness for TIMSS. Our results showed that mathematics teaching practices and instruction for TIMSS mathematics were inconsistent with the other dimensions and did not significantly affect performance when looked at from the perspective of teachers' qualifications. The results showed that qualifications ranged from a Bachelor's degree to a Masters' Degree or PhD. The main difference in perceptions occurred between those teachers with a Master's degree and those with a PhD, with the other groups having minimal significance. These findings are similar to those of Ersan & Rodriguez (2020) on this topic; they showed that teachers' qualifications affected 8th-grade students' performances in TIMSS 2015. These findings are consistent with another related study by Ambussaidi and Yang (2019), in which they showed that it takes much more than a good school and class environment to understand mathematics effectively. According to this study, one requirement for student success is that mathematics teachers should be adequately qualified, where qualifications include being well trained when engaging in teaching and learning activities. Even without the school and class environment, a qualified teacher is likely to teach 8th-grade students to understand mathematics without struggling (Ersan & Rodriguez, 2020).

These previous findings provide support for the present study; the issue of qualifications among teachers has been demonstrated as a critical component in performing well in mathematics. Qualifications can be resolved in different ways, although not necessarily through considering school and class environments. While PhD-holding teachers were not necessarily more useful in teaching young 8th-grade students, their qualifications placed them in a position to understand the primary components affecting their students' TIMSS performance in mathematics.

5.5 Contribution of the Study

This study aimed to identify the factors affecting mathematics achievement of Abu Dhabi 8th grade students in Trends in International Mathematics and Science Study (TIMSS, 2015) and to ascertain mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools.

Principal Component Analysis (PCA) was applied to reduce the number of item-wise variables into a few composite variables for student, teacher, and school questionnaires from TIMSS 2015. The five factors from the school questionnaire were General School Resources, School Discipline and Safety, Parental Support, Principal Experience and Education, and Library and Instruction Resources. The five factors from the student questionnaire were: Mathematics in School, Students' Safety and Behavior, Attitude towards Mathematics, School, and Classroom Environment, and Internet and Tablet (Technology for Students). The factors from the teacher questionnaire were: School Emphasis on Academic Success, Teaching Mathematics to the TIMSS Class, Resources and Time, Mathematics Topics Taught to TIMSS, and Mathematics Assessment of TIMSS.

Multiple regression models have been implemented. The models are statistically significant, indicating that it complements the data. This also demonstrates a significant linear relationship between students' achievement in TIMSS and the variables and factors related to students, teachers, and school-related factors. In the meantime, basic diagnostic tests such as the normality test, the autocorrelation test, the heteroscedasticity test, the multicollinearity test, and the outliers test were carried out, and all conditions were satisfactorily met, making the results of the model robust, valid, and not misleading.

The results showed a statistically significant difference in the overall perception of TIMSS-related practices by teachers. The independent t-test showed no significant difference between male and female teachers in mathematics teaching practices of TIMSS and their perceptions of student readiness of TIMSS. Still, they had significantly different perceptions of the school and classroom environment. In addition, there was no statistically significant difference between public and private schools in the practice of mathematics teachers for TIMSS. Still, the difference was significant in views regarding student readiness for TIMSS and the school and classroom environment.

The study's main contribution is to knowledge and practices related to contributing factors on student achievement in mathematics and teachers' perceptions of TIMSS. The epistemic significance of this study is to improve students' achievement in mathematics and enhance the process of knowing teacher perceptions of TIMSS to design professional development plans for this purpose. Furthermore, the outcomes of the study were to identify the contributing factors which lead to student achievement in TIMSS. In addition, the study aimed to explore the relationship between mathematics teachers' perceptions and mathematics teaching and learning, and how these perceptions can be linked to students' achievement of goals and their learning behavior.

Another main contribution of the study is that TIMSS 2015 data analysis and mathematics teachers' perceptions results, in Abu Dhabi, could help policymakers to integrate test content into the curriculum, conduct practice test sessions prior to the administration dates, and modify the curriculum to incorporate the content included in the international student assessments. Sample questions could be added to the curriculum to familiarize students with the types of questions asked in TIMSS. The finding of this study could provide insight into 8th-grade students' achievement that could help the UAE education system improve students' mathematics performance. Furthermore, the data analysis findings were evaluated considering the national agenda's educational objectives and goals. Science and mathematics policymaking in schools is critical because it allows for optimal curriculum alignment within the schools' areas.

The finding of this dissertation could adopt a test preparation approach to improving the UAE's international exam ranking by benchmarking the curricula from top-performing countries and integrating test questions into the mathematics curriculum. Furthermore, schools appeared to have a test preparation culture before the TIMSS and PISA test dates, with ADEC officials, school principals, teachers, and students involved. Teaching to the test may have some positive effects, such as helping teachers shift from lower-order cognitive skills to higher-order cognitive thinking.

Finally, the regression models of student factors, teacher factors, and school factors could help predict the variations in student performance in TIMSS 2015. Therefore, the findings of this study contributed to the knowledge of factors impacting student performance. Considering these variables, school teachers, leaders, and education authorities may have insights for raising student achievement in Abu Dhabi schools.

5.6 Limitation of the Study

The study sample was limited to one academic year only in 2015 and the Abu Dhabi Emirate for Part 1. A limited set of abilities was assessed, and TIMSS 2015 provided a quick overview of students' abilities simultaneously and did not provide student progress information. Because of the sample size constraint, it is quite natural that this study will fall short of statistical data and significance depending on which research attempts to focus on the underlying factors. In addition, this also contradicts the fact that the demographic constraint would be sufficient to provide a barrier to interpreting the accumulated data. It is essential to have as much diversified data to show significant correlations as the research objective indicates. TIMSS studies do not provide data on the value of schools and school systems that add to students' progress

(Hu et al., 2018; Jerrim & Shure, 2016). Consequently, the findings may not necessarily reflect the actual effects of the education system or specific policies or reforms, so it may also be a challenge to determine the cause-effect relationships.

For mathematics teachers' perceptions of Abu Dhabi schools, the study focused on mathematics teachers who taught mathematics during the academic year 2020 – 2021. The primary focus was on mathematics teachers' perception of their subject, teacher practices and TIMSS Mathematics and Instruction, Readiness of Students for TIMSS, and the School and Classroom Environment. Some findings from TIMSS 2015 may not be relevant now when TIMSS 2019 results are released.

5.7 Conclusion

This study aimed to identify the factors affecting mathematics achievement of Abu Dhabi 8th grade students in the Trends in International Mathematics and Science Study (TIMSS, 2015). In addition, it aimed to ascertain mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools. The first part of this study is a secondary data analysis of Trends in International Mathematics and Science Study (TIMSS) 2015. This is to determine the factors that most affect students' achievement to enable decision-makers and schools' administrations to develop solutions and remedial plans to achieve the goals and vision of UAE 2030, which is for the UAE to represented be among the top 15 countries internationally, in TIMSS.

The second part of this study involves primary data collection through a teacher's questionnaire exploring several factors such as: teachers' practices in their classrooms, the classroom environment prepared for TIMSS, and students' readiness for international tests. This method confirms the results obtained through secondary data from TIMSS 2015.

The study sample for TIMSS 2015 consisted of 4838 students in 8th grade: 2172 girls, 2666 boys, and 220 teachers from Abu Dhabi. Participants were actively engaged in TIMSS 2015 across three domains: school, student, and teacher questionnaires. Overall mathematics test scores were utilized. The sample study of the TIMSS mathematics teacher perception questionnaire on Abu Dhabi Emirate schools included 1253 mathematics teachers teaching in Abu Dhabi emirate schools during the academic years 2020–2021. A Principal Component Analysis (PCA) was run on a 90-item questionnaire that asked students in Abu Dhabi public and private schools to provide information about aspects of their home and school lives, their home environment, school climate for learning, and self-perception and attitudes towards learning mathematics. The PCA revealed five factors: (Factor 1: Mathematics in School, Factor 2: Students' Safety and Behavior, Factor 3: Attitude towards mathematics, Factor 4: School and Classroom Environment, and Factor 5: Internet and Tablet).

A one-sample t-test was calculated to examine the perceptions of students on items related to Factor 1: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude towards Mathematics, Factor 4: School and Classroom Environment, Factor 5: Internet and Tablets on students' achievement in TIMSS 2015. The One-Sample t-test showed that students had a positive perception towards Factor1: Mathematics in School, Students had a negative perception toward Factor2: Safety and Behavior, Students had a positive perception towards Factor 3: Attitude towards Math, Students had a positive perception towards Factor4: School and Classroom Environment, and Students had a positive perception towards Factor5: Internet and Tablet (Appendix B).

To investigate the effects of students' factors (Factor 1: Mathematics in School, Factor 2: Safety and Behavior, Factor 3: Attitude toward Math, Factor 4: School and Classroom Environment, Factor 5: Internet and Tablet) on students' achievement on TIMSS 2015, five-stage multiple regressions using the enter method was deemed a suitable method of analysis (Darren & Paul, 2012).The full model of students' factors' Multiple Regression revealed that all the school factors are statistically significant predictors of student achievement in TIMSS 2015. This implies that Mathematics in School, Safety and Behavior, Attitude toward Math, School, Classroom Environment, and Internet and Tablet significantly impacted students' achievement in TIMSS 2015.

A Principal Components Analysis (PCA) was run on a 174-item questionnaire that measured the responses of mathematics teachers in Abu Dhabi public and private schools to provide information about teachers of eighth-grade students and sought information about teachers' academic and professional backgrounds, classroom resources, instructional practices, and attitudes toward teaching. The PCA revealed five factors (Factor 1: School Emphasis on Academic Success, Factor 2: Teaching Mathematics to the TIMSS Class, Factor 3: Resources and Time, Factor 4: Mathematics Topics Taught to the TIMSS Class, and Factor 5: Mathematics Assessment of the TIMSS Class).

A one-sample t-test was calculated to examine the perceptions of mathematics teachers on items related to Factor 1: Factor 1: School Emphasis on Academic Success, Factor 2: Teaching Mathematics to the TIMSS class, Factor 3: Resources and Time, Factor 4: Mathematics topics taught to the TIMSS class, Factor 5: Mathematics Assessment for TIMSS on students' achievement in TIMSS 2015.

The one-sample t-test showed that mathematics teachers had a positive perception towards Factor 1: School emphasis on academic , Math Teachers had a positive perception towards Factor 2: Teaching Mathematics to the TIMSS Class , Math Teachers had a positive perception towards Factor 3: Resources and Time , Math Teachers had a positive perception towards Factor 4: Mathematics Topics Taught to the TIMSS Class \ Math Teachers Factors , and Math Teachers had a positive perception toward Factor 5: Mathematics Assessment of the TIMSS Class (Appendix C).

To investigate the effects of mathematics teachers' related factors (Factor 1: School Emphasis on Academic Success, Factor 2: Teaching Mathematics to the TIMSS class, Factor 3: Resources and Time, Factor 4: Mathematics Topics Taught to the TIMSS Class, Factor 5: Mathematics Assessment for TIMSS on students' achievement in TIMSS 2015, five-stage multiple regressions using the enter method was deemed a suitable method of analysis (Darren & Paul, 2012). The full model of mathematics teachers' factors on multiple regression revealed that all five factors are statistically significant except teaching mathematics to the TIMSS class, and this tells us that School Emphasis on Academic Success, Resources and Time, Mathematics topics taught to the TIMSS class and Mathematics Assessment for TIMSS had a significant impact on students' achievement on TIMSS 2015.

The Principal Component Analysis (PCA) was used on 77 questions from a school questionnaire that was given to school administrators in order to gather information about the teaching and learning environments in their schools. One sample t-tests were performed for each of the five components, such as General School Resources, School Discipline and Safety, Parental Support, Principal Experience and Education, and Library and Instruction Resources, to understand the participant views about the school environment. Overall, the school principals seemed to possess a negatively perception toward General School Re-sources, Principal Experience and

Education and Library and Instruction Resources indicating these factors were not adequate to support schools. However, they had a positive perception toward School Discipline and Safety and Parental Support to schools indicating that these factors were important for maintaining school environment. The Multiple Regression models showed that all the five models by entering one, two, three, four, and five independent variables, such as General School Resources, School Discipline and Safety, Parental Support, Principal Experience and Education, and Library and Instruction Resources, were statistically significant. One factor, General School Resources, was statically significant factors when it was combined with other four or five factors to predict students' achievement in mathematics (in models 4 and 5). This also indicates a significant linear association between students' achievement and school-factor characteristics in TIMSS 2015. There is a need to increase and improve school-related activities and create a conducive atmosphere in which children can learn and improve their academic accomplishments in TIMSS and other national and international tests in the UAE in general and Abu Dhabi Emirate in particular.

Finally, descriptive statistics in the form of the following tests were used: a one-sample t-test, an Independent Sample Test, a one-way ANOVA, and post hoc comparisons were utilized to address the first question [Research Question 1: What are the mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?]. A one-sample t-test was utilized to address the second question [Research Questions2: Is there a positive or negative perception of TIMSS in Abu Dhabi Emirate Schools?]. An Independent Sample Test was utilized to address question 3 [Research Question 3: Is there a (statistically) significant difference between males and females with respect to mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?]. An Independent sample t-test was utilized to address research question 4: [Research

Question 4: Is there a (statistically) significant difference between public and private schools with respect to mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?]. A one-way ANOVA and post hoc comparisons were utilized to address Research Question 5: [Is there a (statistically) significant difference in mathematics teachers' perceptions with teaching experience?].

Descriptive analysis, a one-sample t-test, an independent sample t-test, and a one-way ANOVA were also carried out on mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate school's data. The one-way ANOVA showed a statistically significant difference in overall teachers' perception of TIMSS, which further used the Tukey HSD test for multiple comparisons to know where the group difference was. The independent t-test showed that both males and females had an equal perception of classroom practices and TIMSS, Mathematics and Instruction, Readiness of students for TIMSS, and different perceptions of school and classroom environment. The independent sample t-test showed that both public and private schools had an equal opinion or perception towards mathematics teacher practices and TIMSS, mathematics, and instruction but different opinions towards students' readiness for TIMSS in a school and classroom environment.

5.8 Implications

This study's core findings have identified the factors that improve students' achievement in mathematics, and which may have further pedagogical implications. These factors may serve to guide mathematics policymakers and educators in consideration of any future curriculum amendments. Moreover, factors linked to schools' levels may also affect students' achievements. With reference to the Abu Dhabi Education Council ("ADEC") Act, it is incumbent on schools to ensure that students improve year on year. When students perform at optimal levels and produce significant achievement in mathematics, it adds value to the subject at all levels of the education hierarchy. All stakeholders in the subject at school level, policymaking level and administration then bask in the reflected glory of the students' success! This research was beneficial in three ways. Firstly, to show the connection between student's achievement in mathematics and the role of the teacher, school levels, and student-level factors. The results of this study can guide future research that targets finding ways for improvement in learning mathematics. Secondly, this research captures general trends, details, and complexity of student and school-level issues that may provide the right direction for school policymakers and administrators to implement the steps closely related to mathematics achievement gaps between students of different age groups. Finally, this research concluded that school factors, along with students' strengths due to extra academic attention, as well as teacher's perception of mathematics, proved to have a significant impact on students' mathematics achievement.

The significant implication of the results is that policymakers in the government or schools appear to identify the most observable components of teacher quality. Relevant and immediate concerns might be that more attention should be given to teachers' training and professional development. For example, more attention should be given to teacher recruiting processes, desired teacher characteristics, types of professional development offered, and teacher qualifications. In other words, policymakers and school administrators must make recruiting, hiring, assignment, and compensation decisions based on carefully planned criteria.

The study's sample is limited to teaching mathematics in Abu Dhabi's public and private schools. The findings of this study may not be generalizable to all UAE schools; therefore, they should be interpreted in this context. Therefore, they should be interpreted in this context. Thus, the study's findings indicated some key areas to which attention to teacher readiness and teacher practices for TIMSS should be given to improve students’ performance on such international tests. Further study can be suggested with a larger sample size to include all UAE schools. Issues of how teachers’ perceptions affect their classroom practices, which might influence students’ performance in TIMSS, should be explored. Future research studies may also consider different variables, such as teacher professional development, teacher job satisfaction, teacher personality and teaching style, and teacher awareness of the nature of TIMMS and their subsequent impact on classroom practices and student performance in TIMSS.

5.9 Recommendations

Based on the overall discussion of results above and the conclusion, it is highly recommended that:

- Schools should create a suitable environment to enable students to perform better in TIMSS.
- Teachers should possess the required skills to enable good teaching that can help students succeed in TIMSS.
- Teachers should adopt interactive sessions as a teaching technique to enable students' participation in the class.
- Teachers should have good classroom management skills to improve students' concentration and enhance their achievement in TIMSS.
- The classroom environment should be conducive enough to encourage students' readiness for TIMSS.

- School authorities should adopt policies that will provide teachers with regular training on effective teaching that will contribute significantly to the students' achievement on TIMSS.
- Researchers in the United Arab Emirates can replicate this study using the latest TIMSS data (e.g., TIMSS 2019) or all TIMSS data to compare trends or the fourth-grade mathematics data. Similarly, in future, this study can be extended to science achievement data as well as other large-scale datasets like PISA.
- ICT will play a substantial and advantageous role in enhancing teaching and learning in the future. Still, the critical factor is that educational leadership must keep addressing policy-related issues, considering the need to improve and develop schools' capability to be ICT-supported learning institutions.
- Future researchers should be encouraged to conduct a similar study on mathematics achievement on TIMSS 2019 in Abu Dhabi schools and then compare the same factors to identify the most affecting student achievement.
- There should be a comparative analysis of TIMSS 2011, 2015, and 2019 with similar economy, culture, and geography.

References

Abdelfattah, F., & Lam, J. (2018). Linking homework to achievement in mathematics: An examination of 8th-grade Arab participation in TIMSS 2015. *International Journal of Instruction, 11*(4), 607-624. Retrieved November 2021 from: https://eric.ed.gov/?id=EJ1191672.

Abdel-Khalek, A. M., Korayem, A. S., & El-Nayal, M. A. (2012). Self-esteem among college students from four Arab countries. *Psychological Reports, 110*(1), 297-303. https://doi.org/10.2466/07.09.17.PR0.110.1.297-303

Abed, A. S. (2001). Mathematics anxiety among eighth-grade students of the United Arab Emirates. *Psychological Reports*, *89*(5), 65. https://doi.org/10.2466/pr0.89.5.65-66

Abu-Al-Aish, A., & Love, S. (2013). Factors influencing students' acceptance of m-learning: An investigation in higher education. *The International Review of Research in Open and Distributed Learning*, *14*(5), 82-107. https://doi.org/10.19173/irrodl.v14i5.1631

Abu-Hilal, M. M., & Bahri, T. M. (2000). Self-concept: the generalizability of research on the SDQ, Marsh/Shavelson model, and I/E frame of reference model to United Arab Emirates students. *Social Behavior and Personality, 28*(4), 309-322. https://doi.org/10.2224/sbp.2000.28.4.309

Acharya, B. R. (2017). Factors affecting difficulties in learning mathematics by mathematics learners. *International Journal of Elementary Education*, *6*(2), 8-15.

Achtziger, A., & Gollwitzer, R M. (2008). Motivation and volition in the course of action. In J. Heckhausen & H. Heckhausen (Eds.), *Motivation and action* (p. 272-295). Cambridge University Press. https://doi.org/10.1017/CBO9780511499821.012

Adnan, M., Abdullah, M. F. N. L., Puteh, M., Ahmad, C. N. C., & Maat, S. M. (2014). The learning environment and mathematics achievement of students of high-performance schools (HPS). *Jurnal Pendidikan Matematik*, *2*(1), 1-15.

Afari, E. (2012). Examining the factorial validity of the attitudes towards mathematics Inventory (ATMI) in the United Arab Emirates: a confirmatory factor analysis. *International Review of Contemporary Learning Research, 2*(1), 15-29. https://doi.org/10.12785/IRCLR/020102

Agbor, C. A., & Ashabua, D. A. (2020). Factors Influencing Academic Performance of students in French language in secondary schools in Boki Local Government Area of Cross River State, Nigeria. *European Journal of Social Sciences*, *59*(4), 405-411.

Akyuz, G., & Berberoglu, G. (2010). Teacher and classroom characteristics and their relations to mathematics achievement of the students in the TIMSS. *New Horizons in Education, 58*(1), 77-96.

AL Shannag, Q. A., Tairab, H., Dodeen, H., & Abdel-Fattah, F. (2013). Linking teachers' quality and student achievement in the Kingdom of Saudi Arabia and Singapore: The impact of teachers' background variables on student achievement. *Journal of Baltic Science Education*, *12*(5), 652-665.

Alam, A., & Ahmad, M. (2018). The role of teachers' emotional intelligence in enhancing student achievement. *Journal of Asia Business Studies*, *12*(1), 31-43.

Alenezi, A. (2017). Obstacles for teachers to integrate technology with instruction. *Education and Information Technologies*, *22*(4), 1797-1816. https://doi.org/10.1007/s10639-016-9518-5

Alghizzawi, M., Habes, M., Salloum, S.A., Ghani, M.A., Mhamdi, C., &, Shaalan, K. (2019). The effect of social media usage on students' eLearning acceptance in higher education: A case study from the United Arab Emirates. *International Journal of Information Technology and Language Studies (IJITLS), 3*(3), 13-26. Retrieved January 2022, from https://journals.sfu.ca/ijitls/index.php/ijitls/article/view/109.

Alharbi, M. S., Almatham, K. A., Alsalouli, M. S., & Hussein, H. B. (2020). Mathematics teachers' professional traits that affect mathematical achievement for fourth-grade students according to the TIMSS 2015 Results: A comparative study among Singapore, Hong Kong, Japan, and Saudi Arabia. *International Journal of Educational Research*, *104*, 1-15. https://doi.org/10.1016/j.ijer.2020.101671

Alhashmi, S. F., Salloum, S. A., & Abdallah, S. (2019). Critical success factors for implementing artificial intelligence (AI) projects in Dubai government United Arab Emirates (UAE) health sector: Applying the extended technology acceptance model (TAM). In A. Hassanien, K. Shaalan, & M. Tolba (Eds.) *Proceedings of the International Conference on Advanced Intelligent Systems and Informatics 2019. AISI 2019. Advances in Intelligent Systems and Computing*, *1058*, 393-405. Springer, Cham. https://doi.org/10.1007/978-3-030-31129-2_36

Alloghani, M., Hussain, A., Al-Jumeily, D., & Abuelma'atti, O. (2015). Technology acceptance model for the use of M-health services among health-related users in UAE. *2015 International Conference on Developments of E-Systems Engineering (DeSE)*. https://doi.org/10.1109/dese.2015.58

Alotaibi, A., Khalil, I., & Wardat, Y. (2021). Teaching practices of the mathematics male and female teachers according to the PISA framework and its relation to their beliefs towards their students. *Elementary Education Online, 20*(1), 1247-1265. https://doi.org/10.17051/ilkonline.2021.01.126

Alqifari, A. N. (2020). The extent of Saudi teachers' knowledge of TIMSS's policies and assessment practices. *Journal of Contemporary Scientific Research*, *4*(2), 8-21.

Alshehri, M. A., & Ali, H. S. (2016). The compatibility of developed mathematics textbooks' content in Saudi Arabia (grades 6-8) with NCTM standards. *Journal of Education and Practice, 7*(2), 137-142.

Altakhaineh, A. R., & Alnamer, S. A. (2018). The impact of Facebookers' posts on other users' attitudes according to their age and gender: Evidence from Al Ain University of Science and Technology. *Social Sciences*, *7*(8), 128. https://doi.org/10.3390/socsci7080128

Ambussaidi, I., & Yang, Y. F. (2019). The impact of mathematics teacher quality on student achievement in Oman and Taiwan. *International Journal of Education and Learning*, *1*(2), 50-62. https://doi.org/10.31763/ijele.v1i2.39

Antwi, S. K., & Hamza, K. (2015). Qualitative and quantitative research paradigms in business research: A philosophical reflection. *European Journal of Business and Management*, *7*(3), 217-225.

Ashour, S. (2020), "Analysis of the attrition phenomenon through the lens of university dropouts in the United Arab Emirates", *Journal of Applied Research in Higher Education, 12*(2), 357-374. https://doi.org/10.1108/JARHE-05-2019-0110

Aydarova, O. (2012). If not "the best of the West," then "look East" Imported teacher education curricula in the Arabian Gulf. *Journal of Studies in International education*, *17*(3), 284-302.

Badri, M. (2019). School emphasis on academic success and TIMSS science/math achievements. *International Journal of Research in Education and Science, 5(1),* 176-189.

Baifakh, N.M.G (2003). The Influence of Student Team-Achievement Division (STAD) for Teachers High School Chemistry in the United Arab Emirates. *International Journal Science of Education*, *25,* 605-624.

Barkatsas, A. (2005). A new scale for monitoring students' attitudes to learning mathematics with technology (MTAS). *Building Connections: Theory, Research and Practice, 1*, 129-137.

Barnes, M., Clarke, D., & Stephens, M. (2000). Assessment: The engine of systemic curricular reform? *Journal of Curriculum Studies, 32(5),* 623-650.

Barwell, R., Clarkson, P., Halai, A., Kazima, M., Moschkovich, J., Planas, N., Setati Phakeng, M., Valero, P., & Villavicencio Ubillús, M. (2016). Introduction: An ICMI study on language diversity in mathematics education. *New ICMI Study Series,* 1-22. https://doi.org/10.1007/978-3-319-14511-2_1

Başol, G., & Johanson, G. (2009). Effectiveness of frequent testing over achievement: A meta-analysis study. *Journal of Human Sciences*, *6*(2), 99-121.

Battey, D., & Leyva, L. A. (2016). A framework for understanding whiteness in mathematics education. *Journal of Urban Mathematics Education*, *9*(2), 49-80. Retrieved from Retrieved December from 2021, https://eric.ed.gov/?id=EJ1124962.

Bdeir, R. (2019). *Investigating the progress of Dubai private schools' PISA and TIMSS results and school inspection reports from 2011 to 2018* (Doctoral dissertation, The British University in Dubai (BUiD).

Belbase, S., Mainali, B. R., Kasemsukpipat, W., Tairab, H., Gochoo, M., & Jarrah, A. (2021). At the dawn of science, technology, engineering, arts, and mathematics (STEAM) education: Prospects, priorities, processes, and problems. *International Journal of Mathematical Education in Science and Technology*, Online First. https://doi.org/10.1080/0020739X.2021.1922943

Benseman, J. (2008). Foundation learning in New Zealand: an overview. In J. Benseman & A. Sutton (Eds.), *Facing the challenge. Foundation learning for adults in Aotearoa New Zealand* (pp. 11-28). Palmerston North: Dunmore Publishing Ltd.

Berger, N., Mackenzie, E., & Holmes, K. (2020). Positive attitudes towards mathematics and science are mutually beneficial for student achievement: A latent profile analysis of TIMSS 2015. *The Australian Educational Researcher, 47*, 409-444. https://doi.org/10.1007/s13384-020-00379-8

Black, P. J., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability,* 21(1), 5-31.

Black, P., & Wiliam, D. (2006). Developing a theory of formative assessment. In J. Gardner (Ed.), *Assessment and learning* (pp. 81–100). London, England: Sage.

Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2004). Inside the black box: Assessment for learning in the classroom. *Phi Delta Kappan, 86*, 8-21. https://doi.org/10.1177/003172171009200119

Bodovski, K., Nahum-Shani, I. & Walsh, R. (2013). School disciplinary climate and students' early mathematics learning: Another search for contextual effects? *American Journal of Education, 119*(2), 209-234. Retrieved December 2021, from: http://eric.ed.gov/?id=EJ1003815.

Booren, L. M., Handy, D. J., & Power, T. G. (2011). Examining perceptions of school safety strategies, school climate, and violence. *Youth Violence and Juvenile Justice*, *9*(2), 171-187. https://doi.org/ 10.1177/1541204010374297

Bos, K., & Kuiper, W. (1999). Modelling TIMSS data in a European comparative perspective: Exploring influencing factors on achievement in mathematics in grade 8. *Educational Research and Evaluation*, *5*(2), 157-179. https://doi.org/10.1076/edre.5.2.157.6946.

Bowen, G. L., Hopson, L. M., Rose, R. A., & Glennie, E. J. (2012). Students' perceived parental school behavior expectations and their academic performance: A longitudinal analysis. *Family Relations*, *61*(2), 175-191. https://doi.org/10.1111/j.1741-3729.2011.00695.x

Brenner, A. (2021). How did philosophy of science come about? From Comte's positive philosophy to Abel Rey's absolute positivism. HOPOS: *The Journal of the International Society for the History of Philosophy of Science*, *11*(2), 428-445.

Brezovszky, B., McMullen, J., Veermans, K., Hannula-Sormunen, M. M., Rodríguez-Aflecht, G., Pongsakdi, N., & Lehtinen, E. (2019). Effects of a mathematics game-based learning environment on primary school students' adaptive number knowledge. *Computers & Education, 128*, 63-74. https://doi.org/10.1016/j.compedu.2018.09.011

Bryman, A. (1998). Quantitative and qualitative research strategies in knowing the social world. In T. May & M. Williams (Eds.), *Knowing the social world* (pp. 138-156). Open University Press.

Bryman, A., & Cramer, D. (2012). *Quantitative data analysis with IBM SPSS 23: A guide for social scientists*. Abingdon-on-Thames: Routledge. https://doi.org/10.4324/9780203180990.

Burns, A. (2005). Action research: An evolving paradigm. *Language Teaching*, *38*(2), 57-74.

Burroughs, N., Gardner, J., Lee, Y., Guo, S., Touitou, I., Jansen, K., & Schmidt, W. (2019). A review of the literature on teacher effectiveness and student outcomes. In *Teaching for excellence and equity: Analyzing teacher characteristics, behaviors and student outcomes with TIMSS, 6*, 7-17. Springer Nature. https://doi.org/10.1007/978-3-030-16151-4_2.

Care, E., Griffin, P., Zhang, Z., & Hutchinson, D. (2014). Large-scale testing and its contribution to learning. In C. Wyatt-Smith, V. Klenowski, & P. Colbert (Eds.), *Designing assessment for quality learning (pp. 55–72)*. Dordrecht, The Netherlands: Springer.

Caruso, M. (2008). World systems, world society, world polity: Theoretical insights for a global history of education. *History of Education*, *37*(6), 825-840. https://doi.org/10.1080/00467600802158256

Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate Behavioral Research*, *1*(2), 245-276. https://doi.org/10.1207/s15327906mbr0102_10

Celedón-Pattichis, S., Borden, L. L., Pape, S. J., Clements, D. H., Peters, S. A., Males, J. R., ... & Leonard, J. (2018). Asset-based approaches to equitable mathematics education research and practice. *Journal for Research in Mathematics Education*, *49*(4), 373-389.

Chan, L. L., & Idris, N. (2017). Validity and reliability of the instrument using exploratory factor analysis and Cronbach's alpha. *International Journal of Academic Research in Business and Social Sciences*, *7*(10), 400-410. Retrieved from https://ideas.repec.org/a/hur/ijarbs/v7y2017i10p400-410.html. Retrieved September 2021, from https://10.0.23.119/IJARBSS/v7-i10/3387.

Chien, S. P., & Wu, H. K. (2020). Examining influences of science teachers' practices and beliefs about technology-based assessment on students' performances: A hierarchical linear modeling approach. *Computers & Education*, *157*, 103986. https://doi.org/10.1016/j.compedu.2020.103986

Cho, M. O. (2011). *A comparison of the effectiveness of science education in Korea and South Africa: a multilevel analysis of TIMSS 2003 data* (Doctoral dissertation, University of Pretoria). Retrieved September 2021, from http://hdl.handle.net/2263/28600.

Clarke, M. (2012). What matters most for student assessment systems: A framework paper. *READ/SABER Working Paper Series*. Washington, DC: World Bank.

Clavel, J. G., Crespo, F. J. G., & Méndez, I. (2016). *Are teacher characteristics and teaching practices associated with student performance? Policy brief no. 11*. International Association for the Evaluation of Educational Achievement.

Coakes, S. J., Steed, L. G., & Ong, C. (2009). *SPSS: analysis without anguish: version 16 for Windows*. Milton, Qld: John Wiley & Sons Australia. Retrieved July 2021, from https://nla.gov.au/nla.cat-vn4406035.

Coakes, S. (2005). *SPSS: Analysis without anguish using SPSS (Vol.12,*1st ed.). Milton: Wiley.

Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education* (8th ed.). Routledge.

Cohen, L., Manion, L., Morrison, K., & Morrison, R. B. (2007). *Research methods in education*: Routledge.

Collins, T. N., & Parson, K. A. (2010). School climate and student outcomes. *Journal of Cross Disciplinary Perspectives in Education, 3*(1), 34-49. Retrieved from https://wmpeople.wm.edu/asset/index/mxtsch/collinsparsonsschoolclimateandstudentoutcomespdf .

Cordero, J. M., Cristobal, V., & Santín, D. (2018). Causal inference on education policies: A survey of empirical studies using PISA, TIMSS and PIRLS. *Journal of Economic Surveys*, *32*(3), 878-915. https://doi.org/10.1111/joes.12217

Creswell, J. W. (2008). *Educational Research*, 3rd edition. New Jersey: Pearson.

Cruz, J. M., Wilson, A. T., & Wang, X. (2019). Connections between pre-service teachers' mathematical dispositions and self-efficacy for teaching mathematics. *International Journal of Research in Education and Science (IJRES), 5*(*2*), 400-420. Retrieved June 2021, from https://www.ijres.net/index.php/ijres/article/view/445.

Cuenca-Carlino, Y., Freeman-Green, S., Stephenson, G. W., & Hauth, C. (2016). Self-regulated strategy development instruction for teaching multi-step equations to middle school students struggling in math. *The Journal of Special Education*, *50*(*2*), 75-85. https://doi.org/10.1177/0022466915622021

Daleure, G. M., Albon, R., Hinkston, K., Ajaif, T., & McKeown, J. (2014). Family involvement in Emirati college student education and linkages to high and low achievement in the context of the United Arab Emirates. *FIRE: Forum for International Research in Education*, *1*(3). https://doi.org/10.18275/fire201401031024

Daniel, B. K., & Harland, T. (2017). *Higher education research methodology: A step-by-step guide to the research process*. Routledge.

Darling-Hammond, L., Bae, S., Cook-Harvey, C. M., Lam, L., Mercer, C., Podolsky, A., & Stosich, E. L. (2016). *Pathways to new accountability through the Every Student Succeeds Act*. Palo Alto, CA: Learning Policy Institute.

Darren, G., & Paul, M. (2012) *IBM SPSS Statistics 19 Step by step. A simple guide and reference* (12th ed.). Pearson.

Davis, A. N., & Carlo, G. (2018). The roles of parenting practices, sociocognitive/emotive traits, and prosocial behaviors in low-income adolescents. *Journal of Adolescence*, *62*, 140-150. https://doi.org/10.1016/j.adolescence.2017.11.011

Di Martino, P., & Zan, R. (2011). Attitude towards mathematics: a bridge between beliefs and emotions. *ZDM Mathematics Education,* 43**,** 471-482. https://doi.org/10.1007/s11858-011-0309-6

Dodeen, H., Abdelfattah, F., Shumrani, S., & Hilal, M. A. (2012). The effects of teachers' qualifications, practices, and perceptions on student achievement in TIMSS mathematics: A comparison of two countries. *International Journal of Testing*, *12*(1), 61-77. https://doi.org/ 10.1080/15305058.2011.621568

Doyle, T. (2008). *Helping students learn in a learner-centered environment: A guide to facilitating learning in higher education*. Stylus Publishing, LLC.

Dukmak, S., & Ishtaiwa, F. F. (2015). Factors influencing the academic achievement of students in the preparatory and secondary schools of the United Arab Emirates. *European Journal of Social Sciences, 46*(2), 132-148.

Dulay, S., & Karadag, E. (2017). The effect of school climate on student achievement. In E. Karadag (Ed.), *The Factors effecting student achievement: Meta-Analysis of empirical studies* (pp. 199-213). Springer. https://doi.org/10.1007/978-3-319-56083-0_12

El Afi, A. D. (2019). The impact of professional development training on teachers' performance in Abu Dhabi cycle two and three schools. *Teacher Development, 23*(3), 366-386.

Eldeeb, A.M. Z. (2012). The impact of parental involvement on academic student achievement (doctoral dissertation). The British University in Dubai (BUiD).

Emirates News Agency WAM. (2015, February 18). *Abu Dhabi schools students participate in TIMSS 2015*. Retrieved June 2021, from http://wam.ae/en/details/1395276704747.

Eriksson, K., Helenius, O., & Ryve, A. (2019). Using TIMSS items to evaluate the effectiveness of different instructional practices. *Instructional Science, 47*(1), 1-18. https://doi.org/10.1007/s11251-018-9473-1

Ersan, O., & Rodriguez, M. C. (2020). Socioeconomic status and beyond: a multilevel analysis of TIMSS mathematics achievement given student and school context in Turkey. *Large-scale Assessments in Education*, *8*(1), 1-32. https://doi.org/10.1186/s40536-020-00093-y

Farooq, M. S., & Shah, S. Z. U. (2008). Students' attitude towards mathematics. *Pakistan Economic and Social Review, 46*(1), 75-83.

Farooq, M. S., Chaudhry, A. H., Shafiq, M., & Berhanu, G. (2011). Factors affecting students' quality of academic performance: a case of secondary school level. *Journal of Quality and Technology Management*, *7*(2), 1-14.

Fauth, B., Decristan, J., Rieser, S., Klieme, E., & Büttner, G. (2014). Student ratings of teaching quality in primary school: Dimensions and prediction of student outcomes. *Learning and Instruction*, *29*, 1-9. https://doi.org/10.1016/j.learninstruc.2013.07.001

Fennema, E., & Sherman, J. (1977). Sex-related differences in mathematics achievement, spatial visualization and affective factors. *American Educational Research Journal*, *14*(1), 51-71. https://doi.org/10.3102/00028312014001051.

Ferrini-Mundy, J. (2000). Principles and standards for school mathematics: A guide for mathematicians. *Notices of the American Mathematical Society*, *47*(8), 868-876. Retrieved June 2021 from: https://www.ams.org/notices/200008/comm-ferrini.pdf.

Fishbein, B., Martin, M. O., Mullis, I. V., & Foy, P. (2018). The TIMSS 2019 item equivalence study: Examining mode effects for computer-based assessment and implications for measuring trends. *Large-scale Assessments in Education*, *6*(1), 1-23.

Foy, P., & Yin, L. (2016). Scaling the PIRLS 2016 achievement data. M. O. Martin, I. V. S. Mullis, & M. Hooper (Eds.), *Methods and procedures in PIRLS* (12.1-12.38). TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College. Retrieved June 2021, from https://timssandpirls.bc.edu/publications/pirls/2016-methods/chapter-12.html.

Frade, C., Acioly-Régnier, N., & Jun, L. (2013). Beyond deficit models of learning mathematics: Socio-cultural directions for change and research. In *Third International Handbook of Mathematics Education* (pp. 101–144). Springer New York. https://doi.org/10.1007/978-1-4614-4684-2_4

Fung, F., Tan, C. Y., & Chen, G. (2018). Student engagement and mathematics achievement: Unraveling main and interactive effects. *Psychology in the Schools*, *55*(7), 815-831. https://doi.org/10.1002/pits.22139

Garbacz, S. A., Herman, K. C., Thompson, A. M., & Reinke, W. M. (2017). Family engagement in education and intervention: implementation and evaluation to maximize family, school, and student outcomes. *Journal of School Psychology, 62,* 1-10. https://doi.org/ 10.1016/j.jsp.2017.04.002

Gentilucci, J. L., & Muto, C. C. (2007). Principals' influence on academic achievement: The student perspective. *NASSP Bulletin, 91*(3), 219-236. https://doi.10.1177/0192636507303738

George, D., & Mallery, P. (2020). *IBM SPSS statistics 26 step by step: A simple guide and reference* (16th ed.). Routledge.

Gillis, N. Y. (2016). Implementing a made-in-New Brunswick outdoor environmental education program: A case study of Salem elementary school. *Journal of New Brunswick Studies/Revue d'études sur le Nouveau-Brunswick*, *7*(1), 129-141. Retrieved June 2021, from https://journals.lib.unb.ca/index.php/JNBS/article/view/25201/29176.

Gipps, C. (1994). *Beyond testing: Towards a theory of educational assessment*. London, England: Falmer Press.

Glaser, R., & Silver, E. (1994). *Assessment, testing, and instruction: Retrospect and prospect* (CSE Technical Report 379). University of Pittsburgh: CRESST/Learning Research and Development Centre.

Glatthorn, A. A., Boschee, F., Whitehead, B. M., & Boschee, B. F. (2018). *Curriculum leadership: Strategies for development and implementation*. SAGE publications.

Goertzen, M. J. (2017). Introduction to quantitative research and data. *Library Technology Reports*, *53*(4), 12-18.

Gonzales, P., Williams, T., Jocelyn, L., Roey, S., Kastberg, D., & Brenwald, S. (2008). *Highlights from TIMSS 2007: Mathematics and science achievement of US fourth-and eighth-grade students in an international context*. National Center for Education Statistics. Retrieved June 2021, from https://nces.ed.gov/pubs2009/2009001.pdf.

Goodall, C. (2018). Inclusion is a feeling, not a place: A qualitative study exploring autistic young people's conceptualisations of inclusion. *International Journal of Inclusive Education, 24(12),* 1285-1310. https://doi.org/10.1080/13603116.2018.1523475.

Goodall, J. (2017). *Narrowing the achievement gap: Parental engagement with children's learning.* Abingdon: Routledge. https://doi.org10.4324/9781315672465.

Green, S. (1991). How many subjects does it take to do a regression analysis. *Multivariate Behavioral Research.*, *26*(3), 499–510.

Greenwald, R., Hedges, L. V., & Laine, R. D. (1996). The effect of school resources on student achievement. *Review of Educational Research*, *66*(3), 361-396. https://doi.org/10.2307/1170528.

Grønmo, L. S., Lindquist, M., Arora, A., & Mullis, I. V. (2015). TIMSS 2015 mathematics framework. *TIMSS 2015* (pp.11-27). IEA TIMSS and PIRLS International Study Center, Lynch School of Education, Boston College. Retrieved June 2021, from https://timssandpirls.bc.edu/timss2015/downloads/T15_FW_Chap1.pdf.

Grouws, D. (Ed.). (2006). *Handbook of research on mathematics teaching and learning :(A project of the national council of teachers of mathematics)*. IAP.

Gurney-Read, J. (2015). Nicky Morgan: Top rugby coaches to teach pupils ‘grit and respect’. *The Telegraph*. Retrieved December 2021, from http://www.telegraph.co.uk/education/educationnews/11642858/Nicky-Morgan-top-rugby-coaches-to-teach-pupils-grit-and-res-pect.htm.

Gustafsson, J., Nilsen, T., & Hansen, K. Y. (2018). School characteristics moderating the relation between student socioeconomic status and mathematics achievement in grade 8. Evidence from 50 countries in TIMSS 2011. *Studies in Educational Evaluation*, *57*, 16-30. https://doi: 10.1016/j.stueduc.2016.09.004.

Güven, U., & Akçay, A. O. (2019). Trends of homework in mathematics: comparative research based on TIMSS study. *International Journal of Instruction*, *12*(1), 1367-1382. https://doi: 10.29333/iji.2019.12187a.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2014). *Multivariate data analysis* (7th ed). Pearson Education Limited Harlow, Essex.

Hair, J. F., Sarstedt, M., Ringle, C. M., & Mena, J. A. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science*, *40*(3), 414-433.

Hamad, S., Tairab, H., Wardat, Y., Rabbani, L., AlArabi, K., Yousif, M., Abu-Al-Aish, A., & Stoica, G. (2022). Understanding science teachers’ implementations of integrated STEM: teacher perceptions and practice. *Sustainability*, *14*(6), 3594. https://doi.org/10.3390/su14063594.

Hannula, M. S. (2002). Attitude towards mathematics: Emotions, expectations and values. *Educational Studies in Mathematics*, *49*(1), 25-46. https://doi.org/10.1023/A:1016048823497

Hannula, M. S., Bofah, E., Tuohilampi, L., & Metsämuuronen, J. (2014). A longitudinal analysis of the relationship between mathematics-related affect and achievement in Finland. In S. Oesterle, P. Liljedahl, C. Nicol, & D. Allan (Eds.), *Proceedings of the 27th conference of the International Group for the Psychology of Mathematics Education, 3,* 249-256. Vancouver, Canada: PME.

Harb, N., & El-shaarawi, A. (2007). Factors affecting business students' performance: The case of students in United Arab Emirates. *Journal of Education for Business*, *82*(5), 282- 290. https://doi.org/10.3200/joeb.82.5.282-290.

Heene, M., Hilbert, S., Draxler, C., Ziegler, M., & Bühner, M. (2011). Masking misfit in confirmatory factor analysis by increasing unique variances: A cautionary note on the usefulness of cutoff values of fit indices. *Psychological Methods*, *16*(3), 319-336. https://doi.org/10.1037/a0024917.

Herges, R.M., Duffied, S., Martin, W., & Wageman, J.J. (2017). Motivation and achievement of middle school mathematics students. *The Mathematics Educator*, *26*, 83-106.

Hittleman, D. R., & Simon, A. J. (1997). *Interpreting educational research: An introduction for consumers of research*. Prentice-Hall, Inc.

Hooper, M., Mullis, I. V. S., & Martin, M. O. (2015). TIMSS 2015 context questionnaire framework. In I. V. S. Mullis & M. O. Martin (Eds.), *TIMSS 2015 assessment frameworks* (pp. 61-82). TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College. Retrieved June 2021, from https://timssandpirls.bc.edu/timss2015/downloads/T15_Frameworks_Full_Book.pdf.

Hooper, M., Mullis, I. V., & Martin, M. O. (2016). PIRLS 2016 context questionnaire framework. In I. V. S. Mullis & M. O. Martin (Eds.), *PIRLS assessment framework* (2nd ed., pp. 31-54). TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College. Retrieved June 2021, from https://timssandpirls.bc.edu/pirls2016/downloads/P16_Framework_2ndEd.pdf.

Hu, X., Gong, Y., Lai, C., & Leung, F. K. (2018). The relationship between ICT and student literacy in mathematics, reading, and science across 44 countries: A multilevel analysis. *Computers & Education*, *125*, 1-13. https://doi.org/10.1016/j.compedu.2018.05.021.

Huguley, J. P., Wang, M., Pasarow, S., & Wallace, J. M. (2020). Just discipline in schools: An integrated and interdisciplinary approach. *Children & Schools*, *42*(3), 195-199. https://doi.org/10.1093/cs/cdaa012.

Ibrahim, A., & Alhosani, N. (2020). Impact of language and curriculum on student international exam performances in the United Arab Emirates. *Cogent Education*, *7*(1), 1808284. https://doi.org/10.1080/2331186X.2020.1808284.

Idris, N. (2009). Enhancing students' understanding in calculus trough writing. *International Electronic Journal of Mathematics Education*, *4*(1), 36-55.

Incikabi, L., Kepceoglu, I., & Pektas, M. (2020). Gamification of middle school mathematics and science: game-playing for learning. In J. Keenge & P. Wachira (Eds.), *Handbook of research on integrating computer science and computational thinking in K-12 education* (pp. 301-316). IGI Global.

Incikabi, L., Serin, M. K., & Incikabi, S. (2021). Flipping the mathematics instruction: A critical overview of recent trends in application. In J. Keengwe & Y. Tran (Eds.), *Handbook of research on equity in computer science in P-16 education* (pp. 219-247). IGI Global. Ch013. https://doi.org/10.4018/978-1-7998-4739-7.

Izumi, Y. (2013). The effect of parental involvement on student achievement in junior secondary school: Examining data from the Botswana TIMSS 2007. *Journal of International Cooperation Studies*, *21*(1), 96-117. Retrieved June 2021, from https://www.research.kobe-u.ac.jp/gsics-publication/jics/yamasaki_21-1.pdf

Jarrah, H. Y., & Alkhazaleh, M. S. (2020). Knowledge sharing behavior in the curricula of United Arab Emirates universities and educational organizations. *International Journal of Instruction*, *13*(3), 1-16. https://doi.org/10.29333/iji.2020.1331a.

Jerrim, J., & Shure, N. (2016). *Achievement of 15-year-olds in Northern Ireland: PISA 2015 national report.* UCL Institute of Education. Retrieved June 2021, from https://www.education-ni.gov.uk/publications/2015-northern-ireland-pisa-results.

Johansone, I. (2016). Survey operations procedures in TIMSS 2015. In M. O. Martin, I. V. S. Mullis, & Hooper, M. (Eds.), *Methods and procedures in TIMSS 2015* (pp. 6.1-6.22). TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College. Retrieved June 2022, from: https://timssandpirls.bc.edu/publications/timss/2015-methods.html.

Jordan, N. C., Glutting, J., & Ramineni, C. (2010). The importance of number sense to mathematics achievement in first and third grades. *Learning and Individual Differences*, *20*(2), 82-88.

Joseph, E. U. (2014). School variables and mathematics performance among students in Akwa Ibom State. *International Journal of Development in Sustainability, 3*(7), 1558-1568.

Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and Psychological Measurement*, *20*(1), 141-151. https://doi.org/10.1177/001316446002000116.

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, *39*(1), 31-36. https://doi.org/10.1007/bf02291575.

Kartal, B. (2020). Pre-service science and mathematics teachers' teaching efficacy beliefs and attitudes toward teaching: A partial correlation research. *Australian Journal of Teacher Education*, *45*(9), 42-61. https://doi.org/ 10.14221/ajte.2020v45n9.3.

Kartianom, K., & Retnawati, H. (2018). Why are their mathematical learning achievements different? Re-analysis TIMSS 2015 data in Indonesia, Japan, and Turkey. *International Journal on New Trends in Education and Their Implications*, 9, 33-46. Retrieved June 2021, from http://www.ijonte.org/?pnum=66&pt=2018%20Volume%209%20Number%202.

Kaur, B. (2009). Performance of Singapore students in trends in international mathematics and science studies (TIMSS). In W. K. Yoong, L. P. Yee, B. Kaur, F. P. Yee, & N. S. Fong (Eds.), *Mathematics education: The Singapore journey* (pp. 439-463). World Scientific Publishing Company.

Kesianye, S. K. (2015). The three perspectives of integrating assessment and instruction in the learning of school mathematics. *Journal of Education and Practice*, *6*(19), 212-214.

Khamis, V., Dukmak, S., & Elhoweris, H. (2008). Factors affecting the motivation to learn among United Arab Emirates middle and high school students. *Educational Studies*, *34*(3), 191-200. https://doi.org/10.1080/03055690701811297.

Kibriya, S., Zhou, S., Zhang, Y., & Fatema, N. (2018). *The effects of school safety on academic achievement*. United States Agency for International Development (USAID). Retrieved June 2021, from https://pdf.usaid.gov/pdf_docs/PA00TGVG.pdf.

Kilic, S., & Askin, Ö. E. (2013). Parental influence on students' mathematics achievement: The comparative study of Turkey and best performer countries in TIMSS 2011. *Procedia - Social and Behavioral Sciences*, *106*, 2000-2007. https://doi.org/10.1016/j.sbspro.2013.12.228.

Kissling, E. M., & O'Donnell, M. E. (2015). Increasing language awareness and self-efficacy of FL students using self-assessment and the ACTFL proficiency guidelines. *Language Awareness*, *24*(4), 283-302.

Klenowski, V. (2009). Assessment for learning revisited: An Asia-Pacific perspective. *Assessment in Education: Principles, Policy, and Practice,* 16(3), 263-268.

Kottasz, R. (2005). Reasons for student non-attendance at lectures and tutorials: an analysis. *Investigations in University Teaching and Learning*, *2*(2), 5-16.

Kromrey, J. D., & Rendina-Gobioff, G. (2006). On knowing what we do not know: An empirical comparison of methods to detect publication bias in meta-analysis. *Educational and Psychological Measurement*, *66*(3), 357-373.

Krzywacki, H., Koistinen, L., & Lavonen, J. (2012). *Assessment in Finnish mathematics education: Various ways, various needs. In Proceedings of the 12th International Congress on Mathematical Education: Topic Study Group 33 (pp. 6661–6670).* Seoul, Korea.

Kumar, A., & Samadder, S. R. (2020). Performance evaluation of anaerobic digestion technology for energy recovery from organic fraction of municipal solid waste: A review. *Energy*, *197*, 117253.

Kumatongo, B., & Muzata, K. K. (2021). Research paradigms and designs with their application in education. *Journal of Lexicography and Terminology, 5*(1), 16-32.

Kupari, P., & Nissinen, K. (2013). Background factors behind mathematics achievement in Finnish education context: Explanatory models based on TIMSS 1999 and TIMSS 2011 data. In *IEA CONFERENCE 2013, Proceedings*.

Kutsyuruba, B., Klinger, D. A., & Hussain, A. (2015). Relationships among school climate, school safety, and student achievement and well-being: a review of literature. *Review of Education*, *3*(2), 103-135. https://doi.org/10.1002/rev3.3043.

Kweon, B. S., Ellis, C. D., Lee, J., & Jacobs, K. (2017). The link between school environments and student academic performance. *Urban Forestry & Urban Greening*, *23,* 35-43.

Lamb, S., & Fullarton, S. (2002). Classroom and school factors affecting mathematics achievement: A comparative study of Australia and the United States using TIMSS. *Australian Journal of Education*, *46*(2), 154-171. https://doi.org/10.1177/000494410204600205.

Lara, L., & Saracostti, M. (2019). Effect of parental involvement on children's academic achievement in Chile. *Frontiers in Psychology, 10*, 1464. https://doi.org/10.3389/fpsyg.2019.01464.

Leahy, S., Lyon, C., Thompson, M., & Wiliam, D. (2005). Classroom assessment: Minute by minute, day by day. *Educational Leadership,* 63*(*3*),* 19-24.

Ledford, J. R., & Gast, D. L. (2018). *Single case research methodology: Applications in special education and behavioral sciences*. Routledge.

Lee, J., & Stankov, L. (2018). Non-cognitive predictors of academic achievement: Evidence from TIMSS and PISA. *Learning and Individual Differences*, *65*, 50-64.

Levine, R. A., & White, M. I. (2017). *Human conditions: The cultural basis of educational developments*. Routledge.

Liang, G., Zhang, Y., Huang, H., Shi, S., & Qiao, Z. (2015). Professional development and student achievement: International evidence from the TIMSS data. *Postdoc Journal*, *3*(2), 17-31. https://doi.org/10.14304/surya.jpr.v3n2.3.

Lincoln, Y. S., & Guba, E. G. (2005). Paradigms and perspectives in contention. In N. Denzin & Y. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed., pp. 163-188). Thousand Oaks, CA: Sage.

Lindfors, M., Winberg, T. M., & Bodin, M. (2017). The role of students' scientific epistemic beliefs in computer-simulated problem solving. *Scandinavian Journal of Educational Research*, *63*(1), 124-144. https://doi.org/10.1080/00313831.2017.1324907.

Liu, J., & Steiner-Khamsi, G. (2020). Human Capital Index and the hidden penalty for non-participation in ILSAs. *International Journal of Educational Development*, *73*, 102149.

Lubienski, S., Lubienski, C., & Crane, C. (2008). Achievement differences and school type: The role of school climate, teacher certification, and instruction. *American Journal of Education*, *115*(1), 97-138. https://doi.org/10.1086/590677.

Lund, A. (2008). Assessment made visible: Individual and collective practices. *Mind, Culture, and Activity*, *15*(1), 32-51.

Malik, R. H., & Rizvi, A. A. (2018). Effect of classroom learning environment on students' academic achievement in mathematics at secondary level. *Bulletin of Education and Research*, *40*(2), 207-218.

Marczyk, G., DeMatteo, D. & Festinger, D. (2005). *Essentials of research design and methodology*. New Jersey. John Wiley and Sons, Inc.

Marback, T. L., Short, S. E., Short, M. W., & Sullivan, P. J. (2005). Coaching confidence: An exploratory investigation of sources and gender differences. *Journal of Sport Behavior, 28*(1), 1-16.

Martin, A. J., & Dowson, M. (2009). Interpersonal relationships, motivation, engagement, and achievement: Yields for theory, current issues, and educational practice. *Review of Educational Research*, *79*(1), 327-365.

Martin, M. O., Mullis, I. V. S., & Hooper, M. (Eds.). (2016). *Methods and Procedures in TIMSS 2015*. Boston College, TIMSS & PIRLS International Study Center. Retrieved February 2022, from http://timssandpirls.bc.edu/publications/timss/2015-methods.html.

Martin, M. O., Mullis, I. V., Foy, P., & Stanco, G. M. (2012). *TIMSS 2011 international results in science.* International Association for the Evaluation of Educational Achievement. Retrieved June 2021, from https://timssandpirls.bc.edu/timss2011/downloads/T11_IR_Science_FullBook.pdf.

Marzano, R. J., Marzano, J. S., & Pickering, D. (2003). *Classroom management that works: Research-based strategies for every teacher*. ASCD.

Mathotaarachchi, K. P., & Thilakarathna, K. A. A. N. (2021). Philosophy of approaches in social sciences: A review of positivism, phenomenology and critical social sciences in qualitative research. *Technium Social Sciences Journal, 20*(1), 944-952. Retrieved June 2021, from https://techniumscience.com/index.php/socialsciences/article/view/3559.

Maxwell, S., Reynolds, K. J., Lee, E., Subasic, E., & Bromhead, D. (2017). The impact of school climate and school identification on academic achievement: Multilevel modeling with student and teacher data. *Frontiers in Psychology, 8*, 2069. https://doi.org/10.3389/fpsyg.2017.02069.

McLeod, D. B., & Adams, V. M. (Eds.). (2012). *Affect and mathematical problem solving: A new perspective*. Springer Science & Business Media.

Ming, T. S., Ling, T. S., & Jaafar, N. M. (2011). Attitudes and motivation of Malaysian secondary students towards learning English as a second language: A case study. *3L: Language, Linguistics, Literature®, 17*(1), 40-54.

Ministry of Education. (2020). *The Ministry of Education strategy 2010-2020*. Dubai: Government of the United Arab Emirates.

Montague, M., Krawec, J., Enders, C., & Dietz, S. (2014). The effects of cognitive strategy instruction on math problem solving of middle-school students of varying ability. *Journal of Educational Psychology, 106*(2), 469-481. https://doi.org/10.1037/a0035176

Morgan, B. J. (2018). *Analysis of quantal response data*. Chapman and Hall/CRC.

Morgan, H. (2020). Best practices for implementing remote learning during a pandemic. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *93*(3), 135-141.

Morris, A. K., & Hiebert, J. (2017). Effects of teacher preparation courses: Do graduates use what they learned to plan mathematics lessons? *American Educational Research Journal*, *54*(3), 524 567. https://doi.org/10.3102/0002831217695217.

Mullis, I. V. S., Martin, M. O., Foy, P., & Hooper, M. (2016). *TIMSS 2015 international results in mathematics*. Retrieved October 2021, from http://timssandpirls.bc.edu/timss2015/international-results/.

Mullis, I. V. S., Martin, M. O., Foy, P., Kelly, D. L., & Fishbein, B. (2020). *TIMSS 2019 international results in mathematics and science.* Retrieved from Boston College, TIMSS & PIRLS International Study Center website: Retrieved June 2021, from https://timssandpirls.bc.edu/timss2019/international-results/

Mullis, I. V., & Martin, M. O. (2012). Using TIMSS and PIRLS to improve teaching and learning. *Recherches en éducation*, *14*, 35-50. https://doi.org/10.4000/ree.5835

Mullis, I. V., & Martin, M. O. (2017). *TIMSS 2019 Assessment Frameworks*. TIMSS & PIRLS TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College. Retrieved June 2021, from https://timssandpirls.bc.edu/timss2019/frameworks/.

Mullis, I. V., Martin, M. O., & Sainsbury, M. (2016). PIRLS 2016 reading framework. In I. V. S. Mullis & M. O. Martin (Eds.), *PIRLS 2016 assessment framework* (2nd ed., pp. 11-29). TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College. Retrieved June 2021, from: https://timssandpirls.bc.edu/pirls2016/downloads/P16_Framework_2ndEd.pdf.

Mullis, I. V., Martin, M. O., Gonzalez, E. J., & Chrostowski, S. J. (2004). *TIMSS 2003 international mathematics report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades*. International Association for the Evaluation of Educational Achievement. Herengracht 487, Amsterdam, 1017 BT, The Netherlands.

Mullis, I. V., Martin, M. O., Ruddock, G. J., O'Sullivan, C. Y., & Preuschoff, C. (2011). *TIMSS 2011 assessment frameworks*. TIMSS and PIRLS International Study Center, Lynch School of Education, Boston College. Retrieved September 2021, from https://timss.bc.edu/timss2011/downloads/TIMSS2011-Frameworks..

Najm, N. A. (2015). Arab culture dimensions in the international and Arab models. *American Journal of Business, Economics and Management, 3*(6), 423-431.

National Center for Education Statistics. (2020). *Trends in International Mathematics and Science Study (TIMSS): Participating countries*. Retrieved June 2021, from https://nces.ed.gov/timss/participation.asp.

Nayak, J. K., & Singh, P. (2021). *Fundamentals of research methodology: Problems and prospects*. SSDN Publishers & Distributors.

Nespor, J. (1987). The role of beliefs in the practice of teaching. *Journal of Curriculum Studies*, *19*(4), 317-328.

Neuman, W. L. (2003). *Social research methods: Qualitative and quantitative approaches* (5th ed.). Boston: Allyn and Bacon.

Nichols, P. D., & Gianopulos, G. (2021). Arguing about the effectiveness of assessments for the classroom. *The Journal of Mathematical Behavior*, *61*, 100839. https://doi.org/10.1016/j.jmathb.2020.100839

Oddone, K. (2016). *The importance of school libraries in the Google Age.* Retrieved May 2022 from. tinyurl.com/munxb2pu

Osborne, J. W. (2015). What is rotating in exploratory factor analysis? *Practical Assessment, Research, and Evaluation, 20*(2), Article 2. https://doi.org/10.7275/hb2g-m060

Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*(3), 307-332.

Pauceanu, A., Alpenidze, O., Edu, T., & Zaharia, R. (2018). What determinants influence students to start their own business? Empirical evidence from United Arab Emirates universities. *Sustainability, 11*(1), 92. https://doi.org/10.3390/su11010092

Pennington, R. (2016, October 17). Abu Dhabi education merger 'will strengthen research'. *The National.* Retrieved June 2021, from www.thenational.ae/uae/abu-dhabi-education-merger-will-strengthen-research.

Provasnik, S. J., Malley, L. B., Neidorf, T., Arora, A., Stephens, M., Balestreri, K., Herz, K., Perkins, R., & Tang, J. (2019). *U.S. Performance on the 2015 TIMSS advanced mathematics and physics assessments: A closer look.* National Center for Education Statistics. Retrieved July 2021, from https://nces.ed.gov/pubs2020/2020051.pdf.

Pryor, J., & Crossouard, B. (2008). A socio-cultural theorisation of formative assessment. *Oxford Review of Education, 34*(1), 1-20.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods*. SAGE.

Rechtschaffen, D. (2014). *The way of mindful education: Cultivating well-being in teachers and students*. W. W. Norton & Company.

Ridge, N. (2010). *Teacher quality, gender and nationality in the United Arab Emirates: A crisis for boys*. *Dubai: Dubai School of Government*. Retrieved June 2021, from https://www.arabdevelopmentportal.com/publication/teacher-quality-gender-and-nationality-united-arab-emirates-crisis-boys.

Rosen, Y., Stoeffler, K., Simmering, V., Hao, J., & Davier, A. V. (2021). Development of Scalable Assessment for Collaborative Problem-Solving. In *International Handbook of Computer-Supported Collaborative Learning* (pp. 517-532). Springer, Cham.

Ruffina, A. N., Esther, A. E., & Anastecia, I. N. (2018). Impact of class size on students' academic performance in Biology in Idemili north local government area of Anambra State. *International Journal of Education and Evaluation, 4*(8), 22-32.

Salloum, S. A., Al-Emran, M., Shaalan, K., & Tarhini, A. (2018). Factors affecting the E-learning acceptance: A case study from UAE. *Education and Information Technologies*, *24*(1), 509-530. https://doi.org/ 10.1007/s10639-018-9786-3

Sanderson, D. (2019, 17 June). *UAE schools improve in maths but lag behind in reading and science, international rankings show*. The National. Retrieved June 2022, from https://tinyurl.com/mr34fkhc.

Sandoval-Hernández, A., & Białowolski, P. (2016). Factors and conditions promoting academic resilience: a TIMSS-based analysis of five Asian education systems. *Asia Pacific Education Review*, *17*(3), 511-520.

Senk, S. L., & Thompson, D. R. (Eds.). (2020). *Standards-based school mathematics curricula: What are they? What do students learn?*. Routledge.

Saragih, D. I., & Surya, E. (2017). Analysis the effectiveness of mathematics learning using contextual learning model. *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, *34*(1), 135-143.

Sarantakos, S. (2005). Social research (3rd ed.). Melbourne: Macmillan Education.

Scherer, M. J., & Federici, S. (2015). Why people use and don't use technologies: Introduction to the special issue on assistive technologies for cognition/cognitive support technologies. *Neuro Rehabilitation*, *37*(3), 315-319.

Schleicher, A. (2012). Preparing teachers and developing school leaders for the 21st century. *International Summit on the Teaching Profession*. https://doi.org/10.1787/9789264174559-en

Schmidt, W. H., Cogan, L. S., Houang, R. T., & McKnight, C. C. (2011). Content coverage differences across districts/states: A persisting challenge for US education policy. *American Journal of Education*, *117*(3), 399-427.

Schoenfeld, A. H. (1985). *Mathematical problem solving*. Academic Press, Inc.

Schukajlow, S., Kolter, J., & Blum, W. (2015). Scaffolding mathematical modelling with a solution plan. *ZDM*, *47*(7), 1241-1254.

Shapira-Lishchinsky, O., & Zavelevsky, E. (2020). Multiple appearances of parental interactions and math achievement on TIMSS International Assessment. *International Journal of Science and Mathematics Education*, *18*(1), 145-161.

Sheldon, S. B., Epstein, J. L., & Galindo, C. L. (2010). Not just numbers: Creating a partnership climate to improve math proficiency in schools. *Leadership and Policy in Schools*, *9*(1), 27-48. https://doi.org/10.1080/15700760802702548

Shepard, L. (2001). *The role of classroom assessment in teaching and learning*. CSE Technical Report 517, CRESST / University of Colorado at Boulder. Retrieved June 2022, from https://cresst.org/wp-content/uploads/TECH517.pdf

Shepard, L. A. (2000). The role of assessment in a learning culture. *Educational Researcher*, *29*(7), 4-14.

Solheim, O. J., Rege, M., & McTigue, E. (2017). Study protocol "Two teachers": A randomized controlled trial investigating individual and complementary effects of teacher-student ratio in literacy instruction and professional development for teachers. *International Journal of Educational Research, 86,* 122-130.

Staats, S., & Robertson, D. (2017). Equity in a college readiness math modelling program: Limitations and opportunities. *Mathematics Education and Life at Times of Crisis*, MES9 Conference (pp. 877-888). Retrieved June 2022, from http://mes9.ece.uth.gr/portal/images/paperslist/mes9apl/26.pdf

Straub, D., Boudreau, M., & Gefen, D. (2004). Validation guidelines for IS positivist research. *Communications of the Association for Information Systems*, *13*(24), pp-380-427. https://doi.org/10.17705/1CAIS.01324

Stronge, J. H., & Tucker, P. D. (2000). *Teacher Evaluation and Student Achievement. Student Assessment Series*. NEA Professional Library, Distribution Center, PO Box 2035, Annapolis Junction, MD 20701-2035.

Sulisworo, D., & Toifur, M. (2016). The role of mobile learning on the learning environment shifting at high school in Indonesia. *International Journal of Mobile Learning and Organisation*, *10*(3), 159-170. https://doi.org/10.1504/IJMLO.2016.077864

Suurtamm, C., & Koch, M. J. (2014). Navigating dilemmas in transforming assessment practices: Experiences of mathematics teachers in Ontario, Canada. *Educational Assessment, Evaluation and Accountability*, *26*(3), 263-287.

Suurtamm, C., Koch, M., & Arden, A. (2010). Teachers' assessment practices in mathematics: Classrooms in the context of reform. *Assessment in Education: Principles, Policy & Practice*, *17*(4), 399-417.

Suurtamm, C., Thompson, D. R., Kim, R. Y., Moreno, L. D., Sayac, N., Silver, E., Ufer, S., & Vos, P. (2016). Assessment in mathematics education: Large-scale assessment and classroom assessment. In G. Kaiser (Ed.), *ICME-13 Topical Surveys* (pp. 1-46). Springer.

Swan, M., & Burkhardt, H. (2012). A designer speaks: Designing assessment of performance in mathematics. *Educational Designer: Journal of the International Society for Design and Development in Education*, *2*(5), 1-41.

Tatto, M. T., & Hordern, J. (2017). The configuration of teacher education as a professional field of practice: a comparative study of mathematics education. In J. Furlong, & G. Whitty (Eds.), *Knowledge and the study of education: an international exploration* (pp. 255-274). (Oxford Studies in Comparative Education). Symposium Books. https://doi.org/10.15730/books.100

Thompson, R. N., Hollingsworth, T. D., Isham, V., Arribas-Bel, D., Ashby, B., Britton, T., & Restif, O. (2020). Key questions for modelling COVID-19 exit strategies. *Proceedings of the Royal Society B*, *287*(1932), 20201405.

Thurstone, L. L. (1947) *Multiple factor analysis: A development and expansion of vectors of the mind*. University of Chicago Press, Chicago.

TIMSS & PIRLS International Study Center. (2021). *TIMSS: Trends in international mathematics and science study*. Retrieved February 2021, from https://timssandpirls.bc.edu/timss-landing.html.

Tucker, B. (2012). The flipped classroom. *Education Next*, *12*(1), 82-83. Retrieved December 2021, from http://www.msuedtechsandbox.com/MAETELy2-2015/wp-content/uploads/2015/07/the_flipped_classroom_article_2.pdf.

UCHICAGO Consortium on School Research. (2018). *How do principals influence student achievement?*. Retrieved August 2021, from https://consortium.uchicago.edu/sites/default/files/2018-10/Leadership%20Snapshot-Mar2018-Consortium.pdf

Vale, C., Davies, A., Weaven, M., Hooley, N., Davidson, K., & Loton, D. (2010). Leadership to improve mathematics outcomes in low SES schools and school networks. *Mathematics Teacher Education and Development, 12*(2), 47-71. Retrieved December 2021, from https://files.eric.ed.gov/fulltext/EJ940921.pdf

Vally, Z., Salloum, L., AlQedra, D., El Shazly, S., Albloshi, M., Alsheraifi, S., & Alkaabi, A. (2019). Examining the effects of creativity training on creative production, creative self-efficacy, and neuro-executive functioning. *Thinking Skills and Creativity*, *31*, 70-78.

Van den Heuvel-Panhuizen, M., & Becker, J. (2003). Towards a didactic model for assessment design in mathematics education. In A. J. Bishop, M. A. Clements, C. Keitel, J. Kilpatrick, & F. K. S. Leung (Eds.), *Second international handbook of mathematics education* (pp. 686-716). Dordrecht, the Netherlands: Kluwer Academic Publishers.

Viberg, O., Gronlund, A., & Andersson, A. (2020). Integrating digital technology in mathematics education: A Swedish case study. *Interactive Learning Environments,* Ahead-of-Print, 1-12. https://doi.org/10.1080/10494820.2020.1770801

Von Suchodoletz, A., Rahn, J., Nadyukova, I., Barza, L., & Achtziger, A. (2020). Can mindsets influence college students' motivation to learn? Findings from the United States and the United Arab Emirates. *Higher Education, 79*(4), 731-748.

Voss, T., Kleickmann, T., Kunter, M., & Hachfeld, A. (2013). Mathematics teachers' beliefs. In *Cognitive activation in the mathematics classroom and professional competence of teachers* (pp. 249-271). Springer, Boston, MA.

Vracheva, V. P., Abu-Rahma, A., & Jacques, P. (2019). Effects of context on the entrepreneurial intent of female students from the United Arab Emirates. *Education+ Training, 61*(6), 700-717.

Wagie, D., & Fox, W. (2006). Transforming higher education in the United Arab Emirates (UAE): Contributing to social progress and the new economy. *The International Journal of Learning: Annual Review*, *12*(7), 277- 286. https://doi.org/10.18848/1447-9494/cgp/v12i07/47926

Waits, B. K., & Demana, F. (1988). Relationship between mathematics skills of entering students and their success in college. *The School Counselor, 35*(4), 307-310.

Wardat, Y., Belbase, S., & Tairab, H. (2022). Mathematics teachers' perceptions of Trends in International Mathematics and Science Study (TIMSS) related practices in Abu Dhabi Emirate schools. *Sustainability, 14*(9), 5436. https://doi.org/10.3390/su14095436

Watkins, M. W. (2021). *A step-by-step guide to exploratory factor analysis with SPSS*. Routledge.

Weisberg, S. (2014). *Applied linear regression*. John Wiley & Sons.

Whisman, A., & Hammer, P. C. (2014). *The association between school discipline and mathematics performance: A case for positive discipline approaches*. West Virginia Department of Education Office of Research. Retrieved June 2022, from https://files.eric.ed.gov/fulltext/ED569903.pdf

Wiliam, D. (2011). *Embedded formative assessment: Practical strategies and tools for K-12 teachers.* Bloomington, IN: Solution Tree Press.

Woessmann, L. (2016). The importance of school systems: Evidence from international differences in student achievement. *Journal of Economic Perspectives, 30*(3), 3-32. https://doi.org/10.1257/jep.30.3.3.

Yalcin, S., Demirtasli, R. N., Dibek, M.I. and Yavuz, H. C., (2017). The effect of teacher and student characteristics on TIMSS 2011 mathematics achievement of fourth-and eighth-grade students in Turkey. *International Journal of Progressive Education, 13*(3), 79-94. https://doi.org/10.29329/ijpe

Yaşaroğlu, C. (2016). Cooperation and importance of school and family on values education. *European Journal of Multidisciplinary Studies, 1*(2), 66-71. https://doi.org/10.26417/ejms.v1i2.p66-71

Yavuz, H., Dibek, M., &Yalcin, S. (2017). The effects of student and teacher level variables on TIMSS 2007 and 2011 mathematics achievement of Turkish students. *Education and Science*, *42*(189), 27-47. https://doi.org/10.15390/eb.2017.6885

Zaharna, R. S. (1995). Understanding cultural preferences of Arab communication patterns. *Public Relations Review, 21*, 241-255. https://doi.org/10.1016/0363-8111(95)90024-1

Zhang, A., Wang, K., Zhang, J., & Oudekerk, B. A. (2019). *Indicators of school crime and safety: 2018* (NCES 2019- 047/NCJ 252571). Retrieved from National Center for Education Statistics. Retrieved October 2021, from https://nces.ed.gov/pubs2019/2019047.pdf.

Appendices

Appendix A

Table A1: Descriptive statistics and one-sample t-test for the components of Factor 1: General school Resources.

No	One-Sample Statistics and t-test (test value=2.5)							
1.	**Items**	**N**	**Mean**	**Std. Deviation**	**Mean Difference**	**t-value**	**Sig.(2-tailed)**	**Confident and Not confident**
2.	Factor 1: General School Resources	4376	2.4165	.88074	-.08349	-6.271	0.000	SN
3.	GEN\SHORTAGE\GEN\INSTRUCTIONAL SPACE	4376	2.54	1.230	.044	2.347	.019	N
4.	GEN\SHORTAGE\GEN\HEATING SYSTEMS	4376	2.45	1.253	-.046	-2.437	0.015	N
5.	GEN\SHORTAGE\GEN\TECHNOLOGICAL STAFF	4321	2.34	1.064	-.157	-9.671	0.000	SN
6.	GEN\SHORTAGE\GEN\INSTRUCTIONAL MATERIAL	4376	2.37	1.199	-.135	-7.429	0.000	SN
7.	GEN\SHORTAGE\GEN\AUDIO-VIDEO RES	4376	2.34	1.063	-.156	-9.684	0.000	SN
8.	GEN\SHORTAGE\GEN\SCHOOL BUILDINGS	4376	2.53	1.143	.028	1.640	0.101	N
9.	GEN\SHORTAGE\GEN\SUPPLIES	4376	2.15	1.186	-.349	-19.481	0.000	SN
10.	GEN\SHORTAGE\MATH\CONCRETE OBJECTS	4297	2.41	.936	-.091	-6.349	0.000	SN
11.	GEN\SHORTAGE\GEN\COMP TECHNOLOGY	4346	2.48	1.042	-.019	-1.194	0.233	N
12.	GEN\SHORTAGE\MATH\TEACH SPEC MATH	4376	2.61	1.302	.112	5.703	.000	SP
13	GEN\SHORTAGE\MATH\LIBRARY RESOURCES	4290	2.37	.939	-.131	-9.136	.000	SN
14.	GEN\SHORTAGE\MATH\CALCULATORS	4286	2.26	1.140	-.237	-13.602	.000	SN
15.	GEN\SHORTAGE\MATH\COMPUTER SOFTWARE	4321	2.53	.986	.029	1.936	0.053	N
16.	GEN\SHORTAGE\GEN\RESOURCES STD WITH DISAB	4218	2.35	1.128	-.147	-8.437	.000	SN

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident.

Table A2: Descriptive statistics and one-sample t-test for the components of Factor 2: School Discipline and Safety.

One-Sample Statistics and t-test (test value=2.5)

Items	**N**	**Mean**	**Std. Deviation**	**Mean Difference**	**t-value**	**Sig.(2-tailed)**	**Confident and not confident**
Factor 2: School Discipline and Safety	4422	1.6013	.49186	-.89869	-121.500	.000	SP
GEN\DEGREE PROBS\VANDALISM	4422	1.56	.732	-.942	-85.552	.000	SP
GEN\DEGREE PROBS\INTIMIDATION OF TEACHER	4422	1.28	.558	-1.221	-145.500	.000	SP
GEN\DEGREE PROBS\THEFT	4395	1.25	.532	-1.254	-156.182	.000	SP
GEN\DEGREE PROBS\PROFANITY	4340	1.72	.775	-.782	-66.521	.000	SP
GEN\DEGREE PROBS\INTIMIDATION AMONG STUD	4366	1.59	.711	-.914	-84.941	.000	SP
GEN\DEGREE PROBS\PHYSICAL INJURY	4422	1.76	.729	-.743	-67.753	.000	SP
GEN\DEGREE PROBS\CHEATING	4411	1.51	.640	-.994	-103.200	.000	SP
GEN\DEGREE PROBS\CLASSROOM DISTURBANCE	4422	2.06	.745	-.436	-38.962	.000	SP
GEN\DEGREE PROBS\ARRIVING LATE AT SCHOOL	4422	1.92	.672	-.578	-57.193	.000	SP
GEN\DEGREE PROBS TEACH\ARRIVING LATE AT SCHOOL	4399	1.62	.837	-.880	-69.746	.000	SP
GEN\DEGREE PROBS TEACH\ABSENTEEISM	4399	1.93	.882	-.573	-43.108	.000	SP
GEN\DEGREE PROBS\PHYSICAL INJURY TO TCH	4396	1.10	.403	-1.400	-230.454	.000	SP

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident.

Table A3: Descriptive statistics and one-sample t-test for the components of Factor 3: Parental Support One-Sam
and t-test (test value=3.0)

No	Items	N	Mean	Std. Deviation	Mean Difference	t-value	Sig.(2-tailed)	Confident not confident
1	Factor 3: Parental Support	4422	2.3159	.55927	-.68408	-81.338	.000	SP
2	GEN\SCH CHARACTER\TCH EXPECTATIONS	4356	2.21	.686	-.787	-75.767	.000	SP
3	GEN\SCH CHARACTER\TCHRS ABILITY TO INSPIRE	4332	2.04	.761	-.965	-83.410	.000	SP
4	GEN\SCH CHARACTER\TCH SUCCESS	4356	1.96	.701	-1.041	-97.982	.000	SP
5	GEN\SCH CHARACTER\STD DESIRE TO DO WELL	4396	2.31	.806	-.689	-56.628	.000	SP
6	GEN\SCH CHARACTER\TCH UNDERSTANDING	4422	1.82	.666	-1.177	-117.539	.000	SP
7	GEN\SCH CHARACTER\TCHRS WORKING TOGETHER	4330	1.99	.743	-1.008	-89.225	.000	SP
8	GEN\SCH CHARACTER\PARENTAL COMMITMENT	4422	2.84	.881	-.161	-12.182	.000	SP
9	GEN\SCH CHARACTER\PARENTAL SUPPORT	4422	2.77	.829	-.230	-18.440	.000	SP
1	GEN\SCH CHARACTER\ABILITY TO REACH GOALS	4367	2.36	.650	-.640	-65.078	.000	SP
1	GEN\SCH CHARACTER\PARENTAL PRESSURE	4422	2.42	.837	-.582	-46.223	.000	SP
1	GEN\SCH CHARACTER\PARENTAL EXPECTATIONS	4422	2.40	.796	-.597	-49.851	.000	SP
1	GEN\SCH CHARACTER\PARENTAL INVOLVEMENT	4422	3.11	1.040	.114	7.316	.000	SN
1	GEN\SCH CHARACTER\RESPECT FOR CLASSMATES	4422	1.85	.694	-1.146	-109.802	.000	SP

Table A4: Descriptive statistics and one-sample t-test for the components of Factor 4: Principal Experience and
Sample Statistics and t-test (test value=1.5*, 2.5**, **3)

Items	**N**	**Mean**	**Std. Deviation**	**Mean Difference**	**t-value**	**Sig.(2-tailed)**	**Confident and not confident**
GEN\HIGHEST LEVEL OF FORMAL EDUCATION REVERSE**	4389	2.6484	.67454	.14844	14.579	*.000	SP
GEN\DEGREES IN EDUCATION LEADERSHIP\ISCED 7*	4066	1.75	.435	-.754	-110.436	*.000	SN
GEN\DEGREES IN EDUCATION LEADERSHIP\ISCED 8*	3514	1.93	.252	-.568	-133.720	*.000	SN
GEN\STUDENTS BACKGROUND\ECONOMIC DISADVA**	4177	2.25	1.140	-.252	-14.266	*.000	SN
GEN\PERCENT OF STUDENTS <LANG OF TEST> REVERSE***	4429	3.7121	1.82277	.71212	26.000	**.000	SP

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident

Table A5: Descriptive statistics and one-sample t-test for the components of Factor 5: library and instruction resources.

One-Sample Statistics and t-test (test value=1.5*, 2.5**, 3***, 3.5****).							
Items	**N**	**Mean**	**Std. Deviation**	**Mean Difference**	**t-value**	**Sig.(2-tailed)**	**Confident and not confident**
Factor 5: library and instruction resources	4453	2.76	0.640	0.259	27.049	0.000	SP
GEN\HAVE PLACE FOR SCHOOLWORK*	4453	1.80	0.399	0.301	50.371	0.000	SP
GEN\USE INCENTIVES\MATH	4356	1.72	0.451	0.216	31.615	0.000	SP
GEN\STUDENTS* BACKGROUND\ECONOMIC AFFLUEN REVERSE**	4110	2.62	1.199	0.179	9.560	0.000	SP
GEN\MAGAZINES IN LIBRARY\DIGITAL REVERSE***	2125	4.27	1.221	0.774	29.217	0.000	SP
GEN\MAGAZINES IN LIBRARY\PRINT REVERSE***	4014	3.41	1.106	0.090	−5.153	0.000	SP
GEN\BOOKS IN LIBRARY\DIGITAL REVERSE****	1977	5.53	1.060	2.033	85.286	0.000	SP
GEN\BOOKS IN LIBRARY\PRINT REVERSE****	4197	2.99	1.245	−0.510	26.558	0.000	SN

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident.

Appendix B

Table B1: Descriptive statistics and one-sample t-test for the components of Factor1: mathematics in school.

One-Sample Statistics and t-test (test value=2.5)								
No	**Items**	**N**	**Mean**	**Std. Deviation**	**Mean Difference**	**t-value**	**Sig.(2-tailed)**	**Confident Not confident**
1.	Factor1: mathematics in school	4774	1.9552	.62760	-.54485	-59.984	.000	SP
2.	MATH\AGREE\TEACHER CLEAR ANSWERS	4639	1.84	.895	-.664	-50.565	.000	SP
3.	MATH\AGREE\INTERESTING THINGS TO DO	4650	2.07	.950	-.428	-30.696	.000	SP
4.	MATH\AGREE\TEACHER EXPLAINS GOOD	4620	1.77	.887	-.726	-55.591	.000	SP
5.	MATH\AGREE\TEACHER SHOWS LEARNED	4629	1.91	.898	-.593	-44.896	.000	SP
6.	MATH\AGREE\TEACHER IS EASY TO UNDERSTAND	4659	1.93	.893	-.571	-43.631	.000	SP
7.	MATH\AGREE\TELLS HOW TO DO BETTER	4639	1.79	.872	-.706	-55.160	.000	SP
8.	MATH\AGREE\INTERESTED IN WHAT TCHR SAYS	4651	1.79	.833	-.706	-57.773	.000	SP
9.	MATH\AGREE\DIFFERENT THINGS TO HELP	4667	1.90	.917	-.604	-44.986	.000	SP
10.	MATH\AGREE\TEACHER LISTENS	4660	1.91	.943	-.587	-42.504	.000	SP
11.	MATH\AGREE\MATHEMATICS WILL HELP ME	4608	1.70	.857	-.798	-63.184	.000	SP
12.	MATH\AGREE\LOOK FORWARD TO MATH CLASS	4700	2.36	1.047	-.137	-8.983	.000	SP
13.	MATH\AGREE\GET AHEAD IN THE WORLD	4569	1.76	.856	-.737	-58.237	.000	SP
14.	MATH\AGREE\NEED MAT TO LEARN OTHER THINGS	4600	1.89	.876	-.613	-47.514	.000	SP
15.	MATH\AGREE\LEARN INTERESTING THINGS	4654	2.04	.976	-.464	-32.442	.000	SP
16.	MATH\AGREE\LIKE MATHEMATICS	4662	2.13	1.057	-.366	-23.617	.000	SP
17.	MATH\AGREE\FAVORITE SUBJECT	4727	2.37	1.131	-.129	-7.811	.000	SP
18.	MATH\AGREE\MORE JOB OPPORTUNITIES	4568	1.71	.847	-.789	-62.981	.000	SP

Table B1: Descriptive statistics and one-sample t-test for the components of Factor1: mathematics in school (continued)

19.	MATH\AGREE\LEARN QUICKLY IN MATHEMATICS	4595	2.05	.923	-.450	-33.073	.000	SP
20.	MATH\AGREE\IMPORTANT TO DO WELL IN MATH	4581	1.57	.794	-.932	-79.454	.000	SP
21.	MATH\AGREE\LIKE MATH PROBLEMS	4701	2.19	1.052	-.307	-20.038	.000	SP
22.	MATH\AGREE\NEED MATH TO GET INTO <UNI>	4584	1.61	.812	-.889	-74.141	.000	SP
23.	MATH\AGREE\I AM GOOD AT MATHEMATICS	4575	2.06	.934	-.440	-31.852	.000	SP
24.	MATH\AGREE\LIKE NUMBERS	4695	2.26	1.009	-.236	-16.047	.000	SP
25.	MATH\AGREE\ENJOY LEARNING MATHEMATICS	4713	2.01	.956	-.487	-34.947	.000	SP
26.	MATH\AGREE\JOB INVOLVING MATHEMATICS	4541	2.33	1.046	-.173	-11.129	.000	SP
27.	MATH\AGREE\NEED MAT TO GET THE JOB I WANT	4569	1.70	.879	-.797	-61.280	.000	SP
28.	MATH\AGREE\GOOD AT WORKING OUT PROBLEMS	4588	2.26	.946	-.236	-16.880	.000	SP
29.	MATH\AGREE\TEACHER EXPECTS TO DO	4636	1.83	.806	-.670	-56.595	.000	SP
30.	MATH\AGREE\PARENTS THINK MATH IMPORTANT	4575	1.58	.793	-.923	-78.687	.000	SP
31.	MATH\AGREE\USUALLY DO WELL IN MATH	4642	1.85	.826	-.645	-53.267	.000	SP

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], $p<0.05$ Confident, $p>0.05$ Not Confident.

Table B2: Descriptive statistics and one-sample t-test for the components of Factor2: Safety and Behavior.

One-Sample Statistics and t-test (test value=2.5)

No	Items	N	Mean	Std. Deviation	Mean Difference	t-value	Sig.(2-tailed)	Confident not confident
1.	Factor 2: Safety and Behavior	4781	3.2490	.65445	.74900	79.134	0.000	SN
2.	GEN\HOW OFTEN\THREATENED	4751	3.60	.858	1.095	87.969	0.000	SN
3.	GEN\HOW OFTEN\EMBARRASSING INFO	4746	3.45	.964	.949	67.829	0.000	SN
4.	GEN\HOW OFTEN\FORCE TO DO STH	4752	3.54	.893	1.039	80.233	0.000	SN
5.	GEN\HOW OFTEN\HURT BY OTHERS	4742	3.35	1.005	.851	58.307	0.000	SN
6.	GEN\HOW OFTEN\POSTED EMBARRASSING THINGS	4756	3.72	.757	1.217	110.852	0.000	SN
7.	GEN\HOW OFTEN\SPREAD LIES ABOUT ME	4694	3.19	1.075	.686	43.703	0.000	SN
8.	GEN\HOW OFTEN\LEFT OUT OF GAMES	4724	3.26	1.092	.758	47.707	0.000	SN
9.	GEN\HOW OFTEN\MADE FUN OF	4694	2.75	1.231	.248	13.809	0.000	SN
10.	GEN\HOW OFTEN\STOLE STH FROM ME	4735	3.24	1.061	.744	48.245	0.000	SN
11.	MATH\EXTRA LESSONS LAST 12 MONTH\MATHEMATICS	4530	2.56	.869	.362	28.079	0.000	SN

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident.

Table B3: Descriptive statistics and one-sample t-test for the components of Student Factor3 Attitude toward Math.

One-Sample Statistics and t-test (test value=2.5)

	Items	**N**	**Mean**	**Std. Deviation**	**Mean Difference**	**t-value**	**Sig.(2-tailed)**	
1.	Factor3 Attitude toward Math	4758	2.3458	.69183	-.15424	-15.378	0.000	SP
2.	MATH\AGREE\MATHEMATICS HARDER FOR ME REVERSE	4626	2.3240	1.05434	-.17596	-11.351	0.000	SP
3.	MATH\AGREE\MATHEMATICS NOT MY STRENGTH REVESE	4574	2.2049	1.01304	-.29515	-19.704	0.000	SP
4.	MATH\AGREE\MAT MAKES NERVOUS REVERSE	4587	2.2906	1.01296	-.20940	-14.000	0.000	SP
5.	MATH\AGREE\MATHEMATICS IS MORE DIFFICULT REVERSE	4630	2.3395	.99168	-.16048	-11.011	0.000	SP
6.	MATH\AGREE\MATH IS BORING REVERSE	4663	2.2644	1.02238	-.23558	-15.735	0.000	SP
7.	MATH\AGREE\WISH HAVE NOT TO STUDY MATH REVERSE	4716	2.1872	1.08939	-.31277	-19.716	0.000	SP
8.	MATH\AGREE\MAHT MAKES CONFUSED REVERSE	4613	2.357	1.66694	-.33568	-34.185	0.000	SP

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident.

Table B4: Descriptive statistics and one-sample t-test for the components of Factor4: School and Classroom Environment.

One-Sample Statistics and t-test (test value=2.5)

	Items	N	Mean	Std. Deviation	Mean Difference	t-value	Sig.(2-tailed)	
1.	Factor4: School and Classroom Environment	4781	2.4005	.63389	-.09949	-15.378	0.000	SP
2.	GEN\AGREE\LEARN A LOT	4709	2.17	.844	-.326	-11.351	0.000	SP
3.	GEN\AGREE\PROUD TO GO TO THIS SCHOOL	4700	2.31	.952	-.193	-19.704	0.000	SP
4.	GEN\AGREE\SAFE AT SCHOOL	4698	2.33	.927	-.171	-14.000	0.000	SP
5.	GEN\AGREE\LIKE TO SEE CLASSMATES	4688	1.95	.786	-.550	-11.011	0.000	SP
6.	GEN\AGREE\BELONG AT SCHOOL	4648	2.41	.934	-.090	-15.735	0.000	SP
7.	GEN\AGREE\BEING IN SCHOOL	4721	2.39	.935	-.108	-19.716	0.000	SP
8.	GEN\OFTEN SPEAK <LANG OF TEST> AT HOME REVERSE	4745	3.1992	.98458	.69916	34.185	.000	SN
9.	GEN\AGREE\FAIR TEACHERS	4689	2.37	.922	-.125	-19.716	.000	SP
10.	GEN\AGREE\LIKE TO SEE CLASSMATES	4688	1.95	.786	-.550	-11.011	0.000	SP

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident.

Table B5: Descriptive statistics and one-sample t-test for the components of Factor5: Internet and tablet.

One-Sample Statistics and t-test (test value= 2)

No	Items	N	Mean	Std. Deviation	Mean Difference	t-value	Sig.(2-tailed)	Confident and not confident
1.	Factor5 Parents Beliefs	4781	1.4664	0.24359	-.53358	-151.460	0.000	SP
2.	GEN\HOME POSSESS\<COUNTRY SPECIFIC>	4747	1.10	.306	-.395	-88.822	0.000	SP
3.	GEN\HOME POSSESS\GAMING SYSTEM	4752	1.22	.417	-.276	-45.702	0.000	SP
4.	GEN\HOME POSSESS\COMPUTER TABLET OWN	4753	1.15	.355	-.353	-68.531	0.000	SP
5.	GEN\HOME POSSESS\<COUNTRY SPECIFIC>	4693	1.70	.457	.202	-30.272	0.000	SP
6.	GEN\HOME POSSESS\<COUNTRY SPECIFIC>	4710	1.46	.498	-.042	-5.819	0.000	SP
7.	GEN\HOME POSSESS\OWN ROOM	4726	1.42	.493	-.083	-11.594	0.000	SP
8.	GEN\HOME POSSESS\INTERNET CONNECTION	4762	1.06	.230	-.444	-133.446	0.000	SP
9.	GEN\HOME POSSESS\OWN MOBILE PHONE	4741	1.21	.404	-.294	-50.139	0.000	SP
10.	GEN\HOME POSSESS\<COUNTRY SPECIFIC>	4738	1.70	.457	.202	-30.394	0.000	SP
11.	GEN\HOW OFTEN USE COMPUTER TABLET\OTHER	4630	2.20	1.178	-.303	-17.492	0.000	SP
12.	GEN\FATHER BORN IN <COUNTRY>	4741	1.70	.644	-.304	-32.523	0.000	SP
13.	GEN\MOTHER BORN IN <COUNTRY>	4751	1.70	.633	-.305	-33.190	0.000	SP

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident.

Appendix C

Table C1: Descriptive statistics and one-sample t-test for the components of Factor 1: school emphasis on academic success.

One-Sample Statistics and t-test (test value=2.5)

No	Items	N	Mean	Std. Deviation	Mean Difference	t-value	Sig.(2-tailed)	Confident and not confident
1.	Factor 1: school emphasis on academic success	4159	1.8726	.38976	-.62742	-103.815	.000	SP
2.	GEN\CHARACTERIZE\COLLABORATION TO PLAN	4101	1.74	.741	-.757	-65.367	.000	SP
3.	GEN\CHARACTERIZE\PARENTAL SUPPORT	4116	2.76	.893	.255	18.317	.000	SN
4.	MATH\CONFIDENT\MAKE MATH RELEVANT	3925	1.64	.638	-.864	-84.828	.000	SP
5.	GEN\CHARACTERIZE\CLARITY OF OBJECTIVES	4101	1.76	.682	-.743	-69.784	.000	SP
6.	GEN\CHARACTERIZE\PARENTAL COMMITMENT	4141	2.90	.893	.403	29.046	.000	SN
7.	GEN\CHARACTERIZE\ABILITY TO REACH GOALS	4064	2.58	.717	.084	7.441	.000	SN
8.	GEN\HOW FREQUENTLY\INSPIRES	4060	1.54	.678	-.957	-89.890	.000	SP
9.	GEN\CHARACTERIZE\PARENTAL INVOLVEMENT	4114	2.98	.958	.481	32.167	.000	SN
10	MATH\CONFIDENT\APPRECIATE MATH	3902	1.61	.657	-.889	-84.500	.000	SP
11	GEN\HOW FREQUENTLY\PROUD	4060	1.35	.596	-1.152	-123.096	.000	SP
12	GEN\HOW FREQUENTLY\SATISFIED TEACHER	4060	1.62	.738	-.884	-76.294	.000	SP
13	GEN\CHARACTERIZE\STUDENTS DESIRE	4075	2.51	.831	.007	.538	.591	N
14	GEN\CHARACTERIZE\SUPPORT FOP PROF DEVELOPM	4101	1.80	.830	-.696	-53.654	.000	SP
15	GEN\THINKING ABT CURR SCH\RULES ENFORCEMENT	4110	1.52	.657	-.975	-95.144	.000	SP
16	GEN\THINKING ABT CURR SCH\STUD BEHAVE	4136	1.93	.689	-.573	-53.462	.000	SP
17	MATH\CONFIDENT\ENGAGE STUDENTS INTEREST	3902	1.74	.670	-.760	-70.818	.000	SP

Table C1: Descriptive statistics and one-sample t-test for the components of Factor 1: school emphasis on academic success (continued)

18	GEN\THINKING ABT CURR SCH\CLEAR RULES	4081	1.50	.667	-1.002	-96.023	.000	SP
19	MATH\CONFIDENT\IMPROVE UNDERSTANDING	3925	1.91	.697	-.594	-53.342	.000	SP
20	GEN\INTERACTIONS\WORK AS A GROUP	4159	1.68	.810	-.823	-65.581	.000	SP
21	GEN\CHARACTERIZE\TCHRS ABILITY TO INSPIRE	4141	1.81	.595	-.687	-74.350	.000	SP
22	MATH\CONFIDENT\CHALLENGING TASKS	3925	1.73	.609	-.774	-79.564	.000	SP
23	GEN\CHARACTERIZE\RESPECT FOR CLASSMATES	4081	2.16	.741	-.337	-29.042	.000	SP
24	MATH\CONFIDENT\DEVELOP HIGHER THINKING	3902	1.79	.637	-.715	-70.111	.000	SP
25	GEN\INTERACTIONS TEACHERS\SHARE LEARNING	4131	1.79	.748	-.708	-60.849	.000	SP
26	GEN\CHARACTERIZE\TCHS EXPECTATIONS	4103	2.31	.669	-.191	-18.282	.000	SP
27	GEN\CHARACTERIZE\PARENTAL PRESSURE	4113	2.55	.883	.046	3.346	.001	SN
28	GEN\HOW FREQUENTLY\ENTHUSIASTIC	4060	1.40	.611	-1.096	-114.186	.000	SP
29	MATH\CONFIDENT\ASSESS COMPREHENSION	3902	1.75	.615	-.752	-76.389	.000	SP
30	GEN\INTERACTIONS\CONTINUITY IN LEARNING	4137	2.07	.852	-.428	-32.341	.000	SP
31	GEN\HOW FREQUENTLY\MEANING AND PURPOSE	4060	1.41	.642	-1.090	-108.228	.000	SP
32	GEN\THINKING ABT CURR SCH\RESPECT PROPERTY	4136	2.03	.897	-.466	-33.430	.000	SP
33	GEN\INTERACTIONS TEACHERS\WORK TOGETHER	4159	1.90	.759	-.599	-50.869	.000	SP
34	GEN\HOW FREQUENTLY\CONTENT PROFESSION	4060	1.52	.671	-.980	-93.018	.000	SP
35	MATH\CONFIDENT\VARIETY PROBLEM SOLVING STRATEGIES	3925	1.71	.649	-.792	-76.423	.000	SP
36	MATH\CONFIDENT\INSPIRE STUDENTS	3902	1.62	.627	-.876	-87.348	.000	SP
37	MATH\PROF DEVELOPMENT\IT	4159	1.42	.493	-1.084	-141.863	.000	SP
38	GEN\INTERACTIONS TEACHERS\COLLABORATE	4131	1.91	.771	-.595	-49.562	.000	SP
39	GEN\CHARACTERIZE\TCHRS WORKING TOGETHER	4141	1.86	.713	-.640	-57.742	.000	SP

Table C1: Descriptive statistics and one-sample t-test for the components of Factor 1: school emphasis on academic success (continued)

40	GEN\THINKING ABT CURR SCH\STUD RESPECT	4136	1.77	.698	-.729	-67.159	.000	SP
41	GEN\THINKING ABT CURR SCH\SECURITY POLICIES	4112	1.28	.489	-1.217	-159.529	.000	SP
42	GEN\INTERACTIONS TEACHERS\DISCUSS TOPIC	4117	1.80	.778	-.696	-57.373	.000	SP
43	GEN\HOW FREQUENTLY\CONTINUE AS A TEACHER	4032	1.60	.862	-.896	-66.017	.000	SP
44	GEN\HOW OFTEN\DAILY LIVES	3898	1.73	.812	-.770	-59.249	.000	SP
45	GEN\CHARACTERIZE\TCHS UNDERSTANDING	4141	1.67	.617	-.828	-86.366	.000	SP
46	GEN\INTERACTIONS TEACHERS\VISITS	4103	2.31	.867	-.194	-14.329	.000	SP
47	GEN\HOW OFTEN\EXPRESS IDEAS	3925	1.46	.677	-1.041	-96.293	.000	SP
48	GEN\HOW OFTEN\EXPLAIN ANSWERS	3897	1.61	.742	-.894	-75.234	.000	SP
49	MATH\COMPUTER TABLET ACTIVITIES\LOOK UP IDEAS	1121	2.54	.817	.042	1.736	.083	SP
50	GEN\HOW OFTEN\CLASSROOM DISCUSSIONS	3925	1.48	.671	-1.023	-95.455	.000	SP
51	GEN\HOW OFTEN\CHALLENGING EXS	3901	1.97	.840	-.531	-39.435	.000	SP
52	GEN\CHARACTERIZE\CLARITY OF OBJECTIVES	4101	1.76	.682	-.743	-69.784	.000	SP

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident.

Table C2: Descriptive statistics and one-sample t -test for the components of Factor 2: Teaching Mathematics to the TIMSS Class.

One-Sample Statistics and t -test (test value=2.5)

No	Items	N	Mean	Std. Deviation	Mean Difference	t-value	Sig.(2-tailed)	Confident and not confident
1.	Factor 2: Teaching Mathematics to the TIMSS Class.	4109	1.9438	.34356	-.55619	-103.773	.000	SP
2.	MATH\PREPARED\DATA\CHARACTERISTCS DATA	4088	1.93	.449	-.571	-81.418	.000	SP
3.	MATH\PREPARED\DATA\INTERPRETING DATA	4088	2.00	.664	-.498	-47.983	.000	SP
4.	MATH\PREPARED\NUMBER\PROBLEM SOLVING	4081	2.01	.387	-.485	-80.105	.000	SP
5.	MATH\PREPARED\GEOMETRY\GEOMETRIC PROPERTIES	4060	1.98	.412	-.516	-79.668	.000	SP
6.	MATH\PREPARED\ALGEBRA\LINEAR EQUATIONS	4088	2.03	.316	-.473	-95.774	.000	SP
7.	MATH\PREPARED\ALGEBRA\PROPERTIES OF FUNCS	4088	1.80	.757	-.701	-59.154	.000	SP
8.	MATH\PREPARED\NUMBER\CONCEPT IRRATIONAL NUMS	4088	1.80	.659	-.701	-67.985	.000	SP
9.	MATH\PREPARED\GEOMETRY\APP MEASUREMENT	4060	2.02	.370	-.477	-82.143	.000	SP
10.	MATH\PREPARED\ALGEBRA\FUNCTIONS	4066	1.99	.583	-.508	-55.600	.000	SP
11.	MATH\PREPARED\ALGEBRA\NUMERIC	4065	1.87	.670	-.632	-60.100	.000	SP
12.	MATH\PREPARED\ALGEBRA\SIMPLIFYING	4067	2.01	.371	-.488	-83.854	.000	SP
13.	MATH\PREPARED\DATA\JUDGING, PREDICTING	4088	2.00	.626	-.500	-51.094	.000	SP
14.	MATH\PREPARED\GEOMETRY\CONGRUENT FIGURES	4060	1.97	.463	-.532	-73.234	.000	SP
15.	MATH\PREPARED\GEOMETRY\TRANSLATION	4067	1.88	.566	-.621	-69.962	.000	SP
16.	MATH\PREPARED\GEOMETRY\RELATION BTW SHAPES	4020	1.89	.661	-.606	-58.144	.000	SP
17.	MATH\PREPARED\NUMBER\COMPARE ORDER NUMBERS	4073	2.02	.444	-.484	-69.523	.000	SP
18.	MATH\PREPARED\ALGEBRA\SIMULTANEOUS EQUATION	4068	1.85	.641	-.650	-64.693	.000	SP
19.	MATH\PREPARED\GEOMETRY\CARTESIAN PLANE	4061	1.96	.490	-.535	-69.565	.000	SP
20.	MATH\PREPARED\NUMBER\COMPUTING RATIONAL NUMS	4060	2.04	.367	-.460	-79.747	.000	SP
21.	MATH\PREPARED\NUMBER\COMPUTING	4088	1.88	.464	-.623	-85.795	.000	SP

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident.

Table C3: Descriptive statistics and one-sample t -test for the components of Factor 3: Resources and Time.

One-Sample Statistics and t -test (test value=2.5)

Items	**N**	**Mean**	**Std. Deviation**	**Mean Difference**	**t-value**	**Sig.(2-tailed)**	**Confident and not confident**
Factor 3: Resources and Time	4159	2.1362	.46501	-.36376	-50.448	.000	SP
GEN\AGREEMENT\NEED MORE TIME TO PREPARE REVERSE	4133	2.6632	.81835	.16320	12.821	.000	SN
GEN\AGREEMENT\TOO MANY HOURS REVERSE	4112	2.6075	.94953	.10749	7.259	.000	SN
GEN\AGREEMENT\NEED MORE TIME TO ASSIST REVERSE	4133	3.1943	.77488	.69429	57.603	.000	SN
GEN\AGREEMENT\TOO MUCH MATERIAL REVERSE	4133	2.7498	.88896	.24982	18.067	.000	SN
GEN\AGREEMENT\TOO MANY STUDENTS REVERSE	4133	2.6579	1.03569	.15788	9.800	.000	SN
GEN\SEVERITY PROBLEM\MATERIAL UNAVAILABLE	4111	1.66	.779	-.836	-68.848	.000	SP
GEN\SEVERITY PROBLEM\INADEQUATE TECH RESOURCES	4111	1.60	0.840	-.902	-68.893	.000	SP
GEN\SEVERITY PROBLEM\MAINTENANCE WORK	4111	1.64	.788	-.863	-70.180	.000	SP
GEN\SEVERITY PROBLEM\INADEQUATE WRKSPACE	4040	1.69	.819	-.809	-62.816	.000	SP
GEN\SEVERITY PROBLEM\BUILDING REPAIR	4061	1.71	.820	-.794	-61.644	.000	SP
GEN\SEVERITY PROBLEM\INADEQUATE SUPPORT FOR TECH	4111	1.62	.768	-.876	-73.149	.000	SP
GEN\AGREEMENT\TOO MANY ADMINISTRATIVE TASKS REVERSE	4133	2.3874	.87074	-.11263	-8.316	.000	SP
GEN\AGREEMENT\CHANGES IN CURRICULUM REVERSE	4133	1.7968	.81392	-.70324	-55.547	.000	SP
MATH\PREPARED\GEOMETRY\RELATION BTW SHAPES	4020	1.89	.661	-.606	-58.144	.000	SP

Table C4: Descriptive statistics and one-sample t -test for the components of Factor 4: Mathematics Topics Taught to the TIMSS Class.

One-Sample Statistics and t -test (test value=2.0)

Items	**N**	**Mean**	**Std. Deviation**	**Mean Difference**	**t-value**	**Sig.(2-tailed)**	**Confident not confident**
Factor 4 :mathematics topics taught to the TIMSS class	4159	2.0794	.61178				
MATH\TOPIC\NUMBER\COMPUTING RATIONAL NUMS	3911	1.47	.514	-.525	-63.985	.000	SP
MATH\TOPIC\GEOMETRY\GEOMETRIC PROPERTIES	3861	1.58	.555	-.420	-47.041	.000	SP
MATH\TOPIC\ALGEBRA\LINEAR EQUATIONS	3908	1.80	.404	-.196	-30.326	.000	SP
MATH\TOPIC\ALGEBRA\SIMPLIFYING	3908	1.67	.525	-.331	-39.452	.000	SP
MATH\TOPIC\GEOMETRY\CONGRUENT FIGURES	3832	1.85	.602	-.146	-15.051	.000	SP
MATH\<PROF DEVELOPMENT> HOURS	4086	3.56	1.406	1.564	71.108	.000	SN
MATH\TOPIC\DATA\CHARACTERISTICS DATA	3888	1.67	.602	-.325	-33.715	.000	SP
MATH\TOPIC\NUMBER\CONCEPT IRRATIONAL NUMS	3741	2.14	.779	.137	10.745	.000	SN
MATH\TOPIC\GEOMETRY\APP MEASUREMENT	3882	1.79	.523	-.213	-25.340	.000	SP
MATH\TOPIC\NUMBER\PROBLEM SOLVING	3911	1.73	.493	-.265	-33.604	.000	SP
MATH\TOPIC\ALGEBRA\PROPERTIES OF FUNCS	3881	2.45	.638	.446	43.506	.000	SN
MATH\TOPIC\ALGEBRA\SIMULTANEOUS EQUATION	3882	2.26	.645	.264	25.523	.000	SN
MATH\TOPIC\GEOMETRY\CARTESIAN PLANE	3864	1.69	.658	-.308	-29.103	.000	SP
MATH\TOPIC\ALGEBRA\FUNCTIONS	3881	1.99	.604	-.009	-.930	.353	SP

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident.

Table C5: Descriptive statistics and one-sample t -test for the components of Factor 5: Mathematics Assessment of the TIMSS Class.

One-Sample Statistics and t -test (test value=2.5*, 2.0, 3.0***)**

Items	N	Mean	Std. Deviation	Mean Difference	t-value	Sig.(2-tailed)	Confident and not confident
Factor 5: mathematics assessment of the TIMSS class	4159	2.3201	.39902	-.17989	-29.074	0.000	SN
MATH\COMPUTER TABLET ACTIVITIES\EXPLORE CONCEPT REVERSE	1121	2.6961	.89350	.10393	3.894	.000*	SP
MATH\HOMEWORK\CORRECT ASSIGNMENTS REVERSE	3663	2.6795	.50333	.17950	21.584	.000*	SP
MATH\COMPUTER TABLET ACTIVITIES\PROCESS DATA REVERSE	1121	2.7024	.81201	.19759	8.147	.000*	SP
MATH\EMPHASIS\ASSESSMENT OF WORK REVERSE	3261	2.8375	.38764	.33747	49.715	.000*	SP
MATH\HOW OFTEN USE CALC\COMPLEX PROBLEM REVERSE	3157	2.9975	.91148	.49747	30.666	.000*	SP
GEN\LIMIT TEACHING\UNINTERESTED STUDENTS	3636	2.05	.522	.049	5.653	.000**	SP
GEN\LIMIT TEACHING\LACK OF SLEEP	3665	1.85	.620	-.153	-14.943	.000**	SN
GEN\LIMIT TEACHING\LACK OF NUTRITION	3617	1.73	.640	-.270	-25.422	.000**	SN
MATH\TOPIC\GEOMETRY\TRANSLATION REVERSE	3879	2.0480	.65250	.04795	4.577	.000**	SP
GEN\LIMIT TEACHING\LACKING KNOWLEDGE	3644	2.07	.456	.070	9.223	.000**	SP
GEN\CHARACTERIZE\PARENTAL EXPECTATIONS	4114	2.51	.873	-.487	-35.765	.000***	SN

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], p<0.05 Confident, p>0.05 Not Confident

Appendix D

A Survey Form to Study Factors Affecting Eighth Grade Students' Mathematics Achievements in TIMSS in Abu Dhabi Emirate

Dear Mathematics Teacher

Greetings!

My name is Yousef Ahmed Wardat, a Ph.D. candidate at the College of Education, United Arab Emirates University (UAEU). I am conducting a research study which is entitled "Factors Affecting Eighth Grade Students' Mathematics Achievements in TIMSS in Abu Dhabi Emirate". The questionnaire given below is designed to get your opinion on four dimensions -- **Mathematics Teachers Practices and TIMSS, Mathematics and Instruction, Readiness of Students for TIMSS, and School and Classroom Environment**. I would like to request you to participate in the survey and response the questions to the best of your knowledge. The data collected will be used for academic purposes only and respondent anonymity is assured. Thank you for your time and support in this study.

With all gratitude and appreciation. If you have any questions or concerns about this survey, please contact me at 201790224@uaeu.ac.ae or call me at 0501250896.

Yousef Wardat

Ph.D. Candidate, College of Education, UAEU

Supervisor: Dr. Shashidhar Belbase

Department of Curriculum and Instruction, College of Education

United Arab Emirates University (UAEU), Al Ain, Abu Dhabi

sbelbase@uaeu.ac.ae

Demographic Information

1. **Gender**
   a. Male
   b. Female
2. **Teacher's experience**
   a. Less than 5 years
   b. Between 6 to 10 years
   c. Between 11 to 15 years
   d. 16 years and above
3. **Teacher's qualification**
   a. Bachelor's degree
   b. Master's degree
   c. Ph.D. degree
   d. Other
4. **School**
   a. Public
   b. Private
5. **The region**
   a. Abu Dhabi
   b. Alain
   c. Al Dhafrah

Dimension 1: Mathematics Teachers Practices and TIMSS

NO.	Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	I have sufficient experience with TIMSS.					
2.	I assign sample questions that align with TIMSS to my students.					
3.	I set the class tests as per the format of TIMSS.					
4.	I encourage my grade 8 students to practice TIMSS questions.					
5.	I am interested in TIMSS for the benefits of my students.					
6.	I focus on mathematical skills that align with the skills in TIMSS.					
7.	Mathematics tests in schools are compatible with TIMSS.					
8.	I follow TIMSS together with standards followed by the school to teach mathematics to grade 8 students.					

Dimension 2: Mathematics and Instruction

NO.	Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	Mathematics curriculum for grade 8 in the UAE schools align with TIMSS.					
2.	Mathematics curriculum for grade 8 in the UAE schools follow teaching methods aligned with TIMSS.					
3.	There are challenges to accommodate UAE mathematics curriculum with TIMSS.					

4.	Mathematics curriculum for grade 8 in the UAE schools covers the standards for the TIMSS					
5.	The mathematics curriculum for grade 8 in the UAE schools considers application of different teaching methods to support TIMSS.					
6.	Mathematics curriculum aligns assessments in grade eight 8 for consistency in the UAE schools with TIMSS.					
7.	The UAE mathematics curriculum lacks questions that contain critical thinking.					
8.	The mathematics curriculum for grade 8 in the UAE covers all topics in TIMSS.					

Dimension 3: Readiness of Students for TIMSS

NO.	Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	Grade 8 students in the UAE schools practice problem solving to improve results in TIMSS					
2.	Grade 8 students in the UAE schools practice reasoning skills to perform well in TIMSS.					
3.	Grade 8 students in the UAE schools are often found unaware of the questions in TIMSS.					
4.	Grade 8 students in the UAE schools persevere in learning mathematics for good results in TIMSS.					
5.	Parents are interested in helping their children to perform well in TIMSS.					
6.	Parents are aware of the importance of urging students to get good results in TIMSS.					

7.	Grade 8 students are motivated to achieve good results in TIMSS.					
8.	Grade 8 students are usually evaluated through pretests to prepare them for TIMSS.					

Dimension 4: School and Classroom Environment

NO.	Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	Schools create suitable environment to help students with TIMSS.					
2.	Teachers have the required skills to maintain a classroom environment to help their students succeed in TIMSS.					
3.	Teachers use interactive sessions to increase student participation in the class.					
4.	Teachers manage their classes to encourage students perform better in TIMSS.					
5.	The classroom environment encourages students to be ready for TIMSS.					
6.	The school environment promotes healthy competitions to motivate students to achieve good results in TIMSS.					

Appendix E

External Validation of Research Questionnaire

Table e1: External Validation of Research Questionnaire

No.	Faculty Name	Ranking	Specialization	University
1	Hamza Dodeen	professor	Measurement and Evaluation	United Arab Emirate University
2	Rachel Alison Takriti	Associate Professor	Curriculum & Method of Instruction (CEDU)	United Arab Emirate University
3	Ayman AL jarrah	Assistant Professor	Math Education	Acadia University\ Canada
4	Zaid Alkouri	Associate professor	Curriculum and Instruction	Jarash University \ Jordan
5	Asim Alshumam	Assistant Professor	Math Education	University of Mosul\Iraq
6	Emad Kamil Hussein	Assistant Professor	Mechanical Engineering	Al-Mussaib Technical College
7	Osama Taani	Associate Professor	Mathematics Education	Higher college of Technology
8	Mitra Devkota	Assistant Professor	Statistics and Data Analysis	University of North Georgia

Appendix F

Ethics Approval

Division of Research and Graduate Studies Ethics Approval System

You are Logged in as: Yousef Wardat

- Logout

Ref No	Subject	Request Type	Request Status	Submit Date	View Documents / Provide Feedback
ERS_2021_7259	Dissertation Form to Study Factors Affecting Eighth Grade Students' Mathematics Achievements in TIMSS in Abu Dhabi Emirate	Social Sciences Ethics Committee - Research	Approved	13/02/21	
ERS_2020_6205	A Survey Form to Study Factors Affecting Eighth Grade Students' Mathematics Achievements in TIMSS in Abu Dhabi Emirate	Social Sciences Ethics Committee - Research	Approved	22/10/20	

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جامعة الإمارات العربيــة المتحدة
United Arab Emirates University

UAE UNIVERSITY DOCTORATE DISSERTATION NO. 2022:13

The study aimed to identify the factors affecting mathematics achievement of eighth grade students in Trends in International Mathematics and Science Study (TIMSS, 2015) and to determine mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools.The first part of the study sample consisted of 4,838 students of grade eight (2,172 girls, 2,666 boys) and 156 respective school principals, and 220 mathematics teachers from Abu Dhabi, who attended TIMSS 2015. The second part of the study included data from 522 mathematics teachers from Abu Dhabi gathered through a perception questionnaire to examine their perception of TIMSS in four areas viz. Mathematics Teachers' Perceptions of TIMSS, Mathematics Teachers' Practices of TIMSS, Readiness of Students for

Yousef Wardat received his PhD from the Department of Curriculum and Instruction, College of Education at UAE University, UAE. He received his MA from the College of Education, Mutah University, Jordan.

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