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Mathematics Teachers' Perceptions of Trends in International Mathematics and Science Study (TIMSS)-Related Practices in Abu Dhabi Emirate Schools

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Abstract: Mathematics teachers' perceptions and awareness of different kinds of assessments (e.g., diagnostic, formative, and summative assessments) may affect their classroom practices. In this context, the current study explored mathematics teachers' perceptions and self-reported practices teaching mathematics for Trends of International Mathematics and Science Study (TIMSS) in Abu Dhabi schools in the United Arab Emirates. A teacher perception questionnaire was designed, then was administered to 522 mathematics teachers in Abu Dhabi schools in the academic year 2020–2021. A One-Sample *t*-test, Independent Sample *t*-test, and ANOVA tests were performed for the four-component variables of teacher perceptions, namely, teachers' perceptions of TIMSS, their instructional practices in relation to TIMSS, the readiness of students for TIMSS, and the school and classroom environment for TIMSS. The results showed no statistically significant difference between male and female teachers in mathematics teaching practices with a focus on TIMSS or their perceptions of student readiness for TIMSS; however, there were differences in their perceptions of the school and classroom environment that were statistically significantly. In addition, there was no statistically significant difference between public and private schools in the practice of mathematics teachers for TIMSS, while the difference was statistically significant on views regarding student readiness for the TIMSS as well as on the school and classroom environment. The findings of the present study have both pedagogical and policy implications, which are discussed at the end of this paper.

Keywords: achievement; international testing; mathematics; teachers' practices; teachers' qualifications; TIMSS

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1. Introduction

The quality of mathematical education received by students may depend on the effectiveness of their teachers. Student achievement in mathematics often depends on the experience of teachers and their professional development as well as on their empowerment with knowledge and skills. As such, much emphasis has been placed on improving teaching quality in order to increase students' academic achievement [1]. The standards for school mathematics designed and implemented by the Ministry of Education (MoE) in the United Arab Emirates have begun to meet the local context and comply with international practices [2]. The standards for mathematics have been established to identify recent trends in their construction in order to achieve the best global practices while maintaining national values, heritage, and identity [3]. There are other different curriculum standards in the UAE in addition to the standards set by the MoE, such as the British, Indian, Australian, IB, French, German, and Philippine curricula. However, most schools in the UAE schools adopt one of three types of curricula: the US Common Core, MoE, or British curriculum. These curricular approaches seem to have similar content and goals in equipping students with the knowledge and skills to succeed in colleges and in the knowledge economy. In

fact, the metrics at both the national and global levels point to a high-performance learning system and identify ways to improve these systems [4].

In order to identify high-performing education systems, international assessments, particularly Trends in International Mathematics Study (TIMSS), have been used to provide potential guidance for decision-making [5]. The United Arab Emirates participated in the TIMSS for the first time in 2007, joining 67 other countries. The TIMSS study was conducted under the auspices of the International Association for the Assessment of Educational Achievement (IEA) in order to provide a global comparative assessment; it was designed to contribute to the process of improving teaching and learning in mathematics for students through evidence-based results. In addition, the TIMSS aims to inform educational policy and highlight similarities and differences among countries to allow participating countries to share experiences regarding the quantity and quality of student learning [6]. In this context, the UAE seeks economic development such as exists in developed countries, a transition to a knowledge-based economy, and a citizenry well-educated in mathematics such as will be necessary for the economic well-being of the nation [7]. Beyond the classroom, understanding basic mathematical concepts can facilitate a productive personal life that includes healthy habits and the use of effective problem-solving skills [8]. By learning about the impact that the study of mathematics might have on the development of both individuals and the state, the UAE regards focusing on achievement and skills as national priorities for mathematics literacy, and has included TIMSS on the national agenda of the United Arab Emirates [9].

TIMSS was first administered in 1995 by the IEA and has continued to be administered every four years. In 2015, the UAE participated in TIMSS for the third time. Both private and public schools participated in 2007, 2011, and 2015 TIMSS cycles. The Emirate of Abu Dhabi began participating as a benchmark in 2011. TIMSS is helpful in assessing curriculum models together with teaching and the school environment, all of which may affect student performance. The curriculum is concerned with the precise knowledge, skills that students learn and achieve, and what they think about learning these materials [6]. Teachers may play a significant role in the student performance in TIMSS. However, the way mathematics teachers think of and about the TIMSS framework of conceptualizing teaching practices has not been investigated. How mathematics teachers perceive TIMSS may influence the classroom activities thy engage in to align their teaching-learning with the focal areas of mathematics in the TIMSS. Currently, there is limited evidence of studies on mathematics teachers' perception of TIMSS-related practices either in general or in the context of the UAE in particular. In this context, this study aimed to investigate mathematics teachers' perceptions of TIMSS-related teaching and learning practices. In particular, this study intends to find answers to questions about the perceptions of mathematics teachers regarding TIMSS-related practices and compare those perceptions using the demographic variables of gender, school type, teaching experience, and educational qualifications.

1.1. Problem Statement

To understand why Grade 8 students in Abu Dhabi performed below the average, the current study aimed to examine mathematics teachers' perceptions of TIMSS and related practices in Abu Dhabi emirate schools.

Teachers' perceptions are essential because the way in which teachers perceive their world influences their instructional practice [10]. Perceptions about mathematics as well as about mathematics teaching and learning might define both how teachers interact with students in the classroom and how they perceive and develop students' skills [11]. Furthermore, the way teachers approach the content, the methodological choices they make, and the assessment practices they use may be affected by the choices they make in the course of their instruction [12]. In other words, the assumption is that "teachers' perceptions influence how they interact with students in the classroom, thus affecting the quality of their instruction and, in turn, students' learning outcomes" [13].

The teacher plays a crucial role in the educational process. The teacher is the one who sees and can clearly identify the strengths and weaknesses of each student in mathematics. For example, teacher perceptions can influence the way students answer questions related to mathematics, how students respond when presented with a variety of problem-solving strategies, how students react to challenging tasks, especially for more capable students, and how the teacher adapts their teaching methods to engage students' interest and meet their needs, all of which can help students appreciate the value of learning mathematics. Therefore, we decided to study mathematics teachers' perceptions towards TIMSS and related practices in Abu Dhabi schools.

1.2. Purpose of the Study and Research Questions

The purpose and overall goal of this study was to examine mathematics teachers' perceptions of trends in international mathematics and science study (TIMSS)-related practices in Abu Dhabi emirate schools. The following research questions were formulated in light of the research objectives:

1. What are mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?
2. Is there a statistically significant difference between male and female mathematics teachers with respect to their perceptions of TIMSS in Abu Dhabi Emirate schools?
3. Is there a statistically significant difference between public and private school mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools?
4. Is there a statistically significant difference between mathematics teachers' perceptions of TIMSS with respect to their years of experience?
5. Is there a statistically significant difference between mathematics teachers' perceptions of TIMSS with respect to differences in their qualifications?

1.3. Significance of the Study

Math teacher perception results in Abu Dhabi could help policymakers better integrate test content into the curriculum, conduct practice test sessions prior to test administration dates, and modify the curriculum to incorporate content included in international student assessments. Sample questions could be added to the curriculum to familiarize students with the types of questions asked in TIMSS. The present study's findings may provide insights and identify areas for training teachers before international tests and provide them with released items in order to achieve better education results.

School improvement consistently shows the valuable role of international tests and benchmarking in driving education reform. Such 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 to carry out in this study, which will 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 can 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 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.

2. Review of Related Work

As the country moves towards becoming an international economic leader, the country's vision is to ensure that its citizens receive a quality education that will enable them to effectively participate in the global economy [14]. Recently, the Abu Dhabi Education Council (ADEC) has been changed to the Department of Education and Knowledge (ADEK),

which handles all educational decisions in the Emirate of Abu Dhabi by managing, guiding, adopting, and implementing the relevant initiatives and strategies related to education. The council operates in 231 public, 205 private, and 13 charter schools in the Abu Dhabi Emirate, which have a workforce including both nationals and expatriates [15]. However, while private schools offer international curricula, public schools use a centralized system and follow the Abu Dhabi School Model that was introduced in 2010. Even though the schools teach Arabic and English, TIMSS subjects are mainly taught in English. The teachers in the schools are expected to provide effective instruction and follow-up services to all children as they learn new concepts in mathematics and science. The teachers are expected to support the individual learning needs of their students as they progress through the grades and use various skills in their classwork [14]. Consequently, there are specialist teachers for the mathematics and science subjects. These teachers enable students to explore mathematics concepts in their early years allowing them to gradually apply these concepts and gain mastery of the subjects [16].

The United Arab Emirates (UAE) first participated in TIMSS in 2011, enabling ADEK to gain valuable information about the strengths and weaknesses inherent in the country's curriculum. In addition, the assessments provided useful information in reviewing ADEK's assessment program, the External Measurement of Student Achievement (EMSA). By comparing the results of the TIMSS and EMSA in the first year of assessment, ADEK was able to gauge the strengths and weaknesses of EMSA. Subsequently, the differences in results have enabled ADEK to modify EMSA using TIMSS as a benchmark. TIMSS is expected to continue to have a significant impact on educational policies in Abu Dhabi. The students who participated in TIMSS in 2015 were the first to be taught under the Abu Dhabi School Model, and a comparison of their results with those of 2011 demonstrated that the educational reforms undertaken by ADEK were useful in enabling students to perform better in TIMSS. According to [17], UAE students have improved in mathematics and science, although they continue to perform below the expected international TIMSS levels. In 2015, approximately 18,000 eighth-graders from across public and private schools in the UAE participated in TIMSS assessments. Grade 8 students in cycle two in the UAE schools performed very well in mathematics and science compared to their GCC neighboring countries [18]. They scored 465 and 477 in mathematics and science, respectively, which is an improvement from previous years [19]. This shows that the country has achieved intermediate scores in its TIMSS performance.

The UAE's Vision 2021 placed a significant focus on the high performance of students in TIMSS assessments, as students in both the 4th and 8th grades were expected to place among the top fifteen countries in the world [9]. The assessment tests have enabled the UAE government to generate comparisons that it can use to measure student skills in these two areas as well as a means of identifying the indicators of enhanced student performance. Consequently, the government has put in place strategies to develop individual goals for every school that participates in future cycles of TIMSS.

According to Anderson [20], there are major differences in the way teachers are trained between the UAE and other Gulf Cooperation Council countries. However, these differences do not affect how the different genders have performed in TIMSS. International evidence demonstrates that girls perform better than boys in the humanities and literacy [21]. Nevertheless, Cimpian et al. [22] state that gender differences and gaps have been reduced in science and mathematics, and in certain instances males perform better than females when they enter secondary school. The increasing improvement in performance by females in Abu Dhabi and in the other GCC countries might be a result of enhanced government efforts to create policy reforms that support girls' success in the classroom [18]. In 2007, Dubai participated in TIMSS as a benchmarking community; the assessment results showed that girls in the region performed slightly better than boys on the 8th-grade TIMSS assessment, by an average of 12 points [23]. Studies carried out in many nations show that girls perform better than boys on standardized tests in primary and secondary school, and that they have better educational experiences than their male counterparts [24]. They

found that while boys are more likely to drop out of school, they tend to remain in school for longer periods or at the same level in countries where there are vocational and technical secondary opportunities. Consequently, even though there is gender parity in the schools of the Abu Dhabi Emirates and other emirates [25], the global improvement in science and mathematics as measured by TIMSS assessment has not yet been realized because of the culture of the region. This means that boys ultimately have better employment and income opportunities than girls in the long term, regardless of their performance on TIMSS assessments [24].

Among these issues of boys' and girls' educational quality and performance, mathematics teachers remain at the core of practice. When teachers are proficient in their subject matter, there is a stronger possibility of high student performance. This is because such teachers are able to effectively teach their grade 8 students the necessary mathematics concepts and theories required for success on TIMSS assessment. A high level of subject matter knowledge, clear instruction, and ability to teach a high-quality curriculum enable teachers to impart more knowledge to their students [26]. A study on schools in Abu Dhabi shows that many teachers lack the requisite skills to effectively teach their curricula. Chu et al. [26] stress that teacher quality is significant in enhancing student achievement. Less than 3% of teachers in the country possess a Master's degree, which would enable them to provide a high-quality learning experience to their students; 90% have a bachelor's degree, while 8% have no degree. Teachers lacking a degree fall below the minimum requirements needed to provide a high-quality curriculum to students. In addition, only 13% of teachers are proficient in English, and a mere 29% have a modest knowledge of the language, which is critical in enabling them to teach their 8th-grade mathematics students and lead them to success on their assessments [26].

Hanushek [27] thus states that students improve by as much as three times when they are taught by high-quality teachers. Several studies have additionally attempted to identify the actual teacher credentials that demonstrate effective teacher quality and its effect on student achievement [28,29]. Teachers are required to invest more time and effort into making their subjects more interesting to students; consequently, Bietenbeck [30] states that active teaching strategies are likely to produce a positive learning effect on students. In addition, while the manner in which the teacher addresses the subject topics may not be directly related to student performance, it is related to overall academic performance. Teachers must therefore properly focus on engaging students and sharing resources and ideas with other teachers in order to ensure students' success. On the other hand, the impact of teachers on student performance has been investigated in relation to variables such as gender, teaching experience, type of schools (public vs. private), and qualifications. For example, Kartal [31] suggested that gender might have an influence on student achievement. Burroughs et al. [32] further suggested that various initiatives should be undertaken to include female teacher perceptions and how their perceptions might influence student performance in TIMSS.

Furthermore, other researchers have considered variables related to the schools themselves. For example, Cordero [33] pointed out that efforts put into supporting 8th-grade students in public and private schools should be promoted in order to ensure better performance. Bdeir [34] further supported this by pointing out that more effective measures should be put in place to support students' performance in public schools, particularly in mathematics. Students, whether in public or private schools, need to be provided with the essentials in order to achieve their potential [35]. Other studies, such as Alarabi and Wardat [36] and Abdelfattah and Lam [37] have shown that a teacher's experience is likely to come into play in determining an 8th-grade student's performance. This is particularly important in those experienced teachers are more likely to use different and effective teaching strategies to teach mathematics to students. Contrary to Burroughs et al. [32] and Abdelfattah and Lam [37], Alharbi et al. [38] found that students' readiness for mathematics exams is not necessarily affected by their teacher's experience. Others have argued that teaching experience is likely to allow teachers to understand their students better [39] which

can aid in the selection of teaching strategies that are congruent with student learning strategies [40].

Conceptual Framework

This study was designed to investigate four aspects of mathematics teachers' perception and self-reported practices related to TIMSS in Abu Dhabi. These four aspects were mathematics teachers' perceptions of TIMSS, mathematics teachers' practices for TIMSS, student readiness for TIMSS, and school and classroom environment for TIMSS; the items associated with these four aspects are presented in a conceptual framework in Figure 1.

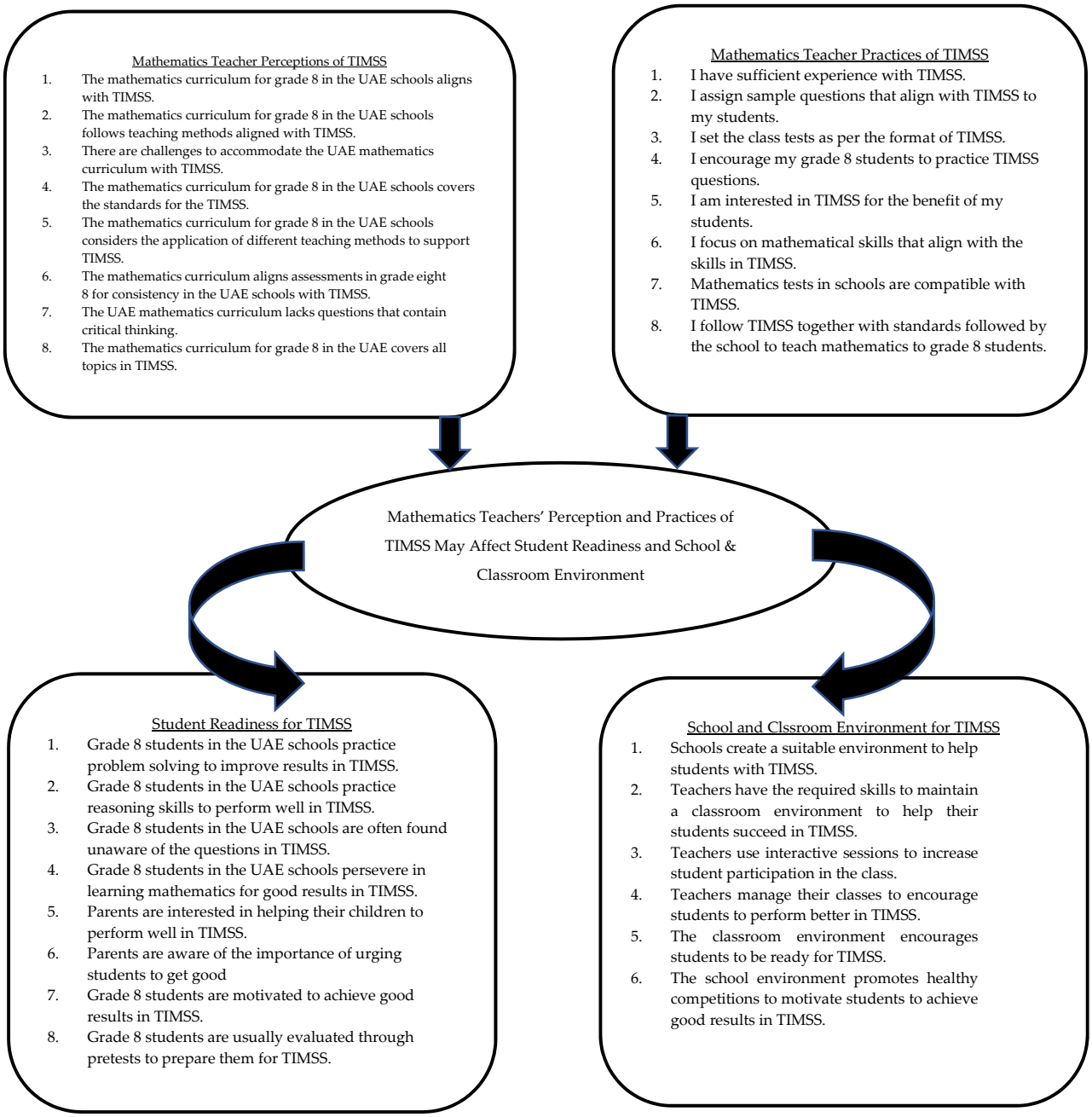

Figure 1. Conceptual framework: mathematics teachers' perceptions and practices for TIMSS may affect student readiness as well as the school and classroom environment.

The conceptual framework provided in Figure 1 shows the interrelationships between the four aspects considered in this study. Mathematics teachers' perceptions of TIMSS

emphasize the kind of perceptions that Abu Dhabi mathematics teachers have formed based on their knowledge and experience while teaching mathematics. This construct included eight items collected from the literature that, while not directly related to TIMSS, were related to teacher perceptions of the mathematics curriculum, challenges associated with implementing the mathematics curriculum, mathematics teaching, mathematics learning, and assessment practices in relation to TIMSS. The second aspect in this study was associated with mathematics teachers' experiences, practices, interests, skills, alignments, and teaching and learning standards with respect to items included in TIMSS. The third aspect in this study was associated with mathematics teachers' perceptions of student readiness for TIMSS, which includes items associated with students' problem-solving practice, mathematical reasoning, awareness of test items, motivation and orientation of learning mathematics with respect to TIMSS, parents' interests and awareness of TIMSS, and use of tests and pretests to prepare students for TIMSS. The fourth aspects in this study was related to the school and classroom environment for TIMSS, which included variables associated with efforts create a suitable environment with interactive classroom sessions, encouragement for students to perform better in TIMSS, and attempts to prepare students for TIMSS through classroom practice.

3. Materials and Methods

3.1. Study Sample

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 3297 (female 2391 and 906 male) mathematics teachers from about 449 schools in Abu Dhabi [14,41]. 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 demographic information of the sampled teachers is presented in Table 1.

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%.

Table 1. Distribution of teachers by demographic information, gender, teacher qualifications, teacher experience, school type, and region.

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	54.4%
	Private	238	45.6%
The region	Abu Dhabi	198	37.9%
	Alain	275	52.7%
	Al Dhafrah	49	9.4%
	Total	522	100%

3.2. Study Instrument

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) [42].

3.3. Study Procedure

A researcher (the first author) 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.

3.4. Data Analysis

To answer the research question, data collected via the online survey were analyzed using descriptive statistics, one-sample *t*-test, independent sample test, and one-way ANOVA. The differences in teachers' perceptions among different groups were analyzed across gender, teaching experience, and educational background.

4. Results

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 2).

Table 2. The means and standard deviations of mathematics teachers' perceptions of their practices, instruction, classroom environment, and student readiness on TIMSS in Abu Dhabi Emirate schools.

NO.	Domain	Frequency	Mean	Standard Deviation
1	Dimension 1: Mathematics Teachers' Perceptions of TIMSS	522	3.17	0.42
2	Dimension 2: Mathematics Teachers' Practices of TIMSS	522	2.86	0.58
3	Dimension 3: Readiness of Students for TIMSS	522	2.72	0.43
4	Dimension 4: School and Classroom Environment	522	2.96	0.59

The teachers; perceptions of TIMSS have the highest mean of 3.17 and the lowest standard deviation of 0.42, meaning that respondents' perception about TIMSS were the strongest and had the least variability. In contrast, teachers' perceptions about "Readiness of Students for TIMSS" have the lowest mean of 2.72, with an SD of 0.43. Teachers' perceptions about "School and Classroom Environment" have the highest standard deviation of 0.59, which means that responses had high variability or dispersion from the mean. We can say that teachers' perceptions of TIMSS were the most consistent or uniform based on this item's highest mean value and lowest standard deviation.

To examine whether mathematics teachers in Abu Dhabi Emirate schools have positive or negative perceptions of TIMSS, a one-sample *t*-test was conducted for each dimension and related items, as illustrated in Tables 3–6. Figures 2–5 show the distribution of average item scores for each dimension.

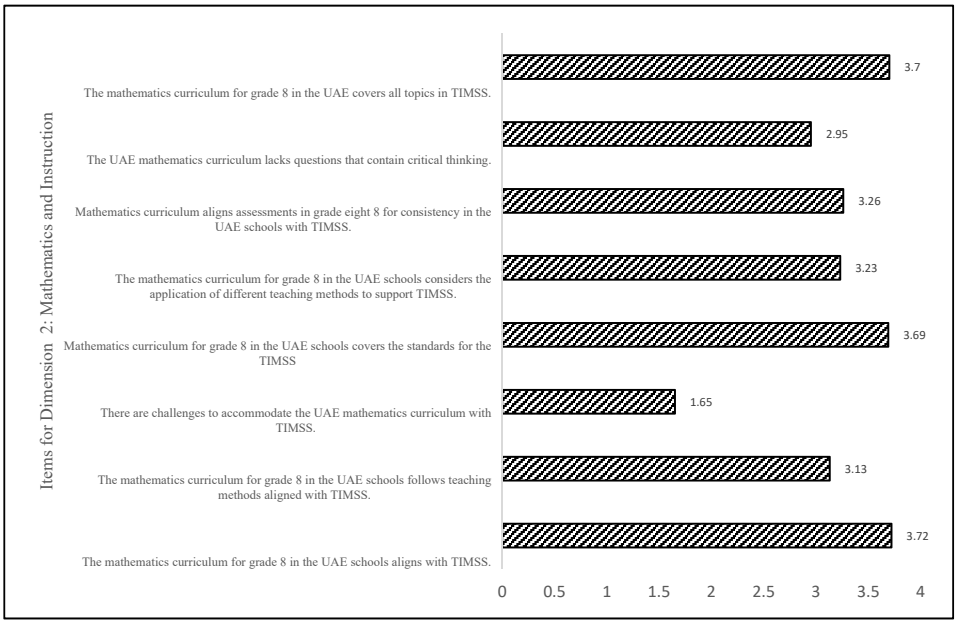

Figure 2. Average scores of the components of Dimension 2: Mathematics and Instruction.

Table 3. One-Sample *t*-test showing mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirates schools (N = 522) (Test value = 3).

S.N.	Items	Mean	Standard Deviation	Mean Difference	t	df	Sig. (2-Tailed)	Significant Positive (SP) or Negative Perceptions
1	The mathematics curriculum for grade 8 in the UAE schools aligns with TIMSS.	3.72	0.79	0.720	20.89	521	0.000	SP
2	The mathematics curriculum for grade 8 in the UAE schools follows teaching methods aligned with TIMSS.	3.13	1.01	0.128	2.90	521	0.004	SP
3	There are challenges to accommodate the UAE mathematics curriculum with TIMSS.	1.65	0.75	−1.352	−41.05	521	0.000	SN
4	The mathematics curriculum for grade 8 in the UAE schools covers the standards for the TIMSS	3.69	0.83	0.693	19.08	521	0.000	SP
5	The mathematics curriculum for grade 8 in the UAE schools considers the application of different teaching methods to support TIMSS.	3.23	1.16	0.226	4.44	521	0.000	SP
6	The mathematics curriculum aligns assessments in grade eight 8 for consistency in the UAE schools with TIMSS.	3.26	1.15	0.257	5.09	521	0.000	SP
7	The UAE mathematics curriculum lacks questions that contain critical thinking.	2.95	1.20	−0.050	−0.94	521	0.344	NC
8	The mathematics curriculum for grade 8 in the UAE covers all topics in TIMSS.	3.70	1.02	0.701	15.71	521	0.000	SP
	Overall Perceptions of TIMSS	3.165	0.42	0.1654	9.05	521	0.000	SP

Note: Significant Positive [SP], Significant Negative [SN], Neutral [N], Level of Significance 0.05.

Table 4. One-Sample *t*-test showing mathematics practices related to TIMSS in Abu Dhabi Emirates schools (N = 522) (Test value = 3).

S.N.	Items	Mean	Standard Deviation	Mean Difference	t	df	Sig. (2-Tailed)	Significant Positive or Negative Perceptions
1	I have sufficient experience with TIMSS.	3.52	1.19	0.525	10.07	521	0.000	SP
2	I assign sample questions that align with TIMSS to my students.	2.99	1.07	−0.008	−0.16	521	0.870	N
3	I set the class tests as per the format of TIMSS.	1.75	1.07	−1.245	−26.49	521	0.000	SN
4	I encourage my grade 8 students to practice TIMSS questions.	3.05	1.05	0.052	1.13	521	0.259	N
5	I am interested in TIMSS for the benefit of my students.	3.70	0.79	0.705	20.28	521	0.000	SP
6	I focus on mathematical skills that align with the skills in TIMSS.	2.31	1.50	−0.693	−10.58	521	0.000	SN
7	Mathematics tests in schools are compatible with TIMSS.	2.91	1.29	−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	1.19	−0.395	−7.58	521	0.000	SN
	Mathematics Teachers Practices of TIMSS	2.86	0.58	−0.143	−5.69	521	0.000	SN

Note: Significant Positive [SP], Significant Negative [SN], Neutral [N], Level of Significance 0.05.

Table 5. One-Sample *t*-test showing mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirates schools (N = 522) based on Dimension 3 items (Test value = 3).

S.N.	Items	Mean	Standard Deviation	Mean Difference	t	df	Sig. (2-Tailed)	Significant Positive or Negative Perceptions
1	Grade 8 students in the UAE schools practice problem solving to improve results in TIMSS	2.11	1.38	−0.887	−14.743	521	0.000	SN
2	Grade 8 students in the UAE schools practice reasoning skills to perform well in TIMSS.	3.52	0.89	0.515	13.202	521	0.000	SP
3	Grade 8 students in the UAE schools are often found unaware of the questions in TIMSS.	3.42	0.88	0.418	10.904	521	0.000	SP
4	Grade 8 students in the UAE schools persevere in learning mathematics for good results in TIMSS.	3.04	1.03	0.042	0.936	521	0.350	NC
5	Parents are interested in helping their children to perform well in TIMSS.	2.23	1.19	−0.774	−14.904	521	0.000	SN
6	Parents are aware of the importance of urging students to get good.	2.05	1.20	−0.946	−18.039	521	0.000	SN
7	Grade 8 students are motivated to achieve good results in TIMSS.	3.89	0.824	0.893	24.744	521	0.000	SP
8	Grade 8 students are usually evaluated through pretests to prepare them for TIMSS.	1.47	0.94	−1.533	−37.348	521	0.000	SN
	Mathematics Teachers' Perceptions of Student Readiness for TIMSS.	2.7160	0.43	−0.284	−14.924	521	0.000	SN

Note: Significant Positive [SP], Significant Negative [SN], Neutral [N], Level of Significance 0.05.

Table 6. One-Sample *t*-test showing mathematics teachers' perceptions of school and classroom environment for TIMSS in Abu Dhabi Emirates schools (N = 522) (Test value = 3).

NO	Items	Mean	Standard Deviation	Mean Difference	t	df	Sig. (2-Tailed)	Significant Positive or Negative Perceptions
1	Schools create a suitable environment to help students with TIMSS.	2.20	1.40	−0.799	−13.020	521	0.000	SN
2	Teachers have the required skills to maintain a classroom environment to help their students succeed in TIMSS.	3.99	0.77	0.987	29.274	521	0.000	SP
3	Teachers use interactive sessions to increase student participation in the class.	3.39	1.15	0.393	7.805	521	0.000	SP
4	Teachers manage their classes to encourage students to perform better in TIMSS.	3.77	0.71	0.772	24.785	521	0.000	SP
5	The classroom environment encourages students to be ready for TIMSS.	1.71	1.14	−1.293	−25.819	521	0.000	SN
6	The school environment promotes healthy competitions to motivate students to achieve good results in TIMSS.	2.72	1.34	−0.280	−4.785	521	0.000	SN
	Dimension 4: School and Classroom Environment.	2.963	0.59	−0.0367	−1.422	521	0.156	SN

Note: Significant Positive [SP], Significant Negative [SN], neutral [N], Level of Significance 0.05.

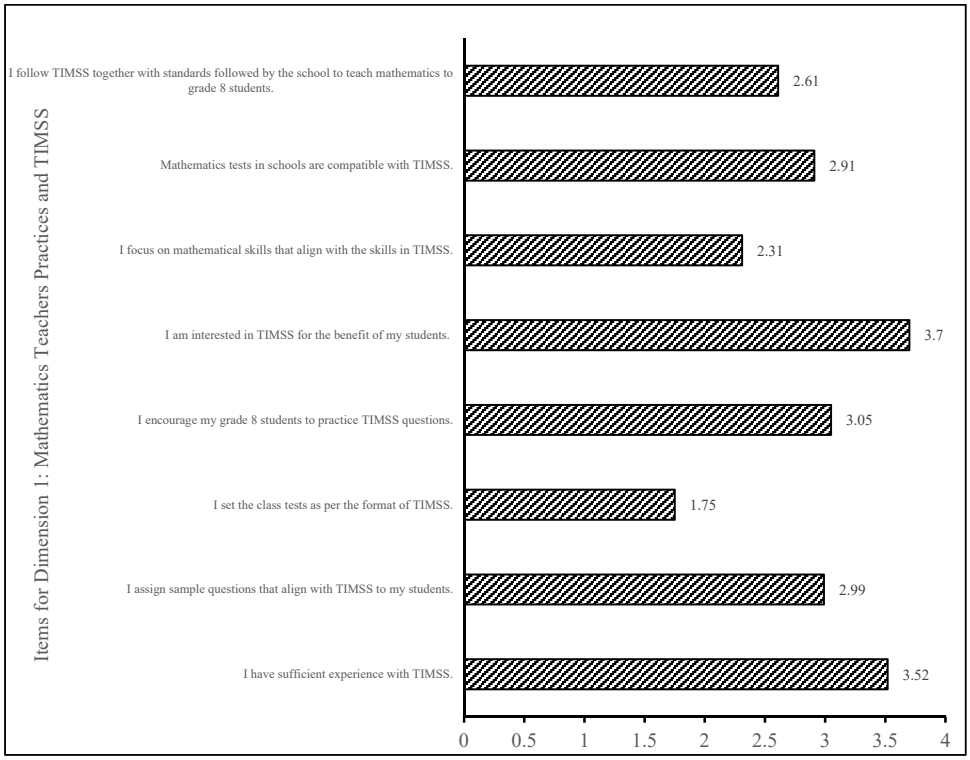

Figure 3. Average scores of the components of Dimension 2: Mathematics Teachers Practices of TIMSS.

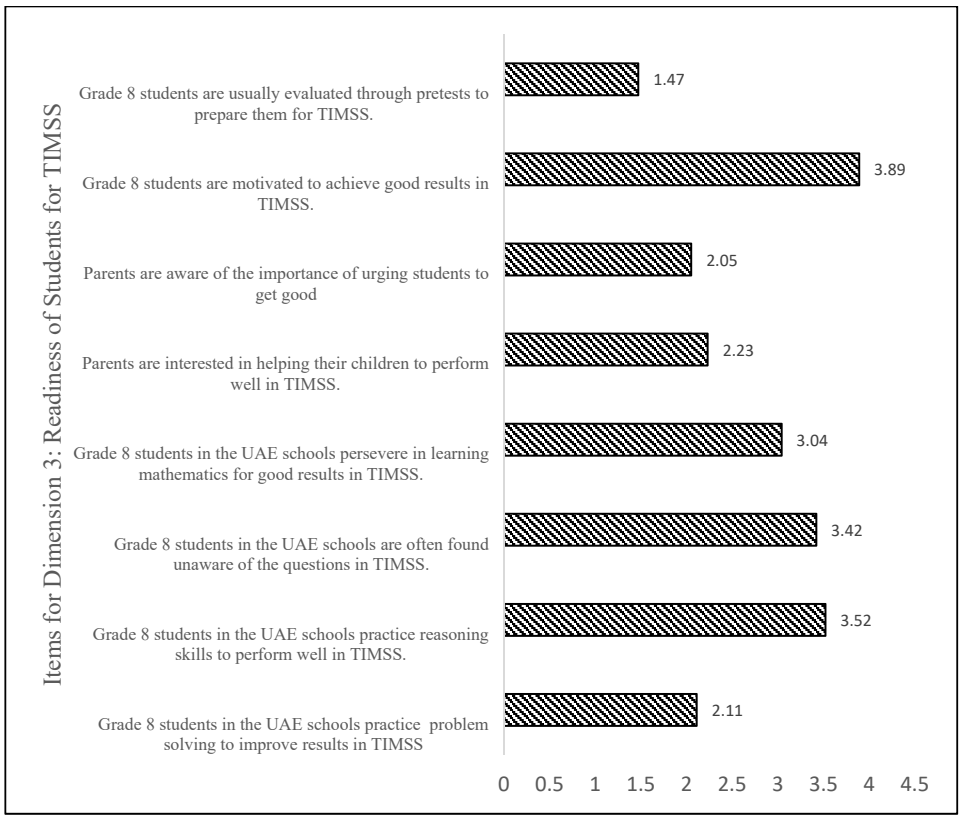

Figure 4. Average scores of the components in Dimension 3: Readiness of Students for TIMSS.

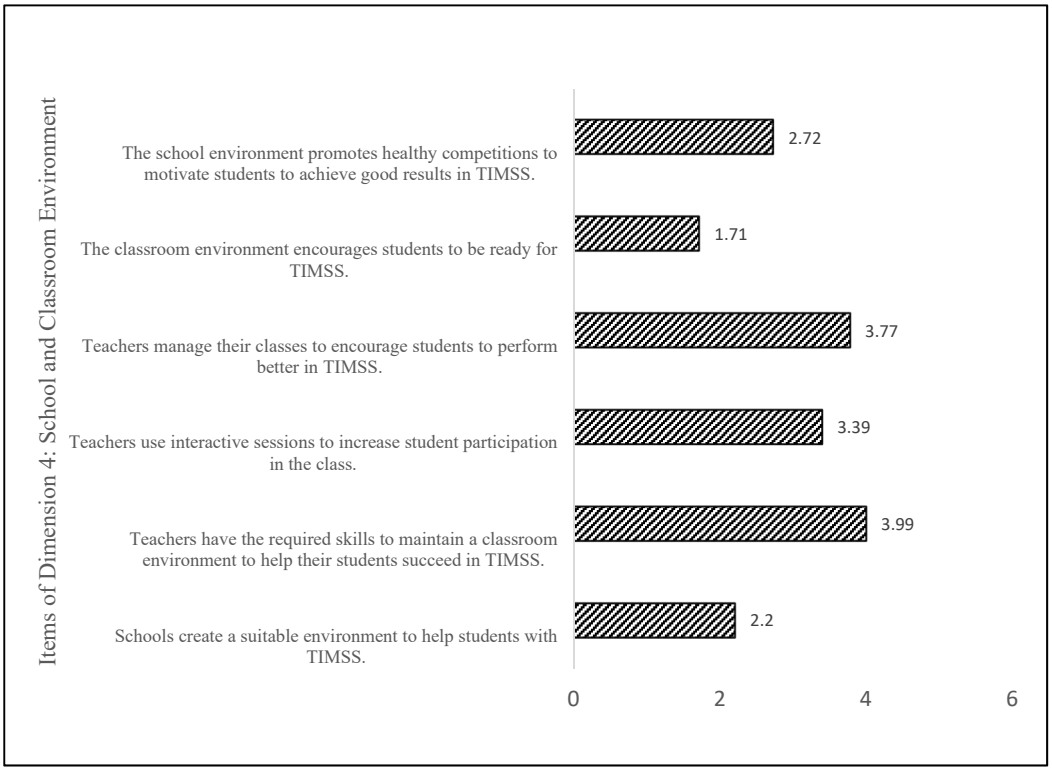

Figure 5. Average scores of the components of Dimension 4: School and Classroom Environment for TIMSS.

4.1. Mathematics Teachers' Perceptions of TIMSS

A One-Sample *t*-test was conducted to examine teachers' perceptions of TIMSS (Table 3).

The one-sample *t*-test above (Table 3) shows that the mathematics curriculum for grade 8 in the UAE schools aligns with TIMSS (Mean = 3.72, SD = 0.788, $p < 0.05$). This means that teachers believed that the mathematics curriculum for grade 8 in the UAE positively aligns with the TIMSS. Similarly, they had a significantly positive perception towards whether the mathematics curriculum for grade 8 in the UAE school covers the standards for TIMSS (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, the participants expressed negative perceptions on the challenges faced in accommodating the UAE mathematics curriculum in the TIMSS context (Mean = 1.65, SD = 0.753, and $p < 0.05$). Their perceptions were neutral toward the UAE mathematics curriculum, which is lacking in questions that require critical thinking ($p > 0.05$). Overall, teachers had positive perceptions towards TIMSS (Mean = 3.17, SD = 0.42 and $p < 0.05$) (Table 3, Figure 2).

4.2. Mathematics Teachers' Self-Reported Practices Related to TIMSS

A One-Sample *t*-test was conducted to examine teachers' self-reported practices related to TIMSS (Table 4).

The one-sample *t*-test results above (Table 4) show that teachers have positive perceptions towards having sufficient experience with TIMSS (Mean = 3.52, SD = 1.190, $p < 0.05$). This means that teachers believe they have sufficient experience with TIMSS. Similarly, they had significantly positive perceptions of the 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 using the format of TIMSS (Mean = 1.75, SD = 1.074, and

$p < 0.05$), the focus on mathematical skills that align with the skills in TIMSS (Mean = 2.31, SD = 1.50, and $p < 0.05$), and following TIMSS together with the 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 compatibility between mathematics tests in schools and TIMSS ($p > 0.05$). Overall, teachers had a negative perception toward Dimension 1: Mathematics Teachers' Practices for TIMSS (Mean = 2.86, SD = 0.58 and $p < 0.05$) (Table 4, Figure 3).

4.3. Mathematics Teachers' Perceptions of Student Readiness for TIMSS

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

Figure 3 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 teachers' perception of student readiness for TIMSS is significantly negative due to the output realized (mean = 2.11, SD = 1.38, $p > 0.05$); the value of this test item was less than 3.0. However, certain items highlighted by Table 3 above, such as students' motivation to attain better results (mean = 3.89, SD = 0.82, $p > 0.05$) and practicing reasoning skills to achieve better results (mean = 3.52, SD = 0.82, $p > 0.05$) had test values higher than 3.0. Among the negative items indicating poor readiness student readiness concern grade 8 students in UAE schools practicing problem solving to improve results in the TIMSS (mean = 2.11, SD = 1.38, $p > 0.05$) and parents' interest in helping their children to perform well in TIMSS (mean = 2.23, SD = 1.19, $p > 0.05$); additionally, Table 3 shows statistically significant negative perceptions regarding parents' awareness of the importance of urging students towards high achievement (mean = 2.05, SD = 1.20, $p > 0.05$) and awareness 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 negative perceptions regarding the readiness of students for TIMSS. Nonetheless, grade 8 students in UAE schools who practice reasoning skills positively perform well in TIMSS (mean = 3.52, SD = 0.89, $p < 0.05$), and grade 8 students in UAE schools were found to often be unaware of the TIMSS questions (mean = 3.42 SD = 0.88, $p < 0.05$) (Table 5, Figure 4).

4.4. Mathematics Teachers' Perceptions of the School and Classroom Environment for TIMSS

A One-Sample *t*-test was conducted in order to examine teachers' perceptions on items related to Dimension 4: School and Classroom Environment. These items had five-point Likert-scale responses from strongly disagree (coded 1) to strongly agree (coded 5), and the neutral value of 3 was used as a test value.

Figure 5 shows the distribution of average item scores for school and classroom environment for TIMSS from the teachers' perspective. The one-sample *t*-test above (Table 6) shows that the teachers had negative perceptions on Dimension 4: School and Classroom Environment. School and classroom environment was statistically significantly negative because it attained an overall mean less than 3.0. The test expressed negative perceptions as to whether the classroom environment encourages students to be ready for TIMSS (Mean = 1.71, SD = 1.14, and $p < 0.05$), emphasis on schools creating a suitable environment to help students with TIMSS (Mean = 2.20, SD = 1.40, and $p < 0.05$), and whether the school environment promotes healthy competition to motivate students achieve good results in TIMSS (Mean = 2.72, SD = 1.34, 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 = 0.77, $p < 0.05$). Equally, teachers use interactive sessions to increase students' participation in their class (Mean = 3.39, SD = 1.15, and $p < 0.05$), and teachers positively manage their classes to encourage students to perform better in TIMSS (Mean = 3.77, SD = 0.71 and $p < 0.05$) (Table 6, Figure 5).

4.5. Differences between Males and Females with Respect to Mathematics Teachers' Perceptions of TIMSS

To examine whether there is any difference between male and female teachers' perceptions of TIMSS in Abu Dhabi Emirate schools, an independent samples *t*-test was utilized. The mean (M) and standard deviation (SD) of each group are illustrated in Table 7.

Table 7. Mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools based on gender (assuming variance is equal).

Dimension	Gender	N	Mean	Mean Difference	Std. Deviation	Sig. (2-Tailed)
Math teachers' overall perception	Male Female	244 278	2.98 2.87	0.11	0.31 0.28	0.000
Mathematics Teachers' Perceptions of TIMSS	Male Female	244 278	3.20 3.14	0.06	0.45 0.39	0.109
Mathematics Teachers Practices' of TIMSS	Male Female	244 278	2.88 2.84	0.04	0.64 0.52	0.465
Mathematics Teachers' Perceptions of Student Readiness for TIMSS	Male Female	244 278	2.75 2.69	0.06	0.45 0.42	0.134
Mathematics Teachers' Perceptions of School and Classroom Environment for TIMSS	Male Female	244 278	3.14 2.81	0.33	0.56 0.58	0.000

An 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, an independent samples *t*-test showed no was statistically significant differences between male and female teachers in Dimension 1: Mathematics Teachers' Practices with TIMSS (Male: Mean = 2.88, SD = 0.64; Female: Mean = 2.84, SD = 0.52, and p-value = 0.47 > 0.01). Male and female teachers have different perceptions concerning "Mathematics Teachers' Practices and TIMSS". Similarly, an independent *t*-test indicated that there was no statistically significantly 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 similar opinions towards Dimension 2: Mathematics and Instruction. The independent *t*-test indicated that there was no statistically significantly difference between male and female teachers in Dimension 3: Readiness of Students for the 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 teachers 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 significantly 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 male and female teachers have different opinions towards Dimension 4: School and Classroom Environment.

4.6. Differences between Public and Private Schools with Respect to Mathematics Teachers' Perceptions of TIMSS

To examine whether there is any difference between public and private school teachers' perceptions of the TIMSS in Abu Dhabi Emirate schools, an independent samples *t*-test was utilized. The mean (M) and standard deviation (SD) of each group are illustrated in (Table 8).

Table 8. Mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools based on School Type (assuming variance is equal).

Dimension	School Type	N	Mean	Std. Deviation	Sig. (2-Tailed)	Mean Difference
Math teachers's overall perception	Public	284	2.95	0.30	0.018	0.06
	Private	238	2.89	0.30		
Mathematics Teaches' Perceptions of TIMSS	Public	284	3.15	0.45	0.512	−0.02
	Private	238	3.18	0.37		
Mathematics Teachers Practices of TIMSS	Public	284	2.87	0.59	0.524	0.03
	Private	238	2.84	0.56		
Mathematics Teachers' Perceptiosn of Student Readiness for TIMSS	Public	284	2.66	0.49	0.000	−0.13
	Private	238	2.79	0.34		
Mathematics Teachers' Perceptiosn of School and Classroom Environment for TIMSS	Public	284	3.18	0.58	0.000	0.48
	Private	238	2.70	0.49		

An independent samples *t*-test for mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirate schools based on school type showed that there was no statistically significant difference between public and private schools in overall teachers' perception of TIMSS (public: Mean = 2.95, SD = 0.30; private: Mean = 2.89, SD = 0.30, and *p*-value = 0.018 > 0.01). In addition, an independent samples *t*- test showed no statistically significant difference between public and private schools in teacher perceptions of Dimension 1: Mathematics Teachers Practices for the 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 significantly difference between public and private schools in terms of teachers' perceptions 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). An independent *t*-test indicated a statistically significantly difference between public and private schools in teachers' perceptions 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, an independent *t*-test indicated a statistically significantly difference between public and private schools in teachers' perceptions 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).

4.7. Differences in Teachers' Perceptions of TIMSS in Abu Dhabi Emirate Schools Based on Math Teaching Experience

To examine whether there is any difference in teachers' perceptions of TIMSS in Abu Dhabi Emirate Schools based on teachers' level of math teaching experience, a one-way ANOVA and post hoc comparisons were utilized.

In order to determine whether the differences in the mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirates schools were statistically significant with experience (at significance level $\alpha \leq 0.05$), one-way ANOVA was used, as shown in Table 9.

A one-way ANOVA test was conducted to determine whether there were differences in overall teachers' perceptions of TIMSS on Dimension 1: Mathematics Teachers perceptions of TIMSS, Dimension 2: Mathematics teachers' practices of TIMSS, Dimension 3: Mathematics teachers' perceptions of student readiness for the TIMSS, and Dimension 4: Mathematics teachers' perceptions of school and classroom environment for TIMSS based on teachers' level of experience (Table 9). Participants were classified into four groups, namely, less than 5 years (n = 40), between 6 and 10 years (n = 40), between 11 and 15 years (n = 226), and 16 years and above (n = 216). There were no outliers, as assessed by boxplot, and data were normally distributed for each group, as assessed by Shapiro–Wilk test ($p > 0.05$). All variances were homogeneous, as assessed by Levine's test of homogeneity of variances ($p = 0.053 > 0.01$). Data are presented as means, and the standard deviations of

math teachers' overall perception scores showed statistically significant differences between groups with different levels of experience: F (3, 518) = 4.12, $p < 0.01$. Teachers' perceptions of TIMSS increased from the group with 11 to 15 years' experience (M = 2.88, SD = 0.26) to the group with 16 years' experience and above (M = 2.96, SD = 0.30), in that order. Tukey's post hoc analysis revealed that the increase from the group with 11 to 15 years' experience to the group with 16 years' experience or more was statistically significant 0.05, but not at 0.01 level ($p = 0.016$). However, no other group differences were statistically significant (Table 10).

Table 9. One-Way ANOVA test of mathematics teachers' perceptions of TIMSS in Abu Dhabi Emirates schools based on teaching experience.

		Sum of Squares	df	Mean Square	F	Sig.
Math teachers' overall perceptions	Between Groups	1.09	3	0.36	4.12	0.007
	Within Groups	45.54	518	0.09		
	Total	46.63	521			
Mathematics Teachers Practices of TIMSS	Between Groups	4.44	3	1.48	4.54	0.004
	Within Groups	168.63	518	0.33		
	Total	173.07	521			
Mathematics Perceptions of TIMSS	Between Groups	1.47	3	0.49	2.84	0.037
	Within Groups	89.44	518	0.17		
	Total	90.91	521			
Mathematics Teachers' Perceptions of Student Readiness for TIMSS	Between Groups	1.068	3	0.356	1.89	0.130
	Within Groups	97.422	518	0.188		
	Total	98.490	521			
Mathematics Teachers' Perceptions of School and Classroom Environment for TIMSS	Between Groups	28.343	3	9.448	31.99	0.000
	Within Groups	152.981	518	0.295		
	Total	181.324	521			

In the same vein, the following data are presented as means and standard deviation. The Dimension 1: Mathematics Teachers' Practices for TIMSS showed statistically significantly differences between different experience groups: F (3, 518) = 4.54, $p < 0.05$. Dimension 1: Mathematics Teachers' Practices for TIMSS showed a change from the group with less than 5 years' experience (M = 3.15, SD = 0.34) to the group with between 11 and 15 years' experience (M = 2.79, SD = 0.44), and the group with 16 years and above (M = 2.87, SD = 0.66). Tukey's post hoc analysis revealed that the changes from the former group to the latter groups were statistically significant ($p < 0.01$). The data revealed that Dimension 2: Mathematics teachers' perceptions of TIMSS showed no statistically significantly differences between groups with different levels of experience: F (3, 518) = 2.84, $p > 0.01$. Similarly, the one-way ANOVA results indicated that Dimension 3: Teachers' perception about student readiness for TIMSS was not statistically significant among groups with different levels of teaching experience: F (3, 518) = 1.89, $p > 0.01$.

However, the Dimension 4: Teachers' perceptions of School and Classroom Environment for TIMSS showed statistically significantly differences among groups with different levels of teaching experience: F (3, 518) = 31.99, $p < 0.01$ (Table 9). Scores on mathematics teachers' perceptions of School and Classroom Environment for TIMSS score changed from the group with less than 5 years' experience (M = 3.10, SD = 0.54) to the group with between 11 and 15 years' experience (M = 2.72, SD = 0.51) and then to the group of 16 years and above (M = 3.22, SD = 0.60), in that order. Tukey's post hoc analysis revealed that the increase from the former group to the latter were statistically significant ($p < 0.01$). Furthermore, there was an increase from the group with between 6 and 10 years' experience (M = 2.82, SD = 0.51) to the group with 16 years' experience and above (M = 3.22, SD = 0.60). The increased scores in the groups with more teaching experience was indicated by Tukey's post hoc analysis, which revealed that the increase from the group with between 6 and 10 years' experience to the group with 16 years' experience or more was statistically significant ($p < 0.01$).

Table 10. Post hoc multiple comparisons across teaching experience levels.

		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' Overall Perceptions	Less than 5 years	Between 6 to 10 years	0.10	0.07	0.441	−0.0717	0.2701
		Between 11 to 15 years	0.13	0.0	0.052	−0.0008	0.2614
		16 years and above	0.05	0.05	0.803	−0.0854	0.1777
	Between 6 to 10 years	Less than 5 years	−0.10	0.07	0.441	−0.2701	0.0717
		Between 11 to 15 years	0.03	0.05	0.928	−0.0999	0.1622
		16 years and above	−0.05	0.05	0.726	−0.1846	0.0785
	Between 11 to 15 years	Less than 5 years	−0.13	0.05	0.052	−0.2614	0.0008
		Between 6 to 10 years	−0.03	0.05	0.928	−0.1622	0.0999
		16 years and above	−0.08 *	0.02	0.016	−0.1569	−0.0115
	16 years and above	Less than 5 years	−0.05	0.05	0.803	−0.1777	0.0854
		Between 6 to 10 years	0.05	0.05	0.726	−0.0785	0.1846
		Between 11 to 15 years	0.08 *	0.02	0.016	0.0115	0.1569
Mathematics Teachers' Practices of TIMSS	Less than 5 years	Between 6 to 10 years	0.27	0.12	0.145	−0.0570	0.6007
		Between 11 to 15 years	0.36 **	0.09	0.002	0.1063	0.6108
		16 years and above	0.28 *	0.09	0.021	0.0311	0.5374
	Between 6 to 10 years	Less than 5 years	−0.27	0.13	0.145	−0.6007	0.0570
		Between 11 to 15 years	0.09	0.10	0.813	−0.1656	0.3389
		16 years and above	0.01	0.10	0.999	−0.2407	0.2655
	Between 11 to 15 years	Less than 5 years	−0.32 **	0.10	0.002	−0.6108	−0.1063
		Between 6 to 10 years	−0.09	0.10	0.813	−0.3389	0.1656
		16 years and above	−0.07	0.05	0.520	−0.2142	0.0657
	16 years and above	Less than 5 years	−0.28 *	0.10	0.021	−0.5374	−0.0311
		Between 6 to 10 years	−0.01	0.10	0.999	−0.2655	0.2407
		Between 11 to 15 years	0.07	0.05	0.520	−0.0657	0.2142
Mathematics Teachers' Perceptiosn of School and Classroom Environment for TIMSS	Less than 5 years	Between 6 to 10 years	0.27	0.12	00.117	−0.0424	0.5840
		Between 11 to 15 years	0.38 **	0.09	00.000	0.1378	0.6183
		16 years and above	−0.12	0.09	0.607	−0.3564	0.1258
	Between 6 to 10 years	Less than 5 years	−0.27	0.12	0.117	−0.5840	0.0424
		Between 11 to 15 years	0.11	0.09	0.659	−0.1331	0.3475
		16 years and above	−0.39 **	0.09	0.000	−0.6272	−0.1450
	Between 11 to 15 years	Less than 5 years	−0.38 **	0.09	0.000	−0.6183	−0.1378
		Between 6 to 10 years	−0.11	0.09	0.659	−0.3475	0.1331
		16 years and above	−0.49 **	0.05	0.000	−0.6266	−0.3600
	16 years and above	Less than 5 years	0.12	0.09	0.607	−0.1258	0.3564
		Between 6 to 10 years	0.39 **	0.09	0.000	0.1450	0.6272
		Between 11 to 15 years	0.49 **	0.05	0.000	0.3600	0.6266

* Significant at 0.05 Level, ** Signifcant at 0.01 Level.

4.8. Differences in Teachers' Perceptions of TIMSS in Abu Dhabi Emirates Schools Based on Math Teachers' Qualifications

To examine whether there are any difference in teachers' perceptions of TIMSS in Abu Dhabi Emirates schools based on math teachers' qualifications, a one-way ANOVA test and post hoc comparisons were utilized. The mean (M) and standard deviation (SD) of each group are illustrated in Table 11, while the post hoc comparisons are shown in Table 12.

Table 11. One-Way ANOVA test of mathematics teachers' perceptions of TIMSS on Abu Dhabi Emirates schools based on teachers' qualifications.

		Sum of Squares	df	Mean Square	F	Sig.
Math Teachers' Overall Perception	Between Groups	0.390	2	0.195	2.191	0.113
	Within Groups	46.240	519	0.089		
	Total	46.630	521			
Mathematics Teachers' Perceptions of TIMSS	Between Groups	0.855	2	0.428	2.465	0.086
	Within Groups	90.055	519	0.174		
	Total	90.911	521			
Mathematics Teachers' Practices of TIMSS	Between Groups	0.655	2	0.327	0.986	0.374
	Within Groups	172.413	519	0.332		
	Total	173.068	521			
Mathemtics Teachers' Perceptions of Student Readiness for TIMSS	Between Groups	1.335	2	0.668	3.566	0.029
	Within Groups	97.155	519	0.187		
	Total	98.490	521			
Mathematics Teachers' Perceptions of School and Classroom Environment for TIMSS	Between Groups	8.368	2	4.184	12.556	0.000
	Within Groups	172.956	519	0.333		
	Total	181.324	521			

Table 12. Post hoc multiple comparisons of teachers' qualifications.

Dependent Variable	(I) 3. Teacher's Academic Qualification	(J) 3. Teacher's Academic Qualification	Mean Difference (I–J)	Sig.
Mathematics Teachers' Perceptions of Student Readiness for TIMSS	Bachelor's degree	Master's degree	0.01	0.989
		Ph.D. degree	−0.29 *	0.025
	Master's degree	Bachelor's degree	−0.01	0.989
		Ph.D. degree	−0.30 *	0.023
	Ph.D. degree	Bachelor's degree	0.30 *	0.025
		Master's degree	0.30 *	0.023
Mathematics Teachers' Perceptions of School and Classroom Environment for TIMSS	Bachelor's degree	Master's degree	−0.30 **	0.000
		Ph.D. degree	−0.16	0.544
	Master's degree	Bachelor's degree	0.30 **	0.000
		Ph.D. degree	0.10	0.763
	Ph.D. degree	Bachelor's degree	0.16	0.544
		Master's degree	−0.10	0.763

* Significant at 0.05 Level, ** Signifcant at 0.01 Level.

A one-way ANOVA test was conducted to determine whether there are differences in overall teachers' perception of TIMSS on Dimension 1: Mathematics Teachers Practices for the TIMSS, Dimension 2: Mathematics and Instruction, Dimension 3: Readiness of Students for the TIMSS, and Dimension 4: School and Classroom Environment on the basis of math teachers' qualifications (Table 11). The participants were classified into three groups: Bachelor's degree (n = 298), Master's degree (n = 208), and PhD (n = 16). There were no outliers, as assessed by boxplot; data were normally distributed for each group, as assessed by the Shapiro–Wilk test ($p > 0.05$). Variances were homogeneous, as assessed by Levine's test of homogeneity of variances ($p = 0.053$). For math teachers' overall perception scores, the one-way ANOVA results indicated no statistically significant differences among groups with different levels of qualifications: F (2, 519) = 2.191, $p > 0.05$.

For Dimension 1: Mathematics Teachers' Practices for TIMSS scores, the 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, the one-way ANOVA results indicated that scores on Mathematics Teachers' Perceptions of TIMSS were not statistically significantly different across the groups with different educational qualifications at

0.05 level of significance. However, the Dimension 3: Mathematics Teachers' Perceptions of Student Readiness for TIMSS showed statistically significant differences by teachers' qualifications: F (2, 519) = 3.566, $p < 0.05$. Mathematics Teachers' Perceptions of Student Readiness for the TIMSS showed an increase from teachers with a Bachelor's degree (M = 2.71, SD = 0.40) to those with a PhD (M = 3.00, SD = 0.34), also Master's degree (M = 2.70, SD = 0.49) to a PhD (M = 3.00, SD = 0.34). Tukey's post hoc analysis revealed that the increase from the Bachelor's degree group to the PhD group was statistically significant ($p = 0.025 < 0.05$); and the increase from the Master's degree group to the PhD group was statistically significant ($p = 0.023 < 0.05$). However, no other group differences were statistically significant.

The one-way ANOVA results indicated that scores on Dimension 4: Mathematics Teachers' Perceptions of School and Classroom Environment for TIMSS were statistically significant among the groups with different qualifications: F (2, 519) = 12.556, $p < 0.01$. Scores on Mathematics Teachers' Perceptions on School and Classroom Environment for TIMSS increased from the Bachelor's degree group (M = 2.85, SD = 0.58) to the Master's degree group (M = 3.28, SD = 0.57). Tukey's post hoc analysis revealed that the increase from the Bachelor's degree group to the Master's degree group was statistically significant ($p < 0.01$), and none of the other pairs were statistically significant different at 0.01 levelo of significance.

5. Discussion

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 [43], teachers should have sufficient experience and knowledge to deliver lessons to students efficiently. Alharbi et al. [38] highlight teacher quality as among the critical determinants of the student learning process. A similar study by Berger et al. [44] 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, Mendez, and Crespo [45] 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. [46] 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 [47]. This is most applicable when introducing new topics

that students might not be conversant in. Another study carried out by Cuenca-Carlino et al. [48] 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 et al. [39] 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 f, and competing milieu in schools all considerably affected mathematics performance in 2015. Furthermore, Ersan and Rodriguez [49] 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 [49]. Another similar study by Provasnik et al. [50] 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. [51] 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 [52] 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 [53].

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 [31] 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. [32] 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*-tests 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 [33] elaborate on this by explaining efforts towards ensuring 8th-grade students in public schools perform better. Despite this, their performance in TIMSS 2015 was significantly low. A different though related study by Bdeir [34] 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 [35]. 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. [32], who showed that a teacher's experience has a role in determining an 8th-grade student's understanding. A more experienced teacher is more likely to

use different and friendlier teaching strategies to teach mathematics to students. These findings are similar to another study by Alharbi et al. [38] 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 [37]. Teachers who used modern teaching methods proved that experience only plays a role in allowing teachers to understand their students better [39], 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 Støle et al. [54] 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 [55], 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 [49]. 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.

6. Conclusions

The purpose of this study was to explore mathematics teachers' perceptions of TIMSS and related practices in Abu Dhabi schools in the United Arab Emirates. A teacher perception questionnaire was designed and administered to mathematics teachers in Abu Dhabi schools in the academic year 2020–2021. A One-Sample *t*-test, Independent Sample *t*-test and ANOVA tests were performed for each component variable of the teachers' perceptions. The results of the One-Sample *t*-test showed that Abu Dhabi mathematics teachers had a positive overall view of TIMSS as a tool to assess students' performance at an international level. They believed that the mathematics curriculum for grade 8 in UAE schools aligns with TIMSS. They did not seem to believe that there are challenges in accommodating the UAE mathematics curriculum with TIMSS. The results revealed that mathematics teachers in Abu Dhabi did not believe their practices to be aligned with TIMSS. They seemed interested in TIMSS for the benefit of their students; however, they disagreed that they could focus on mathematical skills that align with the skills in TIMSS. This mismatch between interest and self-reported practices should be a matter of further study in order to determine what prevents teachers from implementing TIMSS-related activities in the classroom. Teachers did not believe that mathematics students in Abu Dhabi are ready for practices related to TIMSS. This can be another area of further study, as problems may lie with students' lack of readiness to participate in TIMSS and perform well. The independent *t*-test showed no statistically significant differences between male and female teachers in

mathematics teaching practices related to TIMSS or their perception of student readiness for TIMSS; however, they had statistically significant differences in their perceptions of the school and classroom environment. In addition, there were no statistically significant differences between public and private schools in terms of the practice of mathematics teachers for TIMSS. However, a statistically significant difference was found with regard to teachers' views about students' readiness for TIMSS, as well with regard to the school and classroom environment.

7. Implications and Limitation

The aim of this study was to explore mathematics teachers' perceptions of TIMSS in schools in the emirate of Abu Dhabi in the United Arab Emirates. The main significant implication of our results is that they allow policymakers at the government or school level to identify most observable components of teacher quality and the ways in which their perceptions might affect the actual implementation of TIMSS together with classroom teaching and learning of mathematics. Relevant and immediate concerns might include providing additional attention 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.

This study's sample was limited to mathematics teachers teaching in Abu Dhabi's public and private schools. The findings from this study thus may not be suitable for generalization to the entire UAE school system, and should interpret within this context. Nonetheless, the findings of this study indicate several key areas where attention needs to be paid to teacher readiness and teacher practices for TIMSS in order to improve students' performance on such international tests. Suggestions for further study include using a larger sample size to include all UAE schools. Issues with how teachers' perceptions affect their classroom practices, which in turn might influence students' performance in TIMSS, should be explored as well. Future research studies might consider such different variables as teacher professional development, job satisfaction, personality and teaching style, and awareness of the nature of TIMMS as well as the subsequent impact on classroom practices and student performance in TIMSS.

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References

1. Reeves, S.; McMillan, S.E.; Kachan, N.; Paradis, E.; Leslie, M.; Kitto, S. Interprofessional collaboration and family member involvement in intensive care units: Emerging themes from a multi-sited ethnography. *J. Interprof. Care* **2015**, *29*, 230–237. [CrossRef] [PubMed]
2. Jarrah, A.M.; Khasawneh, O.M.; Wardat, Y. Implementing pragmatism and John Dewey's educational philosophy in Emirati elementary schools: Case of mathematics and science teachers. *Int. J. Educ. Econ. Dev.* **2020**, *11*, 58. [CrossRef]

3. Heritage, M.; Wylie, C. Reaping the benefits of assessment for learning: Achievement, identity, and equity. *ZDM* **2018**, *50*, 729–741. [CrossRef]
4. Fulmer, G.W.; Tanas, J.; Weiss, K.A. The challenges of alignment for the Next Generation Science Standards. *J. Res. Sci. Teach.* **2018**, *55*, 1076–1100. [CrossRef]
5. Henrekson, M.; Wennström, J. *Dumbing Down: The Crisis of Quality and Equity in a Once-Great School System—And How to Reverse the Trend*; Palgrave McMillan: London, UK, 2022.
6. Shannag, Q.A.; Tairab, H.; Dodeen, H.; Abdel-Fattah, F. Linking Teachers' Quality and Student Achievement in the Kingdom of Saudi Arabia and Singapore: The Impact of Teachers' Background Variables on Student Achievement. *J. Balt. Sci. Educ.* **2013**, *12*, 652–665. Available online: http://oaji.net/articles/2015/987-1425810596.pdf (accessed on 23 February 2021). [CrossRef]
7. Wardat, Y.; Jarrah, A.M.; Stoica, G. Understanding the meaning of the equal sign: A case study of middle school students in the United Arab Emirates. *Eur. J. Educ. Res.* **2021**, *10*, 1505–1514. [CrossRef]
8. Martin, M.O.; Mullis, I.V.; Foy, P.; Stanco, G.M. TIMSS 2011 International Results in Science. International Association for the Evaluation of Educational Achievement. 2012. Available online: https://timssandpirls.bc.edu/timss2011/downloads/T11_IR_Science_FullBook.pdf (accessed on 20 November 2021).
9. Warner, R. Education Policy Reform in the UAE: Building Teacher Capacity. Mohammed Bin Rashid School of Government. 2018. Available online: https://mbrsgcdn.azureedge.net/cmsstorage/mbrsg/files/87/872091c8-05f3-418b-84a9-48294717ebbb.pdf (accessed on 25 August 2021).
10. Nespor, J. The role of beliefs in the practice of teaching. *J. Curr. Stud.* **1987**, *19*, 17–28. [CrossRef]
11. Pajares, F.M. Teachers' beliefs and educational research: Cleaning up a messy construct. *Rev. Edu. Res.* **1992**, *62*, 307–332. [CrossRef]
12. Barkatsas, A.T.; Malone, J. A Typology of Mathematics Teachers' Beliefs about Teaching and Learning Mathematics and Instructional Practices. *Math. Ed. Res. J.* **2005**, *17*, 69–90. Available online: https://tinyurl.com/kt8emjjd (accessed on 20 November 2021). [CrossRef]
13. Voss, T.; Kleichmann, T.; Kunter, M.; Hatchfeld, A. Mathematics teachers' beliefs. In *Cognitive Activation in the Mathematics Classroom and Professional Competence of Teachers: Results from the COACTIV Project*; Kunter, M., Baumert, J., Blum, W., Klusmann, U., Krauss, S., Neubrand, M., Eds.; Springer: New York, NY, USA, 2013; pp. 249–273.
14. El Afi, A.D. The impact of professional development training on teachers' performance in Abu Dhabi Cycle Two and Three schools. *Teach. Dev.* **2019**, *23*, 366–386. [CrossRef]
15. Government of Abu Dhabi. Abu Dhabi Data Insights. 2022. Available online: https://addata.gov.ae/ (accessed on 21 April 2022).
16. Aloufi, F.; Ibrahim, A.L.; Elsayed, A.M.A.; Wardat, Y.; Ahmed, A.O. Virtual Mathematics Education during COVID-19: An Exploratory Study of Teaching Practices for Teachers in Simultaneous Virtual Classes. *Int. J. Learn. Teach. Educ. Res.* **2021**, *20*, 85–113. [CrossRef]
17. Pennington, D.; Ebert-Uphoff, I.; Freed, N.; Martin, J.; Pierce, S.A. Bridging sustainability science, earth science, and data science through interdisciplinary education. *Sustain. Sci.* **2020**, *15*, 647–661. [CrossRef]
18. Jordan, N.C.; Glutting, J.; Ramineni, C. The importance of number sense to mathematics achievement in first and third grades. *Learn. Individ. Differ.* **2010**, *20*, 82–88. [CrossRef] [PubMed]
19. Battey, D.; Leyva, L.A. A Framework for Understanding Whiteness in Mathematics Education. *J. Urban Math. Educ.* **2016**, *9*, 49–80.
20. Anderson, E.W. Is There a Crisis for Boys? Gender Differences in Student Achievement and Teacher Training Characteristics in the Gulf Cooperation Council Countries. Master's Thesis, Lehigh University, Bethlehem, PA, USA, 2012. Available online: https://core.ac.uk/download/pdf/228641687.pdf (accessed on 12 November 2021).
21. Reilly, D.; Neumann, D.L.; Andrews, G. Gender difference in reading and writing achievement: Evidence from the national assessment of educational progress (NAEP). *Am. Psychol.* **2019**, *74*, 445–458. [CrossRef] [PubMed]
22. Cimpian, J.R.; Lubienski, S.T.; Timmer, J.D.; Makowski, M.B.; Miller, E.K. Have gender gaps in math closed? Achievement, teacher perceptions, and learning behaviors across two ECLS-cohorts. *AERA Open* **2016**, *2*, 1–19. [CrossRef]
23. Gonzales, P.; Williams, T.; Jocelyn, L.; Roey, S.; Kastberg, D.; Brenwald, S. Highlights from TIMSS 2007: Mathematics and Science Achievement of US Fourth-and Eighth-Grade Students in an International Context. National Center for Education Statistics. 2008. Available online: https://nces.ed.gov/pubs2009/2009001.pdf (accessed on 14 October 2021).
24. Cappon, P. Exploring the "Boy Crisis" in Education. Canadian Council on Learning. *Canadian*. 27–29 January 2011. Available online: https://equalitycanada.com/wp-content/uploads/2012/09/Exploring-the-Boys-Crises-in-Education.pdf (accessed on 13 July 2021).
25. Assad, C. Gender equality in the United Arab Emirates: A Driver for Increased Competitiveness? *Dubai Sch. Gov. Policy Brief* **2008**, *5*, 1–7. Available online: https://tinyurl.com/5em6n4fz (accessed on 15 January 2020).
26. Chu, J.H.; Loyalka, P.; Chu, J.; Qu, Q.; Shi, Y.; Li, G. The impact of teacher credentials on student achievement in China. *China Econ. Rev.* **2015**, *36*, 14–24. [CrossRef]
27. Hanushek, E.A. The economic value of higher teacher quality. *Econ. Educ. Rev.* **2011**, *30*, 466–479. [CrossRef]
28. Kukla-Acevedo, S. Do teacher characteristics matter? New results on the effects of teacher preparation on student achievement. *Econ. Educ. Rev.* **2009**, *28*, 49–57. [CrossRef]
29. Harris, D.N.; Sass, T.R. Teacher training, teacher quality and student achievement. *J. Public Econ.* **2011**, *95*, 798–812. [CrossRef]

30. Bietenbeck, J. Teaching practices and cognitive skills. *Labour Econ.* **2014**, *30*, 143–153. [CrossRef]
31. Kartal, B. Pre-service science and mathematics teachers' teaching efficacy beliefs and attitudes toward teaching: A partial correlation research. *Aust. J. Teach. Educ.* **2020**, *45*, 42–61. [CrossRef]
32. Burroughs, N.; Gardner, J.; Lee, Y.; Guo, S.; Touitou, I.; Jansen, K.; Schmidt, W. Measuring teacher effectiveness across time: What does TIMSS reveal about education system level trends? In *Teaching for Excellence and Equity*; IEA Research for Education (A Series of In-Depth Analyses Based on Data of the International Association for the Evaluation of Educational Achievement (IEA)); Springer: Berlin/Heidelberg, Germany, 2019; Volume 6, pp. 29–45. [CrossRef]
33. Cordero, J.M.; Cristobal, V.; Santín, D. Causal inference on education policies: A survey of empirical studies using PISA, TIMSS and PIRLS. *J. Econ. Surv.* **2018**, *32*, 878–915. [CrossRef]
34. Bdeir, R. Investigating the Progress of Dubai Private Schools' PISA and TIMSS Results and School Inspection Reports from 2011 to 2018. Ph.D. Thesis, The British University in Dubai (BUiD), Dubai, United Arab Emirates, 2019.
35. Alenezi, A. Obstacles for teachers to integrate technology with instruction. *Educ. Inf. Technol.* **2017**, *22*, 1797–1816. [CrossRef]
36. Alarabi, K.; Wardat, Y. UAE-based Teachers' Hindsight Judgments on Physics Education during the COVID-19 Pandemic. *Psychol. Educ. J.* **2021**, *58*, 2497–2511.
37. Abdelfattah, F.; Lam, J. Linking Homework to Achievement in Mathematics: An Examination of 8th-Grade Arab Participation in TIMSS 2015. *Int. J. Instr.* **2018**, *11*, 607–624. Available online: https://eric.ed.gov/?id=EJ1191672 (accessed on 16 March 2020). [CrossRef]
38. Alharbi, M.S.; Almatham, K.A.; Alsalouli, M.S.; Hussein, H.B. 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. *Int. J. Educ. Res.* **2020**, *104*, 10167. [CrossRef]
39. Davis, A.N.; Carlo, G. The roles of parenting practices, sociocognitive/emotive traits, and prosocial behaviors in low-income adolescents. *J. Adolesc.* **2018**, *62*, 140–150. [CrossRef]
40. Alotaibi, A.; Khalil, I.; Wardat, Y. Teaching practices of the mathematics male and female teachers according to the PISA framework and its relation to their beliefs towards their students. *Elem. Educ. Online* **2021**, *20*, 1247–1265. [CrossRef]
41. Ministry of Education (MoE). *ESE Unlicensed Teacher Statistics*; January 2022 Updates; Ministry of Education: Dubai, United Arab Emirates, 2022.
42. Altakhaineh, A.R.; Alnamer, S.A. The impact of Facebookers' posts on other users' attitudes according to their age and gender: Evidence from Al Ain University of science and technology. *Soc. Sci.* **2018**, *7*, 128. [CrossRef]
43. Güven, U.; Akçay, A.O. Trends of homework in mathematics: Comparative research based on TIMSS study. *Int. J. Instr.* **2019**, *12*, 1367–1382. [CrossRef]
44. Berger, N.; Mackenzie, E.; Holmes, K. Positive attitudes towards mathematics and science are mutually beneficial for student achievement: A latent profile analysis of TIMSS 2015. *Aust. Educ. Res.* **2020**, *47*, 409–444. [CrossRef]
45. Clavel, J.G.; Crespo, F.J.G.; Méndez, I. Are Teacher Characteristics and Teaching Practices Associated with Student Performance? Policy Brief No. 11. International Association for the Evaluation of Educational Achievement. 2016. Available online: https://www.iea.nl/sites/default/files/2019-04/IEA_Policy_Brief_Sep2016.pdf (accessed on 18 July 2021).
46. Incikabi, L.; Kepceoglu, I.; Pektas, M. Gamification of middle school mathematics and science: Game-playing for learning. In *Handbook of Research on Integrating Computer Science and Computational Thinking in K-12 Education*; IGI Global: Hershey, PA, USA, 2020; pp. 301–316.
47. Incikabi, L.; Serin, M.K.; Incikabi, S. Flipping the mathematics instruction: A critical overview of recent trends in application. In *Handbook of Research on Equity in Computer Science in P-16 Education*; Keengwe, J., Tran, Y., Eds.; IGI Global: Hershey, PA, USA, 2021; pp. 219–247. [CrossRef]
48. Cuenca-Carlino, Y.; Freeman-Green, S.; Stephenson, G.W.; Hauth, C. Self-regulated strategy development instruction for teaching multi-step equations to middle school students struggling in math. *J. Spec. Educ.* **2016**, *50*, 75–85. [CrossRef]
49. Ersan, O.; Rodriguez, M.C. Socioeconomic status and beyond: A multilevel analysis of TIMSS mathematics achievement given student and school context in Turkey. *Large-Scale Assess. Educ.* **2020**, *8*, 15. [CrossRef]
50. Provasnik, S.J.; Malley, L.B.; Neidorf, T.; Arora, A.; Stephens, M.; Balestreri, K.; Herz, K.; Perkins, R.; Tang, J.U.S. Performance on the 2015 TIMSS Advanced Mathematics and Physics Assessments: A Closer Look. National Center for Education Statistics. 2019. Available online: https://nces.ed.gov/pubs2020/2020051.pdf (accessed on 12 September 2021).
51. Eriksson, K.; Helenius, O.; Ryve, A. Using TIMSS items to evaluate the effectiveness of different instructional practices. *Instr. Sci.* **2019**, *47*, 1–18. [CrossRef]
52. Kartianom, K.; Retnawati, H. Why Are Their Mathematical Learning Achievements Different? Re-Analysis TIMSS 2015 Data in Indonesia, Japan, and Turkey. *Int. J. New Trends Educ. Implic.* **2018**, *9*, 33–46. Available online: http://www.ijonte.org/?pnum=66&pt=2018%20Volume%209%20Number%202 (accessed on 15 December 2021).
53. Akyuz, G.; Berberoglu, G. Teacher and Classroom Characteristics and Their Relations to Mathematics Achievement of the Students in the TIMSS. *New Horiz. Educ.* **2010**, *58*, 77–96. Available online: https://eric.ed.gov/?id=EJ893714 (accessed on 9 August 2021).

54. Støle, H.; Mangen, A.; Frønes, T.S.; Thomson, J. Digitisation of reading assessment. In *Learning to Read in a Digital World*; Barzillai, M., Thomson, J., Schroeder, S., van den Broek, P., Eds.; John Benjamins: Amsterdam, The Netherlands, 2018; pp. 205–224. [CrossRef]
55. Ambussaidi, I.; Yang, Y.F. The impact of mathematics teacher quality on student achievement in Oman and Taiwan. *Int. J. Educ. Learn.* **2019**, *1*, 50–62. [CrossRef]