Do Characteristics of Teachers Affect Students' Mathematical Achievement? A Comparative Study between Saudi Arabia and the United States of America according to (TIMSS 2019)

Maha Ibrahim Alomiear & Dr. Ahmed Mubarak Alreshidi

http://dx.doi.org/10.29009/ijres.5.1.3

Do Characteristics of Teachers Affect Students' Mathematical Achievement? A Comparative Study between Saudi Arabia and the United States of America according to (TIMSS 2019)

Maha Ibrahim Alomiear
Mathematics Education, Department of Curriculum and Instruction, College of Education, King Saud University, Riyadh, Saudi Arabia, alomermaha@gmail.com

Dr. Ahmed Mubarak Alreshidi
Ph.D. in Mathematics Education, Department of Curriculum and Instruction, College of Education, King Saud University, Riyadh, Saudi Arabia.
aalreshidi@ksu.edu.sa, ORCID: 0000000313805185

Received September 1st 2021 Accepted November 23, 2021

Abstract: The study aims to investigate some characteristics of fourth-grade mathematics teachers in Saudi Arabia and the United States of America, which may affect students' mathematical achievement. Thus, the research utilized fourth-grade students' data, as the average score of students was (398) compared to (535) in the Unites States. Post fact design was used with a sample of (4174) students and (170) teachers in Saudi Arabia, and (8353) students and (451) teachers in the United States. Result indicated that teacher's gender, age, educational level, and qualification are significant variables that impact mathematical achievement in Saudi Arabia. Results also showed that teachers' years of experience, hours of professional development spent by the teacher during the past two years, and teacher gender are significant variable which impact students' mathematical achievement in America. As for the teachers' gender, findings showed significant differences were in favor of students taught by female teachers in both countries.

Keywords: Teachers' characteristics, Mathematical achievement, 4th grade, TIMSS2019, Saudi Arabia, USA.

http://dx.doi.org/10.29009/ijres.5.1.3

Introduction

Throughout the past years, significant efforts have been dedicated to developing and reforming basic education curricula in the Kingdom of Saudi Arabia. Accordingly, the Comprehensive Enhancement Project comes in response to the requirements of development to develop curricula, meet society and learner needs, and prepare learners for the labor market. The Project aimed to develop the educational process in all its dimensions and elements, as modifications were made to generate insights on objectives and content of academic education, especially in mathematics. Following that, the McGraw Hill Series had been released as an alternative of the Project, where it was translated, aligned, and adopted in the curricula. In light of the Ministry's direction to create an education system that helps improve outcomes, and since we live in the age of science and technology, it has become easy to learn from and benchmark countries that are characterized by the quality of education and outcomes. The large-scale international assessment studies have been adopted by a number of developed countries, given their high-quality data that supports education reform. In fact, the educational systems in those countries offer data that enables them to reveal and benchmark the performance level of their students with the performance of their counterparts in a number of other countries.

One of these important studies is the Trends of the International Mathematics and Science Studies, known as TIMSS, which is supervised by the International Association for the Evaluation of Educational Achievement (IEA), which measures students' mastery of subjects such as: mathematics, science, and literacy. TIMSS is an international assessment of mathematics and science in grades four and eight. As for the fourth-grade mathematics content, the Study targets the following domains: (numbers, measurements, geometry, and data); while it assesses (numbers, algebra, geometry, data, and chance) for the eighth grade. In the cognitive domains for the fourth and eighth grades, (knowing, applying, and reasoning) are assessed. the first assessments began in 1995, and used to be implemented once every four years, i.e., 1999, 2003, 2007, 2011, 2015, and 2019. More than (60) countries actively participate

http://dx.doi.org/10.29009/ijres.5.1.3

in the International Association for the Evaluation of Educational Achievement (IEA), with the participation of more than a hundred educational systems in the studies conducted by the Organization. The first participation of the Kingdom of Saudi Arabia in the fourth grade was in 2001 (IEA, 2019).

TIMSS is designed in an appropriate manner that provides useful information about teaching quality and teacher characteristics and practices that may be related to student outcomes. It aggregates all classrooms randomly and relates students to teacher level in the classroom. Moreover, it collects questionnaire data from students, teachers, parents, and school principals. Countries participating in TIMSS show a wide interest in benchmarking the level of their students, teachers and schools with East Asian countries that are characterized by better achievement in mathematics and science, such as: Singapore, China, and Japan, in order to access as many lessons learned as possible to raise their students' performance level. In a report developed by the Center for Public Education (CPE) in 2008 entitled " U.S Students Make Significant Gains on Assessments (TIMSS 2007)", the achievement made by the U.S in the period between (1995- 2007) in Mathematics for fourth and eighth grades was revealed, emphasizing that the U.S strives to make a greater effort to reach the performance level of students in East Asian countries. As for the Kingdom of Saudi Arabia, it has participated since 2003 in the third session in the eighth grade. At first, the goal was to identify the performance level of Saudi students and benchmark with the international level, but then the Kingdom decided to work seriously towards reforming the problems facing education, as Saudi student made very low performance averages.

After reviewing the achievement results of fourth-grade primary students in the Kingdom of Saudi Arabia in TIMSS across all previous cycles in which the Kingdom participated in the years (2003, 2007, 2011, 2015, 2019), it was found that there is a clear deficiency in the results compared with the rest of the participating countries. Saudi students made an average performance of (410) points in 2011, (383) in 20215 and (398) in 2019; while the average performance of the U.S was (535). (IEA, 2019).

http://dx.doi.org/10.29009/ijres.5.1.3

This, in fact, raises many questions about the reasons and factors behind this apparent deficiency in students' mathematical achievement. To develop better understanding on that regard, a number of studies have examined factors that may be related to the achievement of students in the Kingdom of Saudi Arabia in TIMSS in mathematics, such as Abu Eish study (2008) which relied on (TIMSS 2003) data and aimed to identify personal, family and school factors and study habits, Jafari study (2010), which relied on (TIMSS 2007) data and aimed to identify personal and parental characteristics and study habits and benchmark them with high achievement countries; namely, Singapore and China, Al-Ghamdi study (2010), which relied on (TIMSS 2007) data, examined school characteristics and benchmark them with high achievement countries; namely, Singapore and China, Al-Hajjaji study (2012), which relied on data (TIMSS 2007) and aimed to identify teacher characteristics and benchmark them with high achievement countries; namely, Singapore and China, Dodeen and Hilal's study (Dodeen, Abdelfattah, Shmrani, Hilal, 2012), which relied on data (TIMSS 2007) and aimed to identify the impact of academic qualifications, practices and teacher beliefs and benchmark them with Taiwan, Al-Bursan and Tigza study (2012), which relied on (TIMSS 2007) data and aimed to study teachers' evaluation practices and benchmark them with South Korea, and Al-Zaid study (2020), which relied on (TIMSS 2015) data, aimed to identify the teacher characteristics and their impact on teaching practices.

In fact, mathematics teacher's characteristics and qualifications are very significant as they are one of the variables addressed by TIMSS. Al-Shamrani et al. (2016) reported on the results of the Gulf countries in TIMSS 2015, showing that the focus should be made on the quality and type of professional development programs rather than quantity to create an impact. Some studies have focused on factors that improve students' mathematical achievement. The study of Blomeke et al. (2016) found that participation in professional development programs is one of the strongest factors that impact educational quality, and that teaching experience has improved educational quality, findings were in favor of teachers with higher experience. However, teachers' education level was not significant for educational quality. The results of the Kingdom of Saudi Arabia were consistent with these findings, except for the teaching experience,

http://dx.doi.org/10.29009/ijres.5.1.3

as it did not appear to have any statistical significance on educational quality. Benavot and Romero-celis (Benavot, 2019) concluded that mathematics teachers in high and low-achieving countries do not fully implement their education according to the contents stipulated in the official curricula. As a result, educational policy makers should strengthen educational systems that enable teachers to better activate the intended mathematics curriculum, i.e., help teachers to adapt with the curriculum and students through training courses.

Several conference recommendations highlighted the following: qualifying the teacher in all disciplines in general, and mathematics teacher in particular. At the "Saudi Society for Educational and Psychological Sciences (JUSTIN) 2020" Al-Shami and Al-Ghamdi recommended to improve attracting, preparing, qualifying and developing teachers, because the teacher is the cornerstone of the educational process. There is no doubt that mathematics is a major aspect of any educational program at all levels, as it is related to human reality, future, activities, and daily life. A student who has learned mathematics can solve daily life problems, and deal with problems in other sciences. Hence, the responsibility of the teacher is to provide students with the ability to think, understand, reason and innovate (Sparks,2017).

Building up on the above, it is necessary to identify mathematics teacher characteristics and investigate the aspects that may be related to the teacher's performance. The current study targets the primary education, as it is the starting point for the next educational levels. It aims to contribute to understanding fourth grade mathematics teachers' characteristics in (TIMSS 2019) in the Kingdom of Saudi Arabia and compare the result with the United States of America, whose students have higher achievement level, to understand and address weaknesses and promote strengths in the educational process. The results of the study can provide useful suggestions and guidance for teachers and the Ministry of Education to improve mathematics teaching and learning in both countries.

http://dx.doi.org/10.29009/ijres.5.1.3

Significance of the study

Investigating primary education mathematics teacher's characteristics in Saudi Arabia and compare it with mathematics teacher in the U.S, given that teachers are one of the influential elements in the educational system, by relying on (TIMSS) data, which provides comprehensive and unique information on teacher's background. This research coincides with the eagerness of the Ministry of Education to understand the reasons behind the low achievement of students in mathematics compared to students of participating countries globally. The research contributes to clarifying the level of mathematics education and learning in the Kingdom of Saudi Arabia in a more comprehensive way, compared to the United States of America, which has achieved an advanced position in TIMSS. Moreover, the research may contribute to reconsidering some educational policies that can have an impact on students' achievement in mathematics. It can assist in evaluating the mechanism followed to recruit primary education mathematics teachers, according to their qualifications, by comparing it with the teacher in the United States of America. The results of the research may be useful for the Ministry of Education to work on addressing students' weaknesses in mathematics, as well as teachers' recruitment. Furthermore, the result may be of good use for the primary education mathematics teacher preparation programs and training departments.

Research questions

Q1: *Which one of the Teachers' Characteristics (Teachers' experience, Gender, Age, Qualifications, Major, Hours spent on professional development) has the most effect on students' mathematical achievement according to the results of TIMSS 2019 in: Saudi Arabia and USA?*

Q2: *to what extend does the mathematical achievement of fourth graders differ according to each level of their teachers' characteristics (Teachers' experience, Gender, Age, Qualifications, Major, Hours spent on professional development) according to the results of TIMSS 2019 in each of: Saudi Arabia and USA?*

http://dx.doi.org/10.29009/ijres.5.1.3

Theoretical Framework

Many psychological theories have tried to explain human behavior, as some theories are concerned with internal factors as a major determinant of behavior, while others are concerned with observable and measurable external environmental factors. One of the most interesting of these theories is the Bandura's social learning theory that is focus on human behavior. Social learning theory states that a person acquires new behavioral patterns through observation (Bandura, 1986). It is called "learning theory by modeling" and it means using a social example or model as an effective tool for learning. Generally, kids imitate others' behavior especially after watching an adult's behavior, and one of its results is that children learn social behavior such as Violence through the process of learning to observe (observing another person's behavior).

In schools, teachers play an important role that affect students' behavior. From here, we realize the importance of choosing teachers according to their personal characteristics from their experience and professional development, as they are role models in learning good direct and indirect behaviors for their students, as there is a part of observational learning that is stored in memory to be recalled when it is required to be done. Several studies emphasized the importance of teacher-related factors and their impact on student performance, whether the characteristics, traits, patterns, behaviors or attitudes of teachers (Lajos Göncz, 2017). In 2017, the Education and Training Evaluation Commission in Saudi Arabia adopted in its eleventh meeting of the first session issued in 2017 the standards and professional paths for teachers (Education and Training Evaluation Commission, 2017), which emphasized specialized standards and common general standards for mathematics teachers. The most important of which is the professional development of the teacher and his specialization, and the teacher is considered an essential factor influencing the educational process and the performance of his students. Barber and Mourshed (2007) confirms that the available data and studies confirm that teacher quality is the main driver of student education in schools, and (Hattie, 2009) suggests that the characteristics and quality of teachers are more important than any other factors and

http://dx.doi.org/10.29009/ijres.5.1.3

that they affect the performance of students than any other factors related to the curriculum, teaching methods, school environment buildings, and parental involvements in the educational process which is what the Social learning theory emphasize that teachers' behavior, opinions and experiences, are role models for students.

Literature Review

first: Studies that Investigated Variables Affecting Students' Achievement in Mathematics based on the Data of the International Assessments (TIMSS)

The study of Al-Hajjaji (2012), which aimed to compare the effect of teachers' background in high-achieving countries (China, Singapore) with Saudi Arabia in TIMSS 2007. The most prominent results were that teachers in high-achieving countries are more involved in training courses.

The study of Dodeen et al., (2012), which aimed to identify the impact of the educational qualification, practices, and beliefs of teachers in the Kingdom of Saudi Arabia and compare them with eighth grade students' achievement in Taiwan in TIMSS 2007. The result indicated that teachers' participation in professional development programs improved student grades.

Gustafsson and Nilsen (2016), studied the effect of teacher quality and school climate on the achievement of eighth grade students through the use of TIMSS2007, TIMSS2011 data, the result showed that teachers' educational level has a strong impact on student achievement, while teacher's experience and qualification had no effect on student achievement, and professional development had a positive impact on student achievement.

A study conducted by Alreshidi, A., Alharbi, M., Alshasrif, K., Kandeel, R., (N.D), which studied the effect of teachers' characteristics on student achievement in Saudi Arabia and compared the result with Singapore, the study indicated that teachers who have experience between (15-20) years and (20) years and more had a positive impact on the achievement of their students in Saudi Arabia, while in Singapore, the

http://dx.doi.org/10.29009/ijres.5.1.3

impact was in favor for teachers who had (15-20) years of experience. As for the gender variable, a positive effect was found in favor of female teachers in both countries. In their study also, the result indicated that older teachers in Saudi Arabia had more positive impact on their students' mathematical achievement compared with younger teachers, while in Singapore, younger teachers had more positive impact on their students' mathematical achievement compared with students who taught by older teachers. As for the teachers' educational level, students who studied with teachers with master's degrees had higher mathematical achievement compared with students who taught by teachers with lower degrees in both countries.

A comparative study between Singapore, Hong Kong, Japan and Saudi Arabia was conducted by Al-Harbi et al., (2020), that aimed to investigate the characteristics of mathematics teachers that affect the mathematical achievement of fourth-grade students according to the results of (TIMSS 2015), results indicated that teaching experience, teacher's educational level, and professional development had an impact on student achievement in the comparison countries. As for the gender variable, gender had an impact in favor of female teachers in both Japan and Saudi Arabia. Regarding teaching experience, the effect in Singapore was in favor of female teachers whose experience was less than (5) years and over (20) years old. As for the educational level, differences were in favor of teachers who had a master's degree and its equivalent in Japan.

Second: Studies that Address Teacher Characteristics Affecting Student Achievement.

Blank et al., (2009) conducted a study that provided information about teachers' characteristics and its impact on K-12 student achievement in studies during (1989-2007) advised by the Council of Public Schools in America, specifically Washington, where data of (94) studies were analyzed, the results indicated that student achievement was higher in favor for students who taught by teachers who received professional training in mathematics compared to students whose teachers did not participate in professional development programs, and that the effect is stronger on primary teachers

http://dx.doi.org/10.29009/ijres.5.1.3

compared to middle or secondary school teachers.

A study aimed to understand the effect of the teachers' age and gender on students' mathematical achievement in Finland, the result showed that teacher's age and gender had no effect on students' achievement (Mullola et al., 2011).

In Gonzalez & Maxwell study (2018), which aimed to identify mathematics teachers' perceptions about how their knowledge of mathematical content and qualifications affect the achievement of elementary students in South Texas, with a sample of three primary grade mathematics teachers, one mathematics facilitator, and one furth grade mathematics teacher, the result showed that teachers with stronger knowledge of the content and teacher's self-efficacy help raise students' achievement. Lee & Lee (2020) studied the relationship between teacher qualification (mathematics and science) and student educational achievement in America, findings showed that teachers' educational level and experience positively impacted students' achievement.

Methods

The research aims to reveal some of the characteristics of mathematics teachers that affected the level of student achievement. Correlational and ex-post facto designs were used in this study. In the current research, some characteristics of fourth grade mathematics teachers of primary school and students' achievement in (TIMSS 2019) were described, in order to reveal the possible causes of teacher's characteristics (teacher experience, gender, age, educational level, teachers qualification, and number of hours of professional development during the past two years) which may affect the variation in the level of mathematical achievement for fourth grade students in TIMSS (2019) in both the Kingdom of Saudi Arabia and the United States of America.

Population & Sample

The research population consisted of all fourth-grade primary students in the Kingdom of Saudi Arabia and the United States of America for the year (2019) and their mathematics teachers. IEA, in cooperation with the Canada National Statistic's Agency and the national coordinator of international assessments in each participating

http://dx.doi.org/10.29009/ijres.5.1.3

country, performs specific procedures according to Sample Selection Guide approved by IEA. Schools were first selected, and divided into groups, each with certain characteristics, in consultation between the national coordinator of each participating country and Canada National Statistic's Agency. Following that, one or more classes were selected from each school (LaRoche et al., 2020). After filtering the data by excluding the participations that include missing data for the research variables, research sample consisted of (4174) male and female fourth grade students in the Kingdom of Saudi Arabia who participated in the assessment, and their (170) male and female teachers, while the American sample amounted to (8353) male and female students, and their (451) male and female teachers. Table (1) shows research sample distribution of students and their teachers before filtering, by experience, gender, age, teacher education level, teacher qualification, and hours of professional development.

Table 1. Sample Descriptive per Variable and Level in Saudi Arabia and USA

Teacher Characteristics	Saudi Arabia				United States of America			
	Number of students	Percentage	Average	SD	Number of students	Percentage	Average	SD
Teachers' Experience								
Less than (5) years	562	13.4	389	101.4	1841	22	516	84.6
(5-9) years	568	13.6	387	92.0	1217	14.6	534	81.5
(10-14) years	859	20.6	410	98.9	1458	17.5	537	75.4
(15-19) years	842	20.2	392	93.5	1504	18	545	80.9
More than (20) years	1334	32.2	407	98.0	2333	27.9	537	81.5
Teacher Gender								
Male	2192	52.5	388	103.5	1110	13.3	526	80.8
Female	1982	47.5	413	88.4	7243	86.7	535	81.6
Teacher Age								
29 or younger	338	8.1	384	112.3	1546	18.5	527	84.5
(39-30)	1985	47.6	393	97.3	2002	24	524	84.0
(49-40)	1461	35	407	91.7	2551	30.5	544	77.7
(59-50)	390	9.3	418	100.5	1747	21	532	80.4
60 or more	0	-	-	-	507	6	548	79.0

http://dx.doi.org/10.29009/ijres.5.1.3

Teacher Characteristics	Saudi Arabia				United States of America			
	Number of students	Percentage	Average	SD	Number of students	Percentage	Average	SD
Qualification								
Did not complete high school	24	0.6	481	55.1	-	-	-	-
high school only	301	7.2	402	92.2	-	-	-	-
Teacher Training Certificate	3403	81.5	398	97.8	-	-	-	-
higher diploma	351	8.4	394	95.5	-	-	-	-
Bachelor's degree	77	1.9	469	85.7	4090	49	532	81.9
Master's degree	18	0.4	416	69.2	4202	50.3	535	81.2
Ph.D.	0	-	-	-	61	0.7	589	66.9
Major								
Major in primary education in mathematics	1287	30.8	387	97.5	920	11	542	78.7
Major in primary education in subjects other than mathematics	22	0.5	462	73.2	5900	70.6	535	81.8
Major in non-primary education in mathematics	2232	53.5	402	96.5	171	2.1	532	68.0
Others	308	7.4	417	103.8	1362	16.3	522	83.5
no formal education post-secondary study	325	7.8	408	92.3	0	-	-	-

http://dx.doi.org/10.29009/ijres.5.1.3

Teacher Characteristics	Saudi Arabia				United States of America			
	Number of students	Percentage	Average	SD	Number of students	Percentage	Average	SD
Hours Spent on Professional Development during the past two year								
More than (35) hours	1087	26	415	90.5	1363	16.3	535	83.0
(16 –35) hours	964	23.1	393	93.5	1918	23	531	79.8
(6 - 15) hours	1418	34	403	97.8	2532	30.3	531	82.8
less than 6) hours	452	10.8	377	104.5	1886	22.6	536	81.5
Non	253	6.1	378	111.1	654	7.8	541	78.7

Description of the variables

Teacher Experience: Refers to the number of teaching years described in the Teacher's Questionnaire, “By the end of this school year, how many years will you have been teaching all together?” teacher’s experience variable is denoted in the data file with the code (ATBG01).

Teacher Gender: In this study, teacher gender is recognized through teachers’ response to the following question: “Are you female or male?” The teacher’s gender variable is denoted with the code (ATBG02).

Teacher’s age: In this study, teacher age is recognized through teachers’ responses to the following question: “How old are you?” and is denoted in the data file with the code (ATBG03).

Teacher Qualification: refers to the highest educational level completed by teachers. In this study, teachers’ qualification is coded as (ATBG04).

Teacher Major: Mathematics Teacher's Questionnaire for the fourth grade of primary equation included a question of two parts: the first part addresses post-secondary major as the following: “During your post-secondary education, what was your major or main area(s) of study?”, while the second part addresses the specialization in education as follows: “If your major or main area of study was education, did you have a specialization in any of the following?” The TIMSS 2019

http://dx.doi.org/10.29009/ijres.5.1.3

User Guide for the International Database provides detailed information on how to create major variable (Fishbein et al., 2021). The major variable is denoted with the code (ATDMMEM). Following the codding system as illustrated in the Guide, (5) major categories have been developed; namely, major in primary education and mathematics, major in primary education but not in mathematics, major in mathematics but not in primary education, other majors, and no formal education post-secondary study.

Hours Spent on Professional Development during the past two years: refers to the total number of training hours received by the teacher during the past two years. Several studies revealed that there is an effect of number of hours of professional development on student mathematical achievement, such as Blank et.al study (2009). In the current study, the variable is recognized through the following question: "During the past two years, what is the total number of hours spent in in-service development, such as workshops, seminars, and others for mathematics?" The number of hours the teacher spent in training during the past two years is denoted in the data file with the code (ATBM10).

Data sources

TIMSS (2019) data was accessed via the official website of IEA, which presents achievement results of fourth-grade students in mathematics in both Saudi Arabia and United States of America along with the responses of their teachers. The variables addressed in the current study can be identified in six independent variables: (teachers' experience, gender, age, qualifications, major, and hours spend on professional development during the past two years), and one dependent variable, which is the achievement of fourth-grade students in mathematics. This variable refers to the achievement level of fourth-grade students in mathematics. TIMSS (2019) relies on the achievement of students' grades on five averages, called plausible values: PV, which were calculated by IEA Centers (Von Davier et al., 2020).

http://dx.doi.org/10.29009/ijres.5.1.3

Analysis of Results

Q1: Which one of the Teachers' Characteristics variables (Teachers' experience, Gender, Age, Qualifications, Major, Hours spent on professional development) are more able to explain the variation in the level of mathematical achievement among fourth graders according to the results of TIMSS (2019) in: Saudi Arabia and USA?

To respond to the first question, multiple regression analysis was used using IDB Analyzer. Table (2) shows the values of (Adjusted R2, B, Beta) for the two comparison countries.

Table (2). Impact of Teacher's Characteristics on Students' Mathematical Achievement

Country	Saudi Arabia		United States of America	
	B (s.e)	Beta	B (s.e)	Beta
Teacher Experience	1.6 (4.1)	0.02	4.2*(2.5)	0.08
Teacher Gender	20.03*(8.4)–	- 0.1	-8.24*(7.3)	-0.03
Teacher Age	9.44*(6.1)	0.07	- 0.53(3.3)	-0.01
Qualification	12.1*(10.3)	0.06	1.56(5.3)	0.01
Major	6.01*(5.1)	0.07	-1.91(1.93)	0.03
Hours Spent on Development	4.05(4.2)	0.05	-4.1*(3.6)	0.04
❋Significance Level less than (0.05)				
Adjusted R^2	0.03		0.01	
Constant	329.9(46.5)		556.9(31.0)	

The multiple regression analysis in Table (2) and the values of (Adjusted R2) showed that the combined characteristics of teachers explained (3%, 1%) of the variation in mathematical achievement in Saudi Arabia and America, respectively. The value of (Beta) shows that all these characteristics significantly influence mathematical achievement in at least one country. Teacher characteristics in Saudi Arabia can be

http://dx.doi.org/10.29009/ijres.5.1.3

arranged in terms of significance level according to the absolute Beta values as follows: teacher gender (0.1), noting that the negative value in (B) value means that achievement level of students who study with male teachers is less than those who study with female teachers by B value, followed by teacher's age (0.07), teacher's qualification (0.07), and finally teacher's major (0.06). These characteristics had a smaller effect compared to the influence of teacher gender.

In America the absolute Beta values can be arranged as follows: teacher's experience (0.08), hours spend on professional development during the past two years (0.04) which had a negative effect, that is, the higher the number of training hours for the teacher, the lower the students' mathematical achievement, and then teacher's gender (0.03). The negative value in the value of (B) related to the gender variable means that the achievement level of students who study with male teachers is less than those who study with female teachers. In general, the effect of each of these variables was small but statistically significant.

Q2: to what extend does the mathematical achievement of fourth graders differ according to their teachers' characteristics (Teachers' experience, Gender, Age, Qualifications, Major, Hours spent on professional development) according to the results of TIMSS (2019) in each of: Saudi Arabia and USA?

In response to the second question, various analysis such as: One Way ANOVA, Brown-Forsythe, and T-test were used for each variable and for each country separately to compare levels' effect of each of the teacher's characteristics on mathematical achievement in both Saudi Arabia and America. Table (1) shows the descriptive analysis where Tables (3, 4, 5, 6, 7, 8) show the analysis of these tests at the significance of 0.05.

I: Teacher's Experience

To determine the differences between students' achievement according to their teachers' experience, One-Way ANOVA test was used for the Saudi data, while Brown-Forsythe was used for the American data, due to the lack of the homogeneity

http://dx.doi.org/10.29009/ijres.5.1.3

assumption. As shown in table (3) and by looking to the significantly level, there are statistically significant differences between students' averages in mathematical achievement at the level ($p \leq 0.05$) in both countries attributed to their teachers' years of experience.

Table (3). significance differences of mathematical achievement according to teacher's experience

Test One Way ANOVA						
	Variance	**Total Square**	**Degree of Freedom df**	**Mean Square**	**F**	**Sig**
Saudi Arabia	Among Groups	378864.17	4	94716.043	10.068	0.000
	Within Groups	39220140	4169	9407.566		
Test Brown-Forsythe						
	F		Df1	Df2	Sig	
America	30.337		4	7783.093	0.000	

To identify these differences, (Scheffe Test) was used for Saudi Arabia data and (Games-Hoell Test) was used for the USA data. The post-hoc test showed that there were statistically significant differences between the averages of mathematical achievement according as follows: in Saudi Arabia, students whose teachers have (20) year of teaching experience or more and students whose teachers have (10-14) years of teaching experience got higher scores in mathematics compared to students on other groups.

On the other hand, in America, there was a difference in mathematical achievement in favor of students whose teachers have (20) years of experience and more compared to students whose teachers have less than (5) years of experience. Moreover, students whose teachers have (15-19) years of experience received higher scores in mathematics compared to students whose teachers have experience of (10-14) years, (5-9) years, and (5) years and less. Also, students whose teachers' have (5-9) years of experience got higher mathematical scores compared with students whose teachers' have 5 years of experience or less.

http://dx.doi.org/10.29009/ijres.5.1.3

II: Teacher's Gender

To identify the difference between students' mathematical achievement according to their teachers' gender, a (T-test) was used after verifying the homogeneity condition using the Levene test. The results in Table (4), indicate that there is a difference in students' mathematical achievement attributed to the gender of their teachers, in favor of students taught by female teachers in both countries.

Table (4). differences of students' mathematical achievement according to teacher's gender.

Country	Teacher's Gender	Student Number	Achievement Average	Standard Deviation	Levene Test	T Value	Sig
Saudi Arabia	Male	2192	388	103.5	(66.5)0.00	8.464	0.000
	Female	1982	413	88.4			
USA	Male	1110	526	80.8	(0.2)0.655	3.349	0.001
	Female	7243	535	81.6			

III: Age

To identify the differences between students' mathematical achievement, students were classified based on their teachers' ages to different groups and then (Brown-Forsythe) test was used. As shown in Table (5), there were statistically significant differences between students' mathematical achievement attributed to their teachers' age in both.

Table (5). differences between students' mathematical achievement according to teacher's age

Test Brown-Forsythe				
Country	Value F	Df1	Df2	sig
Saudi Arabia	11.735	3	150.960	0.000
USA	24.195	4	5505.664	0.000

Games-Hoell test showed that the differences were in favor of students who were taught by older teachers in both countries. In America, it was found that the differences were statistically significant in favor of students whose teachers aged 60

http://dx.doi.org/10.29009/ijres.5.1.3

years and over when compared with other students whose teachers aged (59-50) years, (39-30) years and 29 years and younger. The differences were significant in both Saudi Arabia and America in favor of students whose teachers are between (49-40) years old compared with the average achievement of students whose teachers are between (39-30) years, and 29 years and younger.

IV: Teacher's Qualification:

To identify the differences between the averages of mathematical achievement for students in both countries according to their teachers' qualification, students were classified based on their teachers' qualification and then Brown-Forsythe test was used in Saudi data because the homogeneity assumption was not met, while One -way ANOVA test was used for the American data. Table (6) shows that there were statistically significant differences in students' mathematical achievement attributed to their teachers' qualification.

Table (6). differences of students' mathematical achievement according to teacher's Qualification

Test Brown-Forsythe						
	Value F		Df1	Df2	Sig	
Saudi Arabia	17.115		5	385.529	0.000	
Test One Way ANOVA						
	Variance Source	**Total Square**	**Degree of Freedom**	**Mean Square**	**F**	**Sig**
USA	Among groups	207072.169	2	103536.085	15.591	0.000
	Within groups	55450259.84	8350	6640.750		

Scheffe and Games-Hoell tests were used according to the result of the homogeneity assumption. In Saudi Arabia, there was statistically significant differences between students whose teachers' hold master degrees and the average achievement of students whose teachers (did not complete post-secondary) in favor of students (whose teachers did not complete post-secondary study). There were differences also in favor

http://dx.doi.org/10.29009/ijres.5.1.3

of students whose teachers (did not complete post-secondary study) compared with students whose teachers hold the following qualifications: (higher diploma certificate, teacher training certificate, post-secondary study certificate only). While in America the result showed that there were statistically significant differences between the average of mathematical achievement of students whose teachers hold doctorate degrees and students whose teachers hold master degrees as well as bachelor's degrees. Differences were in favor of students whose teachers hold doctorate degrees.

V: Major

In order to identify the differences between the averages of students' mathematical achievement based on their teachers' major, students were classified into different groups according to their teachers' Major, and then Brown-Forsythe test was used for the American data due to the lack of the homogeneity assumption, while ANOVA was used for the Saudi data. Table (7) shows that there are statistically significant differences between the averages of students' mathematical achievement attributed to their teachers' major in both countries.

Table (7). differences of students' mathematical achievement according to teacher's major

Test One Way ANOVA						
	Variance	Total Square	Degree of Freedom df	Mean Square	F	Sig
Saudi Arabia	Among groups	409208.938	4	102302.234	10.883	0.000
	Within groups	39189796.21	4169	940.287		
Test Brown-Forsythe						
	Value F		Df1	Df2	sig	
USA	14.981		3	1771.071	0.000	

In Saudi Arabia, Scheffe test indicated that students whose teachers majored in (educational major in mathematics) gain lower grades in mathematical achievement compared to students whose teachers majored in: (educational major in non-mathematics), (mathematics but non-educational), (other major), (there is no formal

http://dx.doi.org/10.29009/ijres.5.1.3

education post-secondary study). While in America, Games-Hoell test showed that students whose teachers have (other majors) got the lowest grades compared with students in other groups.

VI: Hours Spent on Professional Development during the past Two Years:

To determine the differences between the averages of students' mathematical achievement based on their teachers' professional development, students were classified into different groups based on the number of hours spent on professional development by their teachers. Table (8) shows statistically significant differences between students' mathematical achievement attributed to their teachers' professional development in both countries.

Table (8). Students' mathematical achievement attributed to teachers' professional development

Test Brown-Forsythe						
	Value F		Df1	Df2	sig	
Saudi Arabia	16.239		4	1916.778	0.000	
Test One Way ANOVA						
	Variance	Total Square	Degree of Freedom	Mean Square	F	Sig
USA	Among groups	75704.055	4	18926.014	2.843	0.023
	Within groups	55581627.96	8348	6658.077		

Different post-hoc tests were used according to the significance level of the homogeneity. In Saudi Arabia, the results of (Tukey) and (LSD) tests showed statistically significant differences between the average of students' achievement whose teachers received (more than 35 hours) in professional development, and the average achievement of students whose teachers received professional development hours, as follows: (6-15) hours training, less than (6 hours), and (none). The difference was in favor of students whose teachers received more than (35) hours in professional development. Also, students whose teachers received (6-15) hours of professional development got higher grades in mathematics compared to students whose teachers

http://dx.doi.org/10.29009/ijres.5.1.3

received less than 6 hours and (none). However, in America, students whose teachers did not receive any hours of training in professional development achieved higher grades in mathematics compared to students whose teachers received (16-35) hours of training, and (6-15) hours of training.

Discussion

The results showed a significant effect of the overall teachers' characteristics on the mathematical achievement of fourth-grade students in both Saudi Arabia and America, but it is relatively small in America, compared to Saudi Arabia and statistically significant at the level ($p \leq 0.05$). Overall, the results of the multiple regression were consistent in Saudi Arabia and America regarding the effect of teachers' gender on student achievement, but differed in the rest of the characteristics, as the results in Saudi Arabia showed that there was no effect of teacher's experience and hours spent on professional development programs. This is, in fact, is consistent with the following studies: Al-Zayd study (2020), whose results showed that the effect of teacher's experience in Saudi Arabia according to the results of TIMSS (2015) on teaching practices was weak. Also, Alharbi et al., (2020), indicated that there was no effect of teacher's experience on students' achievement in Saudi Arabia and Hong Kong (Ababneh, 2019; Harris & Sass, 2011; and Loyalka et.al, 2019). On the other hand, results of America showed that there was no effect of teacher's age, qualification, and major. This is consistent with Mullola et.al. study (2011), which showed that the teacher's age variable had no effect on students' achievement. As for teacher's major, results consist with Ababneh study (2019) and Harris & Sass (2011), which indicated that there was no effect on student achievement. Moreover, teacher qualification variable has no effect on students' mathematical achievement. This is consistent with the study of Gustafsson & Nilsen (2016) conducted on (38) participating countries on TIMSS (2007), TIMSS (2011).

As for teachers' experience, the result of ANOVA in Saudi Arabia showed that students whose teachers have experience of (10-14) years and (20 years or more) achieved the highest compared to students whose teachers have other experiences. This

http://dx.doi.org/10.29009/ijres.5.1.3

can be attributed to the fact that this phase is a dividing line between fresh graduated teachers and teachers with longer experience. This is confirmed by the study of Blömeke et al., (2016), which showed that student achievement is affected by teachers with higher experience, and the study of Al-Salihi (2013), which showed that more experienced teachers have a higher level of self-efficacy in teaching compared to less experienced teachers. This is also consistent with the study of Alreshidi et al., (ND), which was conducted on TIMSS (2015), and revealed that teachers with more experience (20 years or more) have a positive impact on the achievement of their students in Saudi Arabia and Singapore.

In America, the result showed that the mathematical achievement of students whose teachers have experience of (20 years or more) was higher compared to students whose teachers have less than (5) years of experience. The results also showed that the achievement of the American students whose teachers have experience of (15-19) years was the highest compared to the achievement of students whose teachers have experience of (10-14) years, (5-9) years and less than (5) years. Moreover, results showed that the achievement of students whose teachers have experience of (10-14) years, and (5- 9) years was significantly higher than the average achievement of students whose teachers have less than (5) years of experience. The results of this study are in consistent with the results of Alreshidi et al., (ND) and Blömeke et al., (2016), which showed that student achievement is affected by teachers with higher experience, as well as the study of Al-Salihi (2013), which revealed that more experienced teachers have a higher level of self-efficacy in teaching compared to less experienced teachers. Furthermore, the results of this study consist with Alharbi et al., (2012), which revealed that the effect in Singapore was in favor of female teachers whose experience is more than (20) years, while they differ with the following studies: Al-Zayd (2020) in Saudi Arabia, Harris & Sass (2011) in Florida, and Staiger & Rockoff (2010) in Los Angeles and New York, which confirmed that the effect of teacher's experience variable is in favor of less experienced teachers, and that the effect is strong in the teacher's early years.

http://dx.doi.org/10.29009/ijres.5.1.3

As for the effect of teachers' gender, the results of the t-test showed that there were statistically significant differences between students attributed to their teachers' gender, in favor to students who taught by female teachers in both countries. This is consistent with the following studies:(Ababneh, 2019; Al-Zaid, 2020) which conducted in Jordan and Saudi Arabia, respectively. This can be attributed to teacher's job which may not meet male teachers' aspirations, but it does fulfill the female teachers' aspirations, which is reflected in their seriousness (Al-Bursan et al., 2015). In addition, female teachers tend to be keener to offer adequate support, provide a positive academic environment, and motivate students (Alharbi et al., 2020). This is also, consist with Alreshidi et al., study (ND), which was conducted on (TIMSS 2015) data and showed that there were differences in favor of female teachers in Saudi Arabia and Singapore. On the hand, this result differs with studies of Driessen, (2007); Mullola et.al. (2011); Odiembo & Simatwa (2014) which conducted in the Netherlands, Finland and Kenya, respectively, which found that the gender of teacher has no effect on students' mathematical achievement.

As for the teacher's age variable, the results showed that there were differences between the averages of students' achievement that attributed to their teachers' age, as the following: in Saudi Arabia and America, the differences were in favor of students whose teachers aged between (50-59) years when compared to students whose teachers aged between (30-39) years, as well as less than (29) years. It was found in America that the differences were statistically significant in favor of students whose teachers aged 60 years and over, when compared with students whose teachers aged between (59-50) years old, (39-30) years (29) years old and younger. The differences were significant in both Saudi Arabia and America in favor of students whose teachers are between (49-40) years old when compared to students whose teachers are between (39-30) years, (29) years and younger. This means that older teachers influence students' achievement. This is consistent with the study of Alreshidi et al., (ND) which conducted on TIMSS (2015), the research showed that older teachers positively affect student achievement in Saudi Arabia. Such result can be explained by the fact that older teachers are more patient and tend to treat students like their own children, which

http://dx.doi.org/10.29009/ijres.5.1.3

contributes to higher achievement. Also, there was no statistically significant difference in both countries between students whose teachers aged between (39-30) years (29) years and younger. This result is consistent with Mullola et.al. study (2011), which showed that there is no relationship between teacher's age and student achievement in Finland, and the study of Odiembo & Simatwa (2014) who highlighted that the age of mathematics teachers has a slight impact on the achievement of students in Kenya.

Considering teacher' qualification, the results of the current research in Saudi Arabia found that there are statistically significant differences in mathematics achievement in favor of students whose teachers did not complete post-secondary study when compared to students whose teachers hold: (Master's degree, higher diploma, teacher training certificate, post-secondary study certificate). In fact, this result may be affected by the groups size, as the percentage of the number of students whose teachers did not complete post-secondary school was (0.5%). This result can also be attributed to the fact that teaching fourth grade of primary school does not require higher education degrees compared to educational degrees required by middle or secondary grades. There were also statistically significant differences in mathematical achievement in favor of students whose teachers hold Bachelor's degree compared to students whose teachers hold: (Higher Diploma, teacher training certificate, post-secondary study certificate only). This is consistent with studies of Lee & Lee (2020) conducted in America and Gustafsson & Nilsen (2016) conducted in 38 countries participating in the study (TIMSS2007, TIMSS2011), which, in return, found that students who were taught by teachers with higher levels of education were more likely to obtain higher educational degrees. Nevertheless, these results differ with the study of Harris & Sass (2011); and Ababneh, (2019), which revealed that there is no relationship between students' achievement and teacher qualification, which was conducted in Florida and Jordan, respectively. In America on the other hand, the result shows that there were statistically significant differences in mathematical achievement in favor of students whose teachers hold a doctorate degree when compared to students whose teachers hold a master's degree, or a bachelor's degree. This result can be attributed to the percentage of the number of students whose teachers hold a doctorate

http://dx.doi.org/10.29009/ijres.5.1.3

degree (1%), as it is very low compared to the other groups. Moreover, this result is consistent with the study of Lee & Lee (2020); Gustafsson & Nilsen (2016) which confirmed that Students whose teachers have higher qualification were more likely to have higher educational degrees, and the study of Alreshidi et al. (ND) conducted on TIMSS (2015) in Singapore which showed that students whose teachers hold a master's degree has higher achievement than students whose teachers hold lower degrees. Moreover, the results showed that there were no differences between the average achievement of students whose teachers hold a master's degree and the average achievement of students whose teachers hold a bachelor's degree. This result is consistent with the study of Harris & Sass (2011); and Ababneh, (2019) which found that there was no relationship between students' achievement and their teachers' qualification.

As for teachers' major, the results of the current study found that in Saudi Arabia, students whose teachers hold the following majors (primary education but non-mathematics, mathematics and non-primary education, other majors, no formal post-secondary study) achieved higher grades in mathematics compared to students whose teachers are specialized in primary education in mathematics This can be attributed to the fact that training offered in educational colleges majored in mathematics is restricted to middle and secondary school rather than primary. It can be due to the nature of the mathematics content for the fourth grade of primary school, which allows teachers to teach it without considering their majors (Alharbi et al., 2020). Such finding was indicated by many studies that found weak or inconsistent relationships between teachers' major and student achievement such as the study of Harris & Sass (2011), which concluded that there is no evidence that teacher major has an impact on student achievement in Florida. The same is consistent with the study of Gustafsson & Nilsen (2016) conducted on 38 countries in TIMSS (2007), TIMSS (2011). It was concluded that teacher's major had no effect on the students' achievement. This is in consistent with the study of Blömeke et al., (2016) that was conducted on (47) countries, including the Kingdom of Saudi Arabia, and concluded that teachers' major did not predict students achievement, and the study of Al-Zayd (2020) which revealed that there was

http://dx.doi.org/10.29009/ijres.5.1.3

no effect of teachers' majors in all teaching practices in Saudi Arabia, and the study of Alreshidi et al., (ND) which was conducted on TIMSS (2015) data, and showed that there was no difference in the achievement of students whose teachers have major in mathematics and primary education in Saudi Arabia. The result also showed that students whose teachers majored in primary education and non-mathematics achieved higher grades in mathematics achievement compared to students whose teachers have major in mathematics but non primary education, which is consistent with the two studies of Oduh & Okanigbuan (2014); and Alharbi et al., (2020) which confirmed the impact of teachers who have major in primary education on student achievement. On the other hand, results in America showed that (students whose teachers majored in primary education in mathematics) and (students' whose teachers majored in primary education but not in mathematics) achieved higher scores compared to (students whose teachers had other majors). This result is consistent with the study of Oduh & Okanigbuan (2014), which confirmed the effect of teachers majored in primary education compared to other majors in Nigeria, and the study of Alharbi et al., (2020) which found that the teacher in Hong Kong majored in primary education affects student achievement.

Regarding teachers' professional development, the results in Saudi Arabia found that students whose teachers received more than 35 hours of training achieved higher scores in mathematics compared with students whose teachers received the following training hours: (6-15) training hours, less than (6) training hours, and (none). Also, the results showed that (students whose teachers received (16-35) training hours) and (students whose teachers received (6-15) training hours) achieved higher mathematical scores compared to (students whose teachers received less than (6) hours of training). It is clear that participation in professional development for Saudi teachers influenced student achievement. Results of this study is fully consistent with the findings of Alreshidi et al. study (ND); Al-Zayd (2020), which found that the average achievement of students whose teachers received more than 35 hours of training in Saudi Arabia was higher than others. This result is also consistent with what was revealed by the study of Al-Hajaji, (2012), which found that teachers in China and Singapore are more involved

http://dx.doi.org/10.29009/ijres.5.1.3

in training courses, the study of Dodeen et al. ., (2012) which found that the majority of Taiwanese teachers participating in professional development programs were able to improve students' grades, the study of Gustafsson & Nilsen (2016) which showed that professional development had a positive impact on student achievement in (38) countries participating in TIMSS (2007); TIMSS (2011), and the study of Blömeke et al.,(2016) which highlighted that participation in professional development programs is one of the strongest factors affecting educational quality in (47) countries including the Kingdom of Saudi Arabia. This is also consistent with the following study: Alharbi et al., (2020), which found that professional development had positive impact in favor of Hong Kong teachers and Chinese teachers, Blank et.al. (2009) conducted in Washington, which revealed that the average achievement of students whose teachers receive professional training in mathematics is higher compared to students whose teachers did not participate in professional development programs, and that the effect was strongest in primary teachers, compared to middle or high school teachers, Swinton et.al. (2010) which found a strong and positive effect on student test scores once their teachers attended three workshops in Georgia, and Oduh & Okanigbuan, (2014), which found that vocational training has a positive effect, and emphasized on the importance of recruiting trained teachers, regardless of their qualifications in Nigeria.

With regard to America, the comparisons showed a different direction were students whose teachers did not receive any training hours achieved higher scores compared to students whose teachers received (6-35) training hours. This is fully consistent with the following studies: Harris & Sass (2011), which found that professional development has a weak impact on student achievement and that there is no consistent relationship between professional development and student achievement in Florida, Loyalka et.al. (2019), which revealed that teachers who have joined professional development programs had no significant impact on student achievement in China. Also, Ababneh (2019), found no effect of hours spent on professional development during the past two years on student achievement in Jordan. This may be due to the fact that teaching profession programs in America are of high quality, as teachers do not need more training, and this training may waste teachers' time, which

http://dx.doi.org/10.29009/ijres.5.1.3

negatively affects the quality of their education, the achievement of their students, or that the training is weak, and do not meet the needs of teachers.

Conclusion

The research concluded with a set of results, the most important of which is that teacher's gender, age, qualification, and major are important variables, and have a significant impact on the mathematical achievement of fourth-grade students in Saudi Arabia. Moreover, years of experience, number of hours spent on professional development in the past two years, and teacher's gender have a significant effect on the mathematical achievement of students in America. The result of this paper suggests the following: first, when recruiting teachers, considerations should be given to their characteristics. Second, the results showed a statistically significant differences between students' mathematical achievement attributed to their teachers' experience in favor of students whose teachers have more than (20) years of experience in Saudi Arabia. Therefore, teachers with higher experience should not be underestimated by transferring their work to administrative or supervisory work instead of teaching. Rather, it is advised to utilize and value their experience, as the current research has showed that teacher's experience affects students' achievement positively. Third, results showed statistically significant differences between students' mathematical achievement regarding teachers' gender. These differences were in favor of students who were taught by female teachers in both countries. Accordingly, the mathematical achievement gap between males and females in Saudi Arabia should be bridged by comparing male and female teachers and identifying their weaknesses. Fourth, there were statistically significant differences between students' mathematical achievement attributed to their teachers' age in favor of students whose teachers' ages range between (50-59) and (40-49) years in Saudi Arabia. On the other hand, in America, students whose teachers aged (60) years and above performed better in general. Therefore, older teachers should remain in teaching without assigning them to administrative tasks as their experiences increase with their ages. Fifth, as discussed earlier, there were statistically significant differences between students' mathematical achievement

http://dx.doi.org/10.29009/ijres.5.1.3

attributed to their teachers' majors, therefore, there is a need to re-evaluate the current teachers' programs established in colleges of education, and to consider teachers' educational and scientific majors in Saudi Arabia. Finally, students whose teachers received more than (35) hours of training in Saudi Arabia achieved higher grades in the mathematics compared with their peers, while in America, differences were in favor of students whose teachers have never received any training. Therefore, it is recommended to continue the application of professional development programs established in the past two years, as the results showed that they are among the factors affecting student achievement in Saudi Arabia.

http://dx.doi.org/10.29009/ijres.5.1.3

References

Abu Eish, Basina (2008). Factors related to the variation in the achievement of second-grade students in mathematics and sciences in the Kingdom of Saudi Arabia in the light of the results of the International Trends in Mathematics and Science TIMSS-2003 (unpublished doctoral thesis). Umm Al Qura University. Makkah. (Translated from Arabic)

Al-Bursan, Ismail. and Taghza, M (2012). Evaluative practices of mathematics teachers of the Saudi sample and mathematics teachers of the South Korean sample in the TIMSS 2007 test, a comparative study. Thesis on Education and Psychology, King Saud University, Riyadh, (39), 25-53. (Translated from Arabic)

Al-Hajjaji, Aisha (2012). Teacher characteristics in high-achieving countries (Singapore - China) and low-achieving countries (Saudi Arabia) in TIMSS 2007 (unpublished master's thesis). Umm Al Qura University. Makkah. (Translated from Arabic)

Al-Zaid, Nada (2020). Teaching practices of mathematics teachers and their relationship to the mathematical achievement of fourth grade students in the light of (TIMSS 2015) tests (unpublished master's thesis). King Saud University. Riyadh. (Tranlated from Arabic)

Shami, Ghada. And Al-Ghamdi, Dhaif Allah (3/5/2020). A proposed strategy for teacher preparation to support technological innovation activities and enhance the digital economy in light of the Kingdom's 2030 vision. Research presented at the nineteenth conference of the Saudi Association for Educational and Psychological Sciences (Justin) 2020.

Al-Shamrani, Saleh bin Alwan. And Alshamrani, Saeed bin Mohammed. And Al-Bursan, Ismail bin Salama. And Al-Darwani, Bakeel bin Ahmed (2016). Highlights on the results of the Gulf countries in the study of international trends in science and mathematics (TIMSS 2015). Center

http://dx.doi.org/10.29009/ijres.5.1.3

for Research Excellence in Science and Mathematics Education Development. King Saud University.

Ababneh, Imad (2019). The achievement of Jordanian students in mathematics in the TIMES study and its relationship to some variables. Journal of Educational Sciences Studies at the University of Jordan, 46 (1), 721-735.

Al-Ghamdi, Hanan (2010). School characteristics in high-achieving (China and Singapore) and low-achieving (Saudi Arabia) countries in the TIMSS-2007 (unpublished master's thesis). Umm Al Qura University. Makkah.

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, 101671.

Alreshidi, A., Alharbi, M., Alshasrif, K., Kandeel, R., (N.D**) .**The impact of teachers' characteristics on students' achievement: A comparison of TIMSS 2015 results in Saudi Arabia and Singapore. Unpublished Study.

Bandura, A. (1986). Social foundations of thought and action: A social-cognitive theory. Englewood Cliffs, NJ: Prentice Hall.

Barber, M., and M. Mourshed. (2007). How the world's best-performing schools come out on top. London: McKinsey.

Benavot. A., Romero-Celis, T. (2019). Promoting Effective Mathematics Teaching Analyzing Teacher Enactment of Grade 8 Mathematics Curricula Using TIMSS Data. Policy Brief No. 6. International Association for the Evaluation of Educational Achievement. https://www.iea.nl/publications/series-journals/iea-compass-briefs-education-series/june-2019-promoting-effective

http://dx.doi.org/10.29009/ijres.5.1.3

Blank, R. K., & de Las Alas, N. (2009). Effects of teacher professional development on gains in student achievement. Washington, DC: Council of Chief State School Officers. https://eric.ed.gov/?id=ED544700

Blömeke, S., Olsen, R. V., & Suhl, U. (2016). Relation of student achievement to the quality of their teachers and instructional quality. Teacher quality, instructional quality and student outcomes, 2, 21-50. https://www.researchgate.net/publication/308342612_Relation_of_Student_Achievement_to_the_Quality_of_Their_Teachers_and_Instructional_Quality

Centre public education (2008). U.S students make significant gains on assessments. https://nces.ed.gov/

Driessen, G. (2007). The feminization of primary education: effects of teachers' sex on pupil achievement, attitudes and behaviour. International Review of Education, 53(2), 183-203.

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://squ.pure.elsevier.com/en/publications/the-effects-of-teachers-qualifications-practices-and-perceptions-

Education & Training Evaluation Commission. (2017). Standards and Professional Paths for Teachers in the Kingdom of Saudi Arabia. Education & Training Evaluation Commission. (In Arabic) https://etec.gov.sa/AR/PRODUCTSANDSERVICES/QIYAS/PROFESSION/TEACHERSLICENSURE/Pages/default.aspx

http://dx.doi.org/10.29009/ijres.5.1.3

Fung, D., Kutnick, P., Mok, I., Leung, F., Lee, B., Mai, Y., et al. (2017). Relationships between teachers' background, their subject knowledge and pedagogic efficacy، and pupil achievement in primary school mathematics in Hong Kong: An indicative study. International Journal of Educational Research, 81, 119–130.

Gonzalez, K., & Maxwell, G. M. (2018). Mathematics Teachers' Efficacy, Experience, Certification and Their Impact on Student Achievement. Journal of Instructional Pedagogies, 21.

https://eric.ed.gov/?id=EJ1194245

Gustafsson, J. E., & Nilsen, T. (2016). The impact of school climate and teacher quality on mathematics achievement: A difference-in-differences approach. Teacher quality, instructional quality, and student outcomes, 2, 81–95.

Harris, D. N., & Sass, T. R. (2011). Teacher training, teacher quality, and student achievement. Journal of Public Economics, 95(7–8), 798–812.

Hattie, J. (2009). Visible Learning. A synthesis of over 800 meta-analyses relating to achievement. London: Routledge.

Lajos Göncz (2017) Teacher personality: a review of psychological research and guidelines for a more comprehensive theory in educational psychology, Open Review of Educational Research, 4:1, 75-95, DOI: 10.1080/23265507.2017.1339572

LaRoche, S., Joncas, M., & Foy, P. (2020). Sample design in TIMSS 2019. In M. O. Martin, M. von Davier, & I. V. S. Mullis (Eds.), Methods and Procedures: TIMSS 2019 Technical Report (pp. 3.1-3.33). Retrieved from Boston College, TIMSS & PIRLS International Study Center website: https://timssandpirls.bc.edu/timss2019/methods/chapter-3.html

http://dx.doi.org/10.29009/ijres.5.1.3

Lee, S. W., & Lee, E. A. (2020). Teacher qualification matters: The association between cumulative teacher qualification and students' educational attainment. International Journal of Educational Development, 77, 102218.

Loyalka, P., Popova, A., Li, G., & Shi, Z. (2019). Does teacher training actually work? Evidence from a large-scale randomized evaluation of a national teacher training program. American Economic Journal: Applied Economics, 11(3),128-54. https://www.aeaweb.org/articles?id=10.1257/app.20170226

Mullola, S., Jokela, M., Ravaja, N., Lipsanen, J., Hintsanen, M., Alatupa, S., & Keltikangas-Järvinen, L. (2011). Associations of student temperament and educational competence with academic achievement: The role of teacher age and teacher and student gender. Teaching and Teacher Education, 27(5), 942-951.

Odiembo, E. J. A., & Simatwa, E. M. W. (2014). The relationship between secondary school mathematics teacher age, gender and student's academic achievement in mathematics in Kenya: A case study of Muhoroni Sub County. Educational Research, 5(7), 225-240. https://www.semanticscholar.org/paper/The-Relationship-between-Secondary-School-Teacher-A-Odiembo-Simatwa/c01095125adc3ca393cf5c665300c72448de9922

Oduh, W. A., & Okanigbuan, P. N. (2014). Relationship between teachers' qualification and students' performance in mathematics among students of private secondary schools in Ikpoba-Okha Local Government Area of Edo State, Nigeria. Journal of Emerging Trends in Educational Research and Policy Studies, 5(4), 416-422. on Assessments https://nces.ed.gov/timss/results07_math95.asp

http://dx.doi.org/10.29009/ijres.5.1.3

Sparks, S. (2017, May 9). Do parents see math as 'less useful' than reading? Education Week،36(30),9. https://link.springer.com/chapter/10.1007/978-3-030-16151-4_1

Staiger, D., & Rockoff, J. (2010). Searching for effective teachers with imperfect information. Journal of Economic Perspectives, 24(3), 97–118**.**

Statistics Canada (IEA) (2019). Trends in the Study of International Mathematics and Science: TIMSS. Retrieved on March 18, 2020 from the link:

https://timssandpirls.bc.edu/timss2019/frameworks/framework-chapters/assessment-design/student-booklet-design

Swinton, J.; Thomas, B.; Benjamin, S. & Howard, C. (2010). Does In-Service Professional Learning for High School Economic Teachers Improve Student Achievement. Education Economics, 18(4), 395- 406.

Von Davier, M., Foy, P., Martin, M. O., & Mullis, I. V. S. (2020). Examining eTIMSS country differences between eTIMSS data and bridge Data: A look at country-level mode of administration effects. In M. O. Martin, M. von Davier, & I. V. S. Mullis (Eds.), Methods and Procedures: TIMSS 2019 Technical Report (pp. 13.1-13.24). Retrieved from Boston College, TIMSS & PIRLS International Study Center website: https://timssandpirls.bc.edu/timss2019/methods/chapter-13.html

http://dx.doi.org/10.29009/ijres.5.1.3