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The Effects of Teachers', Parents', and Students' Attitudes and Behavior on 4th and 8th Graders' Science/math Achievements: A model of School Leaders' Perspectives

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Abstract: The study provided a multi-group structural equation model (SEM) of school leaderships' views of teachers', parents', and students' characteristics related to students' performances in TIMSS 2015 science and math assessment for 4th and 8th grade students in the United Arab Emirates (UAE). For both student groups, school questionnaire items concerning school leaders' perception of teachers, parents, and students were used for the analysis (13 items). The analysis employed exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to construct the models. Both models provided acceptable fit statistics with several, but different significant paths. The SEM models of both Grade 4 and Grade 8 students almost replicated each other. Results pointed to the significance of attitudes and behavior of teachers, parents, and students. There were significant paths from teachers to students, from parents to both students and TIMSS scores, and from students to TIMSS scores. The direct impact of the parent construct on TIMSS scores was elaborated carefully. Implications of the study were addressed along with future research directions.

Keywords: TIMSS, Achievement, Parental attitude, Teacher attitude, Student attitude, UAE

Introduction

The school education system in the UAE is made up of public and private schools. On the one hand, the public school system is characterized by a highly centralized educational system and often there is a great deal of educational uniformity in terms of regulations, curriculum, textbooks, and general policies. The private school system, on the other hand, is characterized by more decentralized systems in which many important decisions are left to the schools in light of some general policies issued by the government bodies. This decentralized structure of private schools has led to greater variation in schools' climate, operations, student learning, teacher recruitment, student attachment, and academic outcomes.

Schools in the UAE are regulated and monitored by some government entities such as the Ministry of Education (MoE), the Abu Dhabi Education Council (ADEC), and the Knowledge and Human Development Authority (KHDA). Given that these government entities are responsible for the policies and regulations, and school resources and management, curriculum design and development for the public schools in particular, they have significant influence on the outcomes of the schools within their plans, support and strategic initiatives, and therefore they are responsible in one way or another for the outcomes of students' national and international

achievement in the country. Thus, understanding what factors affect the performance of students in national and international assessment is high on the agenda of these authorities.

Currently, there are several studies and reports within the UAE seeking to explain the factors necessary to produce outstanding schools with high student achievement in both national and international assessments. Of the factors highlighted in these studies are parental involvement (Badri, Al Mazroui, Al Rashedi & Yang, 2016), teacher satisfaction (Badri, Mohaidat, Ferrandino, & El Mourad, 2013), school climate (Badri & Muhaidat, 2014), students' interest and motivation (Badri, Al Rashedi, Yang, Mohaidat, & Al Hammadi, 2016), curriculum and other factors (Badri, Al Qubaisi, Al Rashedi, & Yang, 2014).

Internationally, research also generally shows the role of parental involvement (Chao, 2000; Fan, 2001; Fan & Chen, 2001; Hong & Ho, 2005; Papanastasiou, 2002), teachers and teaching practices (Kingdon & Teal, 2010), and student attitudes toward education (Erdogan, Bayram, & Deniz, 2008; Konting, 1990; Lee & Malik, 2015) in shaping the educational aspirations and achievements of young children. However, it should be noted that some analysts criticize that previous research tends to focus on the determinants of school academic achievement independently considering isolated variables or factors without looking at the structural links that might exist (Kocakaya & Kocakaya, 2015; Papanastasiou, 2002), although there are a few empirical studies that try to link several factors when ascertaining the science and mathematics achievements of students (Kung & Lee, 2016; Pullmann & Allik, 2008).

The general framework of TIMSS is built on the principle that understanding how to improve student achievement and learning in mathematics and science is important for educational policy makers, school leaders, teachers, and parents (TIMSS, 2015). The TIMSS 2015 project collected extensive information from school leaders on how they perceived their own school teachers, school children, and their parents. For school policy makers, as well as for teachers, the wealth of such information could provide valuable resources for them to implement the school's curriculum, collaborate and work together to improve student achievement, understand the school's curricular goals and their ability to inspire students (Marzano, 2003). With regard to parents, TIMSS 2015 covered many important parental and home issues including support for student achievement, commitment to ensure that students are ready to learn, expectations for student achievement, pressure for the school to maintain high academic standards, and involvement in school activities. With regard to students, the school questionnaire asked school leaders to provide their judgment on their students' attitudes. Those items were related to students' desire to do well in school, students' ability to reach school's academic goals, and students' respect for classmates who excel in school. As such, TIMSS 2015 provides an ideal dataset to examine the structural links between and among the factors of schools, parents, teachers, and students.

This study aims to use the UAE's data for 4^{th} and 8^{th} Grade schools to advance research on the effects of structural conceptualization of parental involvement, students' features, and teachers' features on students' science and mathematics achievement. It is not the intention of this study to compare student achievements across grade 4 and grade 8 since there are differences in many important settings and variables. We assume comparing those contributing factors across age groups is not feasible as it is probably not possible to isolate the differences in teacher quality, in student characteristics, and in other classroom and school inputs/features.

Literature Review

Parental involvement is seen as a cultural conception of parental duties and responsibilities that influence children's academic achievement significantly (Hong & Ho, 2005; Ho, Chen, Tran, & Ko, 2010). Both Chao (2000) and Wong-Lo & Bai (2013) point out that in most academically-oriented societies, parental involvement focuses mainly attitudes and academic beliefs and expectations. Both studies argue that direct parental involvement and instruction, and indirect home structure for supporting learning and provision of resources significantly affect and improve children's school performance. Jeynes (2007) also notes that parental involvement could include parental aspirations and expectations for children's education, the communication with children about school-related matters, supervision, and more active participation in school activities. Other researchers add that parents have the role to talk to their children about the value of education and its impact on their occupational expectations, help their children to better understand the linkages between what they learn at school and the real world (Hill & Tyson, 2009; Hong & Ho, 2005; Taylor, Clayton, & Rowley, 2004; Hornby, & Lafaele, 2011). Hong & Ho (2005) stress that from a cultural perspective, a more precise and differentiated understanding of the construct of parental involvement is needed.

The multiple aspects associated with parent involvement and participation are dealt with by many studies (Chen & Gregory, 2010; Somers, Chiodo, Yoon, Ratner, Barton, & Delaney-Black, 2011; Strayhorn, 2010; Trask-Tate & Cunningham, 2010). Many empirical research examines effective programs aimed at fomenting parental involvement (Jeynes, 2010; LaRocque, Kleiman, & Darling, 2011; Mattingly, Prislin, McKenzie, Rodriguez, & Kayzar, 2002). Some studies suggest the most effective types of parental involvement and participation (Park, Byun, & Kim, 2011; Pomerantz, Moorman, & Litwack, 2007). For example, George & Kaplan (1998) stresses that the effectiveness of parents' encouraging children to participate in various extracurricular activities is related to students' math and science activities and performance both within and out of school. With regard to its influence on children's academic achievement, research has consistently demonstrated the importance of parental involvement (Griffith, 1996; Jeynes, 2003; Jeynes, 2007; Shute, Hansen, Underwood, 2007). Deslandes, Royer, Turcotte, & Bertrand (1997) argues that parental involvement constructs or dimensions could be the strongest predictor of school achievement than many other variables. Fan & Chen (2001) also highlights that parents' expectations and aspirations are one of the most important specific aspects of parental involvement influencing school outcomes. Many studies suggest that parents can convey the value of science or math to their children, and this can be associated with achievement in the subject (Martin, 1996; Brown, McBride, Bost, & Shin, 2011; Hong, Yoo, You, & Wu, 2010; Sun, Bradley, & Akers, 2012).

With regard to the effects of teachers, research has identified some features and characteristics of teachers that are highly influential in enhancing student performance and achievement (Jackson, 2014; Zakharov, Tsheko, & Carnoy, 2016). Teacher's higher levels of subject matter knowledge is crucial in influencing and encouraging students to better perform and understand school process (Hill, Rowan, & Ball, 2005). Teacher's higher levels of subject matter knowledge and understanding, if focused on instruction, could provide students greater opportunity to learn more (Darling-Hammond, 1997; Hanushek & Rivkin, 2010). Chu, Loyalka, Chu, Qu, Shi, & Li (2015) stresses that quality of teaching is an essential factor in improving student academic achievement. Hanushek (2011) notes that a student improves three times more in his or her academic achievement when taught by a high quality teacher, relative to a low quality teacher. Some studies have sought to identify the specific teacher credentials that signal teacher quality that has an effect on raising student achievement (Harris & Sass, 2011; Kukla-Acevedo, 2009).

Research shows that teacher collaboration with each other can have direct positive effect on student learning (Goddard, Goddard, & Tschannen-Moran, 2007; Wheelan & Kesselring, 2005). Teachers who discuss their work with peers and collaborate in planning and implementing lessons usually feel more attached and feeling good about their jobs (Johnson, Berg, & Donaldson, 2005). On the other hand, bullying among students is often seen as a threat to the school learning environment, as it could have a direct effect on students' performance and achievement (Rothon, Head, Klineberg, & Stansfeld, 2011). As a result, effective teachers should try to create an optimal classroom environment by encouraging clear guidance and by ensuring collaboration among students based on respect between students and between students and the teacher (Marzano, Marzano, & Pickering, 2003). Productive and positive teacher-student relationships are essential in fostering academic achievement (Cornelius-White, 2007; Marzano, Marzano, & Pickering, 2003) and in increasing student participation and motivation and interest to teach the subject (Cornelius-White, 2007; Martin, & Dowson, 2009). Teachers have an essential role in facilitating a sense of belonging by working to create an environment that allows students to work autonomously, and to provide support, guidance, and positive feedback when needed (Goodenow & Grady, 1993; Ryan & Deci, 2000). Reeve (2002) stresses the importance of teachers providing constant positive feedback, listening and responding to students' questions, and be empathetic to their needs.

A positive school climate and environment can enhance student learning indirectly by facilitating greater teacher job satisfaction and self-efficacy (Caprara, Barbaranelli, Borgogni, Petitta, & Rubinacci, 2003). TIMSS (2011a and 2011b) reports show that schools that provide good working conditions for teachers may experience higher student achievement. Johnson, Kraft, & Papay (2012) identify some work features to include manageable workload, adequate facilities, and availability of instructional materials and resources which all promote teacher satisfaction. Greenberg, Skidmore, & Rhodes (2004) also identify some aspects that contribute to a positive school climate that lead to greater student achievement. Those aspects include respect for students and teachers, a safe school environment, and effective communication among school administrators, teachers, parents, and students.

Popham (2005) argues that students' attitudes are powerful predictors of students' subsequent behavior and academic performance. The study by Zainudin, Suhashila, Najib, & Hamdan (2007) finds a positive relationship between students' interest in academic subjects and their academic achievement. Bandura (1997) notes the importance of students' readiness and motivation to learn as essential to academic success. Other studies suggest that negative attitudes toward education cause some unwanted and challenging behavior (Awang, Jindal-Snape,

& Barber, 2013; Farooq, Chaundhry, & Berhanu, 2011; Ghazali, 2008; Ming, Ling, & Jaafar 2011). In particular, in a number of societies and cultures, research shows that academic motivation, intrinsic or extrinsic, can be facilitated within the school, classroom, and home (Bandura, 1997; Csikszentmihalyi, 1990; Deci & Ryan, 1985), in which intrinsic motivation refers to students who are motivated to learn mathematics or science because they find the subject to be interesting and enjoyable (Deci & Ryan, 1985) and extrinsic motivation is driven by expectations for external rewards like praise, career success, money, and other incentives (Becker, McElvany, & Kortenbruck, 2010).

Methods and Design

Research Design

The current study aims to better understand the causal relationships that may exist among features associated with parents, teachers and students and their collective influence of scores of the UAE's 4th and 8th grade students in Science and Math in TIMSS 2015. For the UAE, the integration of how school leaders perceive the attitudes and behavior of students, teachers, and parents in their schools would provide valuable information on how these variables of different stakeholders are related in their influence on student academic achievement. For the current study, we try to raise common concerns related to the question of a possible existence of causal relationships among features associated with students, teachers, and parents through the assessment of school leadership. Better understanding of the collective influence and their significance on student achievement in science and math can provide key insights for school administrators and might lead to certain recommendations and policies in a long run.

The specific objectives of this research are the following:

- Collectively, which variables in each of the three constructs of school leaders' view of the attitudes and behavior of teachers, parents, and students are more significant when looking at science and math performances?
- Is there an overall structural model to better understand and test natures of relations among observed and latent variables of teachers, parents, students, and academic achievements?
- What are the direct and indirect structural relationships between the constructs of teachers, parents, and students when student achievement is the dependent variable?

The Sample

A total of 558 schools across the UAE participated in TIMSS 2015 Grade 4 assessment. Out of the total, 186 schools (33.3%) were public schools and 372 schools (66.7%) were private schools. The public schools taught government curriculum, while private schools followed different curriculums. Public-MoE curriculum constituted 33.3% of the sample, while Private-MoE curriculum accounted for 15.8% of the sample. Other private school curriculum included UK (18.3%), Indian (14%), US (10%), and Pakistani (2%), as well as Australian, Canadian, IB, Philippine, and SABIS. The schools were selected to represent schools in the seven Emirates of the UAE: Abu Dhabi (163 schools), Dubai (168), Sharjah (85), Ajman (43), Umm Al Quwain (11), Fujairah (34), and Ras Al Khaima (54).

A total of 477 schools across the UAE participated in TIMSS 2015 Grade 8 assessment. Out of the total, 175 schools (36.7%) were public schools and 302 schools (63.3%) were private schools. Public-MoE curriculum constituted 36.7% of the sample, while Private-MoE accounted for 15.3% of the sample. Other private school curriculum included UK (15.3%), Indian (13.0%), US (10.7%) and Pakistani (2.3%). Other curriculums included Australian, Canadian, IB, Philippine, and SABIS. The breakdown of schools by Emirate is as follows: Abu Dhabi (156 schools), Dubai (135), Sharjah (70), Ajman (34), Umm Al Quwain (7), Fujairah (29), and Ras Al Khaimah (46).

The Data and Instrument

The math overall and science overall scores of TIMSS 2015 for the 4th Graders and 8th Graders of the UAE schools were used for this study. Items 15a – 15m from the 4th Grade school questionnaire and items 14a -- 14m from the 8th Grade school questionnaire were also used. These items were related to school emphasis on academic success. For all those items, schools leaders were asked to tell how they would characterize the statements within their school. A five-point scale was used (1: Very high, 2: High, 3: Medium, 4: Low, and 5:

Very low). It is important for the intended analysis to use standardized variables since the scales used in the school questionnaire were measured differently for TIMSS math and science scores.

Data Analysis

Descriptive statistics of the 13 items were presented. Before conducting SEM, the scales used in the school questionnaire were validated using EFA to identify a set of latent constructs. EFA would further our understanding if the multiple observed variables have similar patterns of responses. Factor loading was analyzed to examine the relationship of each variable to the underlying factor. CFA measurement models were then tested to determine if the variables share common variances in defining the latent variables as assumed. Finally, a general structural equation model was run by testing all possibilities of linkages between the constructs representing teachers, parents, students, and TIMSS scores.

Both the measurement models and the structural equation model were analyzed using LISREL 9.2, by examining fit statistics such as Chi-square ($\chi 2$) statistics and associated p-values (and degrees of freedom), root mean square error of approximation (RMSEA), the goodness of fit index (GFI), the normed-fit index (NFI), the non-normed-fit index (NNFI), the adjusted goodness-of-fit index (AGFI), the comparative fit index (CFI), and the Root Mean Square Residual (RMR). Values for ($\chi 2$/df) is considered satisfactory when < 3. Values of CFI, GFI, AGFI, NFI, and NNFI of > 0.90 are recommended. An RMSEA in the range of 0.05 to 0.10 is considered an indication of fair fit, while values smaller that 0.05 is considered good fit (Steiger, 2007).

Results

Descriptive Statistics

Table 1 provides the mean and standard deviation for each of the items for both student groups. The questions were scored where one denoted very high, so higher scores reflected more negative perception. It is interesting to note that all parent-related items recorded higher scores. Three teacher-related items recorded lower mean scores when we compared the two groups of students. However, two teacher-related factors experienced higher mean scores (‘Teachers’ understanding of the school’s curricular goals” and “Teachers’ degree of success in implementing the school’s curriculum”).

Table 1. School Feedback on Teachers, Parents, and Students for 4th and 8th Graders

		4th Graders		8th Graders	
		Mean	Standard deviation	Mean	Standard deviation
A	Teachers’ understanding of the school’s curricular goals	1.73	.660	1.68	.648
B	Teachers’ degree of success in implementing the school’s curriculum	1.84	.688	1.83	.666
C	Teachers’ expectations for student achievement	1.94	.706	2.00	.697
D	Teachers working together to improve student achievement	1.76	.729	1.78	.715
E	Teachers’ ability to inspire students	1.83	.721	1.84	.709
F	Parental involvement in school activities	2.45	.990	2.76	1.063
G	Parental commitment to ensure that students are ready to learn	2.47	.889	2.62	.934
H	Parental expectations for student achievement	2.04	.817	2.14	.853
I	Parental support for student achievement	2.44	.840	2.55	.870
J	Parental pressure for the school to maintain high academic standards	2.14	.866	2.24	.898
K	Students’ desire to do well in school	2.03	.740	2.09	.778
L	Students’ ability to reach school’s academic goals	2.18	.698	2.18	.709
M	Students’ respect for classmates who excel in school	1.79	.696	1.77	.670

**The scorings are in negative forms (the higher the score, the less agreement)*

Students-related items received mixed responses. The item “Students’ respect for classmates who excel in school” witnessed improvements for 8th grade students. For both 4th and 8th grades, the two items that received the highest agreements were related to “Teachers’ understanding of the school’s curricular goals”, and “Students’ respect for classmates who excel in school”. For 4th grade students, the two items that received the lowest agreements from school leadership were “Parental commitment to ensure that students are ready to learn” and “Parental involvement in school activities”. For 8th graders, the same two items received the highest scores. Only one item related to “Students’ ability to reach school’s academic goals” did not change when we compared

the two groups. If we look at the standard deviation values in the table, we note that the scores increased for 6 items for the 8th grade students compared to same 4th grade values (all 5 parent-related items increased).

Factor Analysis

For the 4th graders, a first run of EFA with Varimax rotation (with principal component) yielded two factors with 63.566% variance explained. For the 8th graders, the equivalent run of EFA also yielded two factors with 63.780% variance explained. Another EFA was run by asking for specific three factors to be produced. The Varimax rotation results for both groups are provided in Table 2. For both groups, the solutions ideally were divided into three dimensions with components loading on the three factors of teachers, parents, and schools. For 4th graders, the total variance explained is 70.493%. For 8th graders, the total variance explained were recorded to be 70.598%. Both values are considered to be good. For both groups, Cronbach Reliability Alpha considers each of the factors (teachers, parents, and students) as good. For the 4th graders, the values were 0.885, 0.871, and 0.831 respectively. For the 8th graders, the values were 0.886, 0.882, and 0.818 respectively. Factor loadings usually reveal the extent to which each of the variables contributes to the meaning of each of the factors. The numbers indicate high loadings for all of the variables in the EFA for both groups. In fact, the magnitude of the factor loadings are consistent for both groups as the same order is maintained.

Table 2. EFA Results with Three Factors Requested for Both Groups

		4th Graders			8th Graders		
		F1	**F2**	**F3**	**F1**	**F2**	**F3**
B	Teachers' success in implementing the school's curriculum	.822			.811		
A	Teachers' understanding of the school's curricular goals	.801			.793		
E	Teachers' ability to inspire students	.783			.789		
D	Teachers working together to improve student achievement	.763			.779		
C	Teachers' understanding of the school's curricular goals	.656			.630		
G	Parental commitment to ensure that students are ready to learn		.793			.849	
I	Parental support for student achievement		.790			.820	
H	Parental expectations for student achievement		.734			.723	
J	Parental pressure on school to maintain high academic standards		.726			.680	
F	Parental involvement in school activities		.668			.632	
M	Students' respect for classmates who excel in school			.804			.785
K	Students' desire to do well in school			.737			.698
L	Students' ability to reach school's academic goals			.709			.688

The Measurement Models

The covariance matrices of the items in the three constructs of (teachers, parents, and students) are shown in Table 3 and Table 4 for 4th graders and 8th graders respectively. For both groups, the student constructs were made up of only three variables. As a result, no CFA process was possible to perform. CFA of the two constructs of teacher and parents were performed for each group separately.

For the 4th graders, the resulting fit statistics for the teacher construct were adequate. The recorded Chi-square ($\chi 2$) is 7.274 with a P of 0.1221, with 4 degrees of freedom (df), and $\chi 2/df = 1.811$. The RMSEA is 0.07, NFI is 0.985, NNFI is 0.983, CFI is 0.993, RMR is 0.0261, GFI is 0.982, and AGFI is 0.966. There was a need to correlate the covariance matrix for two of the variables. The resulting standardized estimates ranged between 0.73 and 0.92. For the parent construct, the resulting fit statistics were adequate also. The recorded Chi-square ($\chi 2$) is 2.174 with a P of 0.7038, with 4 degrees of freedom (df), and $\chi 2/df = 0.5435$. The RMSEA is 0.002, NFI is 0.994, NNFI is 0.990, CFI is 0.999, RMR is 0.0148, GFI is 0.995, and AGFI is 0.980. There was a need to correlate the covariance matrix for two of the variables. The resulting standardized estimates ranged between 0.63 and 0.80.

Table 3. The Covariance Matrix (Grade4)

	ZMath	ZScie	G15A	G15B	G15C	G15D	G15E	G15F	G15G	G15H	G15I	G15J	G15K	G15L	G15M
ZMath	.998														
ZScie	.980	1.002													
G15A	-.264	-.259	.990												
G15B	-.267	-.265	.735	.999											
G15C	-.356	-.362	.574	.629	1.00										
G15D	-.267	-.278	.541	.593	.612	1.01									
G15E	-.190	-.191	.580	.611	.532	.709	1.04								
G15F	-.239	-.253	.425	.382	.457	.521	.477	1.02							
G15G	-.405	-.426	.394	.419	.511	.491	.434	.625	1.03						
G15H	-.433	-.453	.347	.330	.492	.374	.285	.450	.642	1.07					
G15I	-.338	-.352	.364	.405	.439	.397	.408	.581	.746	.607	1.07				
G15J	-.383	-.399	.288	.317	.395	.368	.283	.438	.562	.585	.572	.995			
G15K	-.348	-.367	.397	.396	.481	.429	.467	.412	.529	.506	.526	.520	.982		
G15L	-.372	-.381	.425	.497	.528	.460	.489	.443	.562	.489	.555	.434	.661	.999	
G15M	-.280	-.310	.377	.376	.450	.404	.403	.375	.455	.427	.424	.366	.593	.608	.997

For the 8th graders, the teacher construct, the resulting fit statistics were adequate too. The recorded Chi-square ($\chi 2$) is 11.053 with a P of 0.0114, with 3 degrees of freedom (df), and $\chi 2/df = 3.68$. The RMSEA is 0.075, NFI is 0.991, NNFI is 0.979, CFI is 0.991, RMR is 0.0138, GFI is 0.991, and AGFI is 0.956. There was a need to correlate the covariance matrix for two of the variables. The resulting standardized estimates ranged between 0.74 and 0.78. For the parent construct, the resulting fit statistics were adequate also. The recorded Chi-square ($\chi 2$) is 11.954 with a P of 0.01771, with 4 degrees of freedom (df), and $\chi 2/df = 2.9885$. The RMSEA is 0.065, NFI is 0.991, NNFI is 0.985, CFI is 0.994, RMR is 0.0185, GFI is 0.990, and AGFI is 0.962. There was a need to correlate the covariance matrix for two of the variables. The resulting standardized estimates ranged between 0.62 and 0.88.

Table 4. The Covariance Matrix (Grade 8)

	ZMath	ZScie	G15A	G15B	G15C	G15D	G15E	G15F	G15G	G15H	G15I	G15J	G15K	G15L	G15M
ZMath	1.02	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ZScie	.991	1.01	.	.	.	.	.	.	.	.	.	.	.	.	.
G15A	-.203	- .197	1.05	.	.	.	.	.	.	.	.	.	.	.	.
G15B	- .208	-.205	.711	1.04	.	.	.	.	.	.	.	.	.	.	.
G15C	-.336	- .352	.552	.621	1.04	.	.	.	.	.	.	.	.	.	.
G15D	- .135	-.152	.563	.552	.600	1.01	.	.	.	.	.	.	.	.	.
G15E	-.136	-.153	.578	.610	.582	.722	1.04	.	.	.	.	.	.	.	.
G15F	- .267	-.286	.430	.402	.463	.430	.450	.994	.	.	.	.	.	.	.
G15G	-.457	- .458	.378	.399	.508	.352	.356	.660	.970	.	.	.	.	.	.
G15H	- .484	- .501	.307	.314	.493	.296	.284	.472	.596	.963	.	.	.	.	.
G15I	- .381	-.375	.388	.408	.494	.345	.371	.608	.730	.577	.957	.	.	.	.
G15J	-.406	- .414	.300	.316	.442	.282	.312	.402	.529	.622	.555	.954	.	.	.
G15K	- .383	-.402	.446	.436	.564	.449	.477	.463	.551	.573	.537	.550	1.09	.	.
G15L	-.362	- .381	.442	.500	.570	.472	.473	.433	.472	.504	.474	.467	.693	.996	.
G15M	- .236	- .249	.397	.358	.386	.387	.392	.334	.339	.414	.363	.354	.570	.546	1.09

Next, CFA for the complete measurement models for both Grade 4 and Grade 8 schools are estimated and is shown in Figure 1, 2. All standardized estimates are also shown. The resulting fit stats for the 4th Grade model with all three constructs were good [maximum likelihood ratio of Chi-square is 156.81 with 57 degrees of freedom ($\chi 2/df$ is 2.751), NFI of 0.958, CFI of 0.970, RMSEA of 0.0636, RMR of 0.0359, GFI of 0.953, and AGFI of 0.924]. With those fit statistics, we may conclude that the measurement models show that the corresponding latent variables can be represented by the observed ones (Bentler, 1990). As a result, for Grade 4 schools, we could develop a structural model where the dependent variable is TIMSS math and science scores to better understand how latent variables interact with each other.

The students construct shows a direct effect (relatively medium) to TIMSS scores with a path coefficient of 0.22 and a t-value of 2.59 for Grade 4 schools, and .28 with t-value of 2.98 for Grade 8 schools. The student construct is composed of variables that are reflective of student's desire to do well in school and their ability to reach school's academic goals. The third variable reflects their association with high achievers in school.

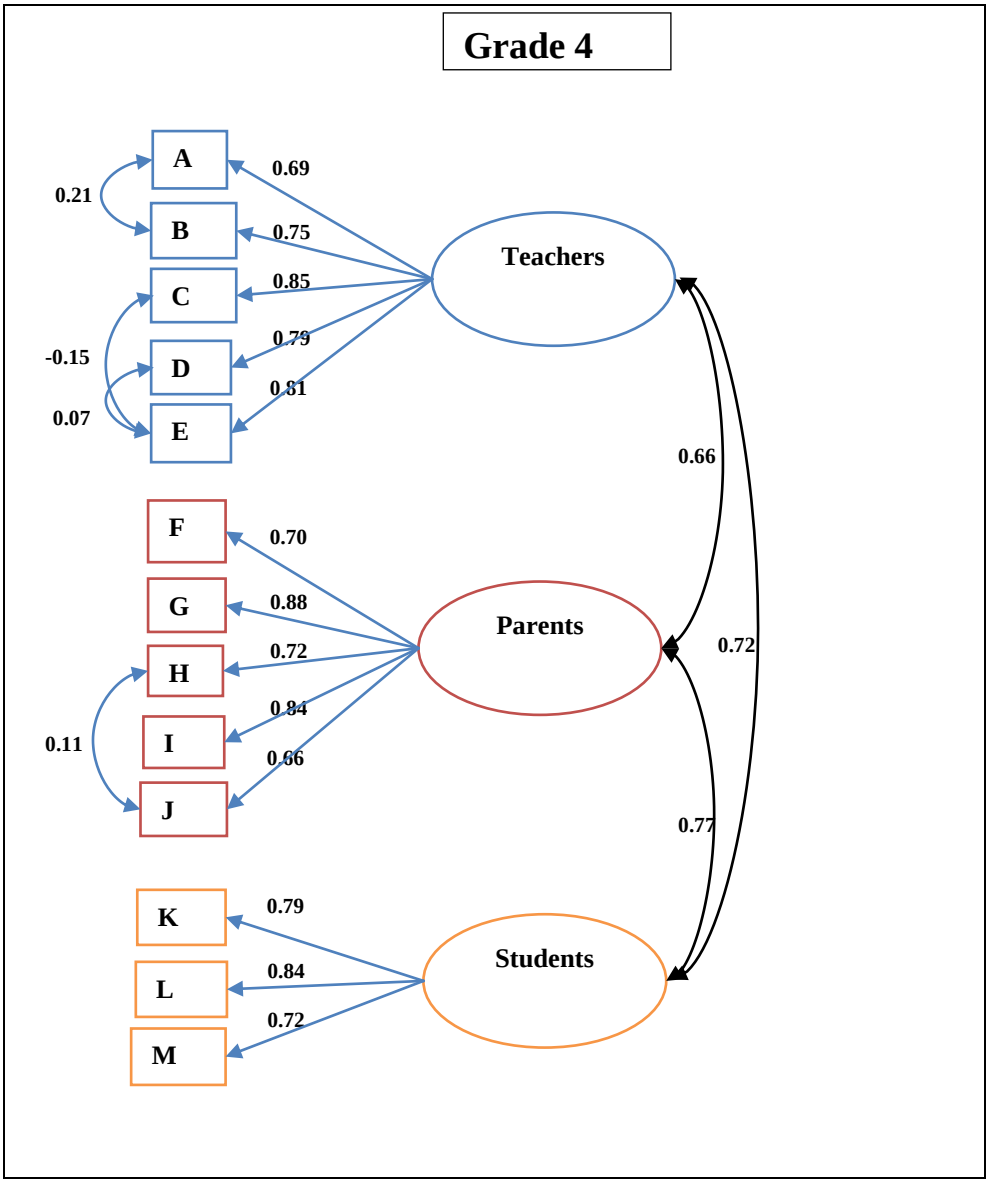

Figure 1. CFA for the Complete Measurement Models for Grade 4

One more thing to note in the two models is that there are no links between the parent and teacher constructs. However, it should be pointed out here that the five variables of the teacher construct do not directly address their relationships with parents. This observation is also true for the teacher's construct, where no variable echoes the communication between teachers and parents.

As for Grade 8 schools, CFA resulted also in a good model. The standardized estimates ranged between 0.64 and 0.86. The resulting fit stats resulted in a Chi-square is 166.01 with 59 degrees of freedom ($\chi 2$/df is 2.814), NFI of 0.951, CFI of 0.966, RMSEA of 0.0674, RMR of 0.0435, GFI of 0.941, and AGFI of 0.909]. Results indicate that the corresponding latent variables can be represented by the observed ones. As a result, for Grade 8 schools, we could also develop a structural model where the dependent variable is TIMSS Math and Science scores to better understand how latent variables interact with each other.

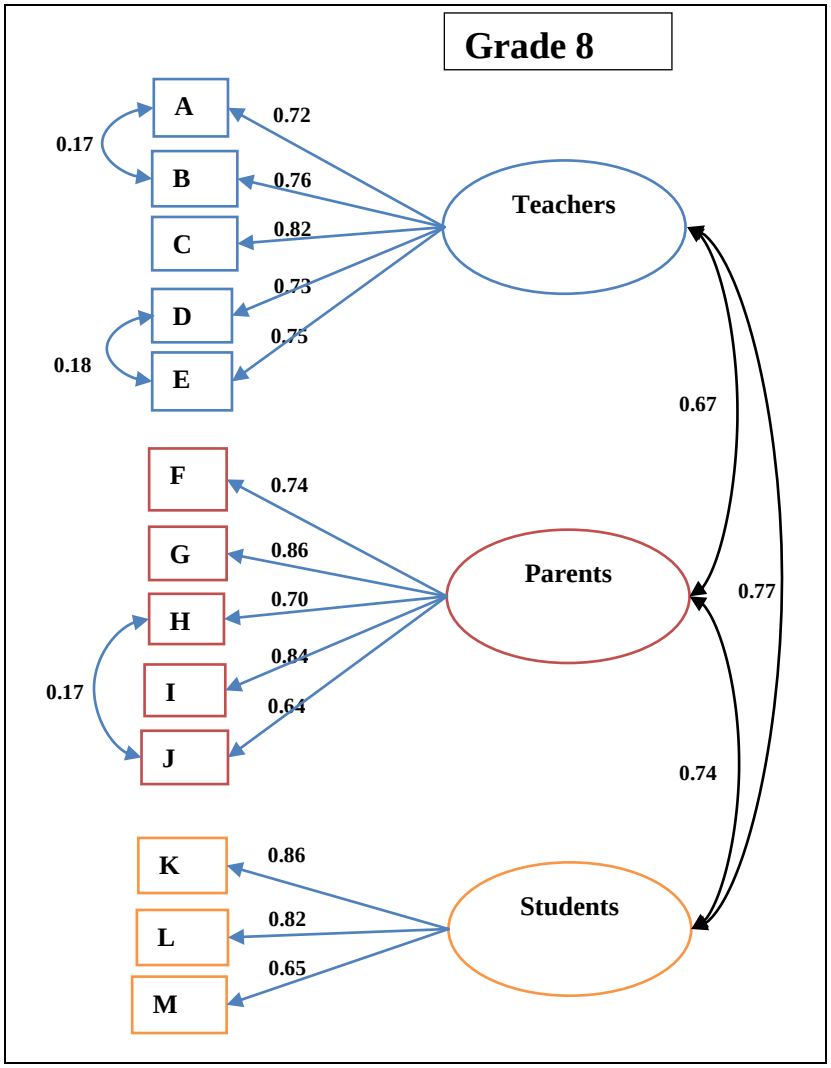

Figure 2. CFA for the Complete Measurement Models for Grade 8

The Structural Equation Model

A general structural equation model is run by testing all possibilities. For both Grade 4 and Grade 8, Figure 3 provides the final models where all constructs of teachers, parents, students, and TIMSS scores are shown. Table 5 shows the final standardized loadings, t-statistics, and path standardized coefficients for both groups. The final models provided acceptable fit indices. For Grade 4 schools, the maximum likelihood ratio of Chi-square is 148.102, with 79 degrees of freedom ($\chi 2$/df is 1.87), NFI of 0.962, CFI of 0.973, RMSEA of 0.0619, RMR of 0.0404, GFI of 0.944, and AGFI of 0.915. All standardized estimates with their t-values are shown in the table. For Grade 8 schools, the maximum likelihood ratio of Chi-square is 194.29, with 78 degrees of freedom ($\chi 2$/df is 2.49), NFI of 0.965, CFI of 0.978, RMSEA of 0.0559, RMR of 0.0463, GFI of 0.945, and AGFI of 0.916.

The figures show that for both models, the same conclusions could be reached. The most significant path coefficient is the one from parents to students with values of 0.56 and 0.53 respectively. The connection strength (path coefficient) represents the response of the dependent variable to a unit change in an explanatory variable when other variables in the model are held constant (Bollen, 1989).

For both models, given the nature of the variables on the parent's construct, it is important to point out that parents have both direct and indirect effect on TIMSS scores. For Grade 4 schools, the direct effect of 0.33 is significant with a t-value of 4.41. The indirect effect of 0.1166 is through the mediation of students. As a result, parents exert a total effect of 0.4466 on 4th graders' TIMSS scores. For Grade 8 schools, the direct effect of 0.69 is significant with a t-value of 9.85. The indirect effect of 0.1568 is through the mediation of students. As a result, parents exert a total effect of 0.8468 on the TIMSS scores of 8th graders.

Table 5. The Standardized Estimates (Loadings) and t-statistics for Grade 4 and Grade 8

	Grade 4		Grade 8	
	Standardized estimates	t-values	Standardized estimates	t-values
Teachers				
Understanding of the school's curricular goals	0.70	17.60	0.70	16.53
Success in implementing the school's curriculum	0.75	19.29	0.75	17.97
Expectations for student achievement	0.85	21.53	0.84	20.88
Working together to improve student achievement	0.78	19.06	0.73	17.29
Ability to inspire students	0.80	19.74	0.78	18.24
Parents				
Involvement in school activities	0.69	17.98	0.61	13.69
Commitment to ensure students are ready to learn	0.88	25.51	0.77	18.50
Expectations for student achievement	0.73	19.23	0.80	19.62
Support for student achievement	0.83	23.44	0.75	17.98
Pressure on school to maintain high academic standards	0.67	17.06	0.73	17.20
Student				
Desire to do well in school	0.81	19.01	0.86	20.21
Ability to reach school's academic goals	0.84	20.84	0.81	18.28
Respect for classmates who excel in school	0.72	17.72	0.64	14.96
TIMSS scores				
Math scores	0.97	57.77	0.97	56.02
Science scores	0.95	54.52	0.93	51.50

For both models, there is no significant path from teachers to TIMSS scores. However, results show that teachers have a significant effect on students with a direct effect of 0.37 with a t-value of 7.20 for Grade 4 schools, and 0.38 with t-value of 6.88 for Grade 8 schools. For both groups, all five variables in the teacher's construct demonstrated high and significant loadings; as the highest loading was pertinent to teacher's ability to inspire students. The other variable that got a relatively high loadings were associated with teacher's expectation for student achievement. Thus, teachers seem to do their utmost to influence the student's knowhow and knowledge of both math and science.

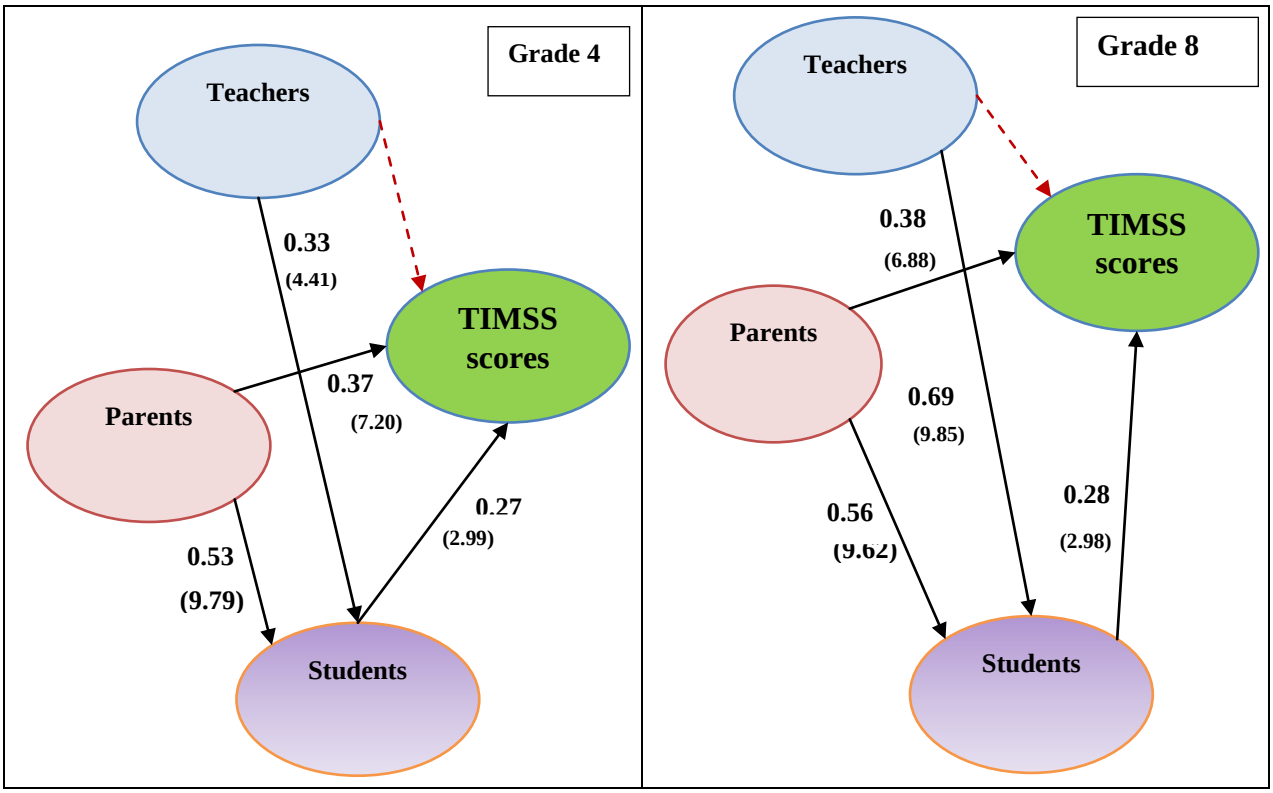

Figure 3. The Structural Equation Model (Grade 4 and Grade 8)

Discussion

On one hand, this study explored how science and mathematics outcomes are stimulated by predictors related to the features of teachers, parents, and students as perceived by school leadership. On the other hand, the research was extended to test if there are differences between 4th Grade and 8th Grade schools with regard to the same objective. We used the UAE TIMSS 2015 overall Science and Math scores and results from the school questionnaire for both grades.

The multi-group structural equation model for both 4th and 8th grade students revealed extensive similarities in most aspects of parameters, paths, direct or indirect links, and structure. Both models provided acceptable fit statistics with several significant paths. The SEM models of both Grade 4 and Grade 8 schools almost replicated each other. Results point to the significance of attitudes and behavior of teachers, parents, and students. There were significant paths from teachers to students, from parents to both students and TIMSS scores, and from students to TIMSS scores.

The results of the structural equation model are consistent with other research results on the effect of teachers, parents, and students on school achievement. In general, and regardless of school grade level, the results indicated several exogenous factors related to the three constructs of teachers, parents and students. All previous studies conducted in other cultures and incorporated the three constructs yielded similar results of their significance (Trask-Tate & Cuningham, 2010; George & Kaplan, 1998; Dumont, Trautwein, Lüdtke, Neumann, Niggli, & Schnyder, 2012)

This present research provides strong evidence to suggest that teacher's understanding and implementation of school curriculum, their expectation and ability to inspire students, and their collaboration with other teachers play a significant role in improving students' academic achievement. This is consistent with the research findings reported elsewhere (Chu, Loyalka, Chu, Shi & Li, 2015; Kocakaya & Kocakaya, 2015; Zakharov, Tsheko & Carnoy, 2016). Teachers show significant direct influence on students for both Grades. This result is in line with other similar studies (Cornelius-White, 2007; George & Kaplan, 1998; Harris & Sass, 2011). In addition to their role of providing class instruction to students, they have the momentous role of inspiring them and have high expectations for their achievement. Analyses reflected that students with teachers, who solve examples and explain rules, are successful in the TIMSS. The TIMSS achievement test seemed to be appropriate for measuring the outcomes of teacher-centered instruction as suggested by other researchers too (Chu, Loyalka, Chu, Qu, Shi & Li, 2015; Hill, Rowan, & Ball, 2005). Another possible reason for this relationship is that teacher-centered instructional environment may be more appropriate for the UAE culture. This result indicates the importance of teacher and the methodology they use in the classroom as indicated by similar studies (Desforges, & Abouchaar, 2003; George & Kaplan, 1998).

Meanwhile, the widely acclaimed significant effect of parental involvement, either direct or indirect, on the Math and Science achievement (Adamski, Fraser & Peiro, 2013; Park, Byum & Kim, 2011; Wilder, 2014) is also supported by this research. Most notably also, the students' attitudes toward reaching the school's academic goals, and their desire and motivation to do well in school provide significant evidence that the phenomenon of Science and Mathematics achievement is multidimensional in nature (Lee & Mallik, 2015; Ming, Ling & Jaafar, 2011).

Both groups portrayed strong direct association between type of parental involvement and academic achievement. This phenomenon is effectively true specially when parents have high academic expectations for their children, develop and maintain communication with them about school activities and schoolwork. These findings are consistent with the previous related studies (Rubin, 2005; West & Thoemmes, 2010; El Nokali, Bachman & Votruba-Drzal, 2010), which suggest that the most effective modality of parental involvement has to do with accompanying and supervising children's main school goals, those being to study and to learn. Some research suggested that the lower the academic achievement of the students, the higher the probability of the parents' presence at the school, or of their direct or indirect involvement in the school-related activities of their children (Yahya & Ayasrah, 2018; Hong, S., & Ho, H. Z. (2005). Contrary to this finding, scrutinizing the data further, we found out that parental involvement was not necessarily higher for low performing students.

It should be stressed further that this present research is consistent with other studies as it highlights that parental factors may exert influence on student achievement through different ways. Parental factors, especially three of the five items (G,H, and I) that comprised the 'parents' construct adopted by this research, contribute to the development of student's learning ability, potential, and efforts or cultural capital in a broader sense. Students inherited, habituated, and nurtured in such cultural capital rich home environment are more likely to

excel in academic achievement (Hartas, 2011; Lareau, and Horvat, 1999). In this sense, parental factors have a 'direct' effect on student achievement, as shown by this research. Parental factors, including involvement in school activities (F, and J), also contribute to the development of student's dispositions at school (Bourdieu, 1977), through which students capitalize school learning resources. This may explain the 'indirect' path of parental effects on student achievement.

We can assume that students with higher latent ability would have steeper slopes for the function relating the parent involvement scale with student's academic achievement. When we look at the simple means of the variables of the three constructs of "parents", "students", and "teachers", (Table 1), we note the highest averages for both 4 and 8 grade schools are associated with "Parents" (1 denotes "very high", and 5 denotes "very low"). This fact might call for more investigation to better understand where parental involvement is high, and where it is low. Understanding the differences among parents and correlating them with student's achievement might lead policy makers to focus and concentrate on specific cases to achieve effective results.

Conclusions, Implications, and Future Research Directions

To the best of our knowledge, our study is the first to explore linkage between related constructs of parents, teachers, students, and the student achievement construct in the UAE. A strong relationship was found between parental expectations and educational achievement. In general, results are congruent with many other studies that attempted to analyze the relationship between parental involvement and the academic achievement of their children (Wilder; 2014). Wilder (2014) believes that "parental expectations reflect parents' beliefs and attitudes toward school, teachers, subjects, and education in general. As children are likely to harbor similar attitudes and beliefs as their parents, having high parental expectations appears vital for academic achievement of children" (p. 392).

One significant implication of the results is that policymakers at the government or school level in the UAE appear to be able to identify most observable components of teacher quality. Many relevant and immediate concerns might be analyzed deeper. For example, teacher recruiting processes, most desired characteristics and features of teachers, type of professional developments offered, and degree and type of teacher are not communicated. In other words, policymakers and school administrators must make recruiting, hiring, assignment, and compensation decisions based on carefully planned criteria and maybe new approaches.

TIMSS has provided a good database and source of information for describing the variation found across the country in many of the variables (some not discussed in this study) that have been shown to be related to student achievement. This study shows that the quality of the database stands given the statistical fits that were observed in this study of the measurement models. It should be stressed that TIMSS 2015 questionnaires (for students and school) provide valuable information with regard to many important school, student, teacher, and other characteristic data. Performing both ANOVA and MANOVA of TIMSS scores relative to each of these features and characteristics could shed light on important differences between the different related categories of each sample. Such analysis could provide additional insight for policy makers to better understand the nature of differences between schools and students. The resulting information could be used in developing significant initiatives and policies with regard to school education.

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