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A Structural Equation Modeling of the Impact of Teacher Self-Efficacy on Teachers' Teaching Practice in Saudi Arabia: Evidence from TALIS 2018

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Abstract. This paper intends to investigate the causal relationship between teachers' self-efficacy and teacher teaching practices in Saudi Arabia using Structural Equation Modeling (SEM) based on the public database of the Teaching and Learning International Survey (TALIS 2018). In this study, 2744 teachers responded to the survey, representing lower secondary in mainstream public and private schools in Saudi Arabia. Based on the literature review and the exploratory factor analysis presented in the TALIS 2018 technical report, three constructs represent teacher teaching practices including (clarity of instructional, cognitive activation, and classroom management practices). Teacher self-efficacy includes two constructs (classroom management efficacy and instruction efficacy). After applying structural equation modeling, the main finding indicates a positive influence of teacher self-efficacy on the clarity of instructional practices, cognitive activation practices, and classroom management practices.

2020 Mathematics Subject Classifications: 62Hxx,62H12,62H15,62H25,62Pxx

Key Words and Phrases: Teacher self-efficacy, Teacher teaching practices, Structural Equation Modeling, TALIS, Saudi Arabia.

1. Introduction

Improving the education system and maintaining its success is not an easy task. It requires comprehensive and integrated efforts in several areas such as teacher quality and professional development, training, curriculum enhancement, assessments reforming, technological integration, cultural awareness, parental and community involvement, and emphasis on lifelong learning as mentioned by [56],[40],[39]. Hattie [31] defines that teacher quality is considered one of the most critical factors for improving the education system as it is linked to teaching practices and affects student achievement. Several ingredients influence teacher quality such as teacher self-efficacy, training, and development, working

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environment, and relationships between team members. Through the literature, teachers' self-efficacy has been identified as a crucial factor for shaping teacher behavior, and attitude, hence affecting students learning. This research utilizes Structural Equation Modeling (SEM) to investigate the relationship between teacher self-efficacy and teacher teaching practices. Self-efficacy is an individual's belief about their ability to accomplish a task or a goal in life. It affects a person's cognitive, motivational, affective, and selection processes [10]. Guskey and Passaro [26] mentioned that teacher self-efficacy is teachers' beliefs about their teaching abilities, which can directly or indirectly influence students' learning. Holzberger et al.[33] pointed out that there is broad consensus among educational scholars, policymakers, and practitioners on the importance of teacher self-efficacy and its high correlation with both the quality of teaching provided by teachers. It is evident that teacher self-efficacy and teaching practice are crucial for education development, however, the inner relationship between teacher self-efficacy and teachers' teaching practice is frequently disregarded. Such a relationship needs to be investigated and clarified. Hair [27] define Structural Equation Modeling (SEM) as a mechanism that validates a theoretical framework and reflects it into a model based on empirical data. It is a statistical technique that tests the relationship between latent variable (indirectly measured) and observed variables (directly measured) from the data. Schumacker et al. [52] illustrate that structural equation modeling can be applied in different fields due to its ability to analyze complex relationships such as educational studies, social science, psychology, economic and marketing studies, health, industrial, and environmental studies. This study analyzes large-scale data from the Teaching and Learning International Survey (TALIS). TALIS is a global survey that targets teachers and school leaders, conducted by the Organization for Economic Cooperation and Development (OECD). The Teaching and Learning International Survey (TALIS) was conducted worldwide for the first time in 2008 followed by consecutive cycles in 2013, 2018, and 2024 respectively. Saudi Arabia participated in TALIS for the first time in the third cycle (2018). TALIS designed to help teachers and school leaders improve the education system. The questionnaire covers 11 aspects related to teachers and leadership, including teachers' instructional practices, school leadership, teachers' professional practices, teacher education, and initial preparation, teacher feedback and development, school climate, job satisfaction, motivation, teacher human resource measures, stakeholder relations, teacher self-efficacy, innovation, and equity and diversity [32]. This study focused on two aspects of teachers: teacher teaching practices and teacher self-efficacy. It contributed to the current understanding of the impact of teacher self-efficacy on teacher teaching practices in Saudi Arabia using structural equation modeling, which implicitly contributed to the development of the education system in Saudi Arabia.

2. Literature Review

2.1. Structural Equation Modeling

SEM has the ability to analyze causal and correlational relationships and provide the fit analysis of various latent components simultaneously, this is what (Hair[27], Schumacker and Lomax [52], Civelek [17]) pointed out. Schumacker et al [9] stated that SEM was developed by the work proposed by Karl Jöreskog between 1969 and 1973, Ward Keesling in 1972, and David Wiley in 1973. Numerous SEM research has been broadly published in multiple disciplines, such as industrial, medical, environmental, managerial, and psychological sectors. SEM's popularity has expanded to have computer software, training workshops, postgraduate courses, and research articles [41].

2.2. Structural Equation Modeling in Education

Structural equation modeling has been extensively applied in the education field. For example, Chine et al.[16] studied the causal relationship between teacher self-motivation and their participation in web-based development programs in Taiwan using SEM. In Turkey, an application of SEM to analyze the impact of gender and age on the teacher's attitude was conducted by Hürsen [35]. Afari [1] used SEM to investigate whether the classroom environment affects students' understanding and enjoyment of mathematics lessons in the United Arab Emirates. Green [25] conducted a review on the application of SEM in higher education research. The aim was to assess the aptness and sufficiency of their research methodology. Badri et al. [9] applied SEM to the data collected from the Abu Dhabi education system in 2013. The aim was to understand the effect of professional development and its causal drivers on school climate, feedback, environment, teachers' beliefs, general, student behavior, and perceived needs for professional development. Karakaya-Ozyer and Aksu-Dunya [37] demonstrated the growth in the number of research articles utilizing SEM in the Turkish education sector between 2010 and 2015. Panchenko [50] investigated the employees' level of self-efficacy in Ukraine's education system using structural equation modeling. Lavidas et al.[43] used SEM to show that four factors (perceived self-efficacy, self-criteria, facilitating condition, and technological complexity) have an indirect effect on students' desire to use technology for research purposes in Greece. Annas et al. [8] analyzed data collected from 120 students to determine if the students accepted online teaching during Covid19 pandemic. They tested the relationship between the perceived usefulness of technology, attitude towards using the technology in learning, and behavioral intention to use the technology in learning. They found that the perceived usefulness of technology has a positive effect on attitudes towards using technology in learning. In addition, the attitude towards using technology in learning has a positive effect on behavioural intention to use technology in learning. Wijaya et al. [59] used structural equation modeling to analyze data from 47 doctorate students in mathematics education in Indonesia. The purpose of the analysis was to determine how the academic performance of these students was affected by factors such as stress levels, well-being, parental support, student engagement, fear of delay, and facilitating conditions.

The results showed that the greatest positive influence on the academic achievement of Indonesian doctorate students was teacher support. Parental support might greatly lower doctorate students' stress levels, but student engagement has the most significant positive influence in enhancing their well-being.

2.3. Application of Structural Equation Modeling on TALIS

Several studies applied SEM on TALIS data to test the relationship between the factors, and latent variables, in the questionnaire. For example, Sun and Xia [55] used SEM to analyze TALIS 2013 data to model the relationship between school leadership and teacher job satisfaction. The results showed that distributed leadership at the school and teacher had a significant positive impact on teachers' job satisfaction, whereas teachers' self-efficacy affected teacher job satisfaction as a mediator. Anand [7] applied SEM to TALIS 2018 to investigate the relationship between school leadership and school innovativeness. He found that there is a causal relationship between school leadership and school innovativeness. Bellibaş et al.[13] used SEM at TALIS 2013 to investigate how principal leadership affects teaching practices. The mediator is teacher collaboration and job satisfaction. The results showed that principals' instructional leadership had a major direct impact on the quality of instruction, while distributed leadership mostly had an indirect effect that was mediated by teacher cooperation and job satisfaction. A study by Fackler et al. [20] investigated the relationship between teacher self-efficacy (student engagement, instruction, and classroom management) with the characteristics (teacher, classroom-, school, and principal characteristics) using TALIS 2013 in 32 countries. The findings confirmed that there was a causal relationship between characteristics and teacher self-efficacy. Özkan and Akgenç[49] applied SEM on TALIS 2018 data to investigate the effect of school factors and determinants of teachers, and principals on teachers' job satisfaction. They found that the determinants of teachers such as age, gender, career preferences, participation in professional development activities, the locations of the schools, and the type of school had impact on job satisfaction of teachers. On the other hand, the determinants of principal (having foreign students in classes, school principal's age, and work experience) did not had impact on job satisfaction of teachers. Jung and Woo [36] studied the effect of preparedness, self-efficacy, and career motivation on Korean teachers' job SEM to TALIS 2018 data. They found that teacher preparedness did not affect job satisfaction, whereas career motivation affected job satisfaction. Xie et al. [60] studied the relationship between teacher cooperation (professional cooperation and exchange and coordination) and teaching practice in China and the United Kingdom, using SEM on TALIS 2018, where the mediator was teacher self-efficacy. They found that exchange and coordination have significantly and positively affected clarity of instruction practice in both China and the United Kingdom. On the other side, professional collaboration has no significant impact on clarity of instruction practice in both China and the United Kingdom. In addition, Teacher self-efficacy mediate the relation between teacher cooperation on teaching practice.

2.4. Teacher Self-Efficacy and Teacher Practices

The concept of teacher self-efficacy plays a crucial role in promoting effective teaching. The importance emerged from the fact that it can influence many teachers' aspects such as teacher well-being, teacher-student relationship, class management, student achievements, and teacher professional development. Gibson and Dembo [22] divided teacher self-efficacy into two main factors: "personal instruction efficacy" and "instruction efficacy". Teachers' self-efficacy was divided into three sub-factors by Hoover-Dempsey et al. [34]; teachers' belief in themselves, teachers' belief in their students, and teachers' belief in their professional knowledge. Friedman and Kass [21] categorized teacher self-efficacy into two factors: classroom efficacy, which is the extent of the teacher's ability to teach and manage the education process, and efficiency of the organization, which is the teacher's ability to achieve educational goals, integration into the work environment and social communication with co-workers. According to the TALIS technical report in [32], the TALIS questionnaire 2018 includes the teacher self-efficacy factor, which was divided into three constructs self-efficacy in classroom management, self-efficacy in instruction, and self-efficacy in student engagement. Teaching practices have been determined into three main facets: cognitive activations, classroom management, and student learning support. Cognitive activations are teaching strategies implemented by teachers. Classroom management refers to the extent to which the teacher manages the classroom. Student learning support refers to all practices that aim to encourage and motivate students [12],[58],[42]. According to the TALIS technical report , the TALIS questionnaire 2018 includes the teacher teaching practices factor, which has three sub-constructs: clarity of instruction, cognitive activation, and classroom management. The relationship between beliefs and teaching practices was explored in the literature. According to Gilakjani and Sabouri [23], beliefs play a crucial role in explaining how instructors choose their curricula and teaching approaches. In addition, their beliefs influence the teaching methodologies and the established principles for their classrooms. They indicated that teachers' professional growth and classroom practice are also significantly influenced by their beliefs. Teachers' decisions and classroom behavior can be more accurately predicted when their beliefs are stronger. There is a favorable association between teacher self-efficacy and actual teaching practice. Specifically, there is a strong causation between instructors' self-efficacy and their practice and quality of instruction in Germany as Holzberger et al. mentioned in [33]. Depaepe and König [19] examined the causal relationship between teaching practice, professional knowledge, and instruction efficacy in Germany using SEM, and they found that teacher self-efficacy significantly affects teaching practices. Chen et al. [15] applied SEM to TALIS 2018 data collected from Taiwan to study the relationship between teaching self-efficacy and teaching practice. He found that there is a significant relationship between teacher efficacy and teacher teaching practices. Li [44] used SEM to examine the causal relationship between teaching practices and school climate, while teacher self-efficacy was a mediator. He used TALIS 2018 data collected from the United States. He found that there is a positive effect between school climate and teacher self-efficacy. Whereas teacher self-efficacy has a positive effect on teacher practice.

2.5. Structural Equation Modeling in Saudi Arabia

Recently, the application of SEM in the different aspects of the Saudi education system significantly emerged. AL-Dossary [3] utilized SEM to confirm the planned behavior theory and related it to Saudi students' cheating attitudes. Gorondutse et al. [24] applied SEM to investigate the relationship between school leadership and training on teachers' performance, the moderator was ambiguity. A sample of 366 employees in higher education in Saudi Arabia was chosen. The results show there is a positive impact of school leadership and training on teachers' performance. Also, the results showed that there was an indirect effect between leadership manner and employees' performance, whereas ambiguity is the moderator. Osman et al. [48] applied SEM to identify the causal relationship between student satisfaction, quality program, institution image, and service quality. Basri et al.[11] studied how Information Communication Technology (ICT) is used in colleges and how it affects students' academic performance. Structure equation modeling was used, and a sample size of 1000 students in Saudi Arabia was selected. The results show that there is a relationship between ICT usage and academic performance. A further finding indicated that female students' performance improved more than male students' when ICT was adopted. It was found that students' academic success was unaffected by their Information Technology (IT) major. Akinwale et al. [2] used SEM approach to identify the factors affecting students' entrepreneurial interests among Saudi university students. Alshehri et al. [5] conducted a study using SEM to investigate how students accept and use the Blackboard system. He selected a sample of 171 students from King Khalid University in Saudi Arabia. The results showed that three factors significantly influence students' behavioral intention to use a learning management system (LMS): performance expectations, social influence, and technical support. However, the facilitating condition, and effort expectation, do not influence students' behavioral intention to utilize an LMS. Alshuwaysh et al. [6] studied the influence of teachers' beliefs on teaching performance in a sample of 401 teachers from intermediate schools in Riyadh. Using SEM, they found that there is a positive effect of teachers' beliefs on teaching performance. Also, they found that the relationship between teachers' beliefs and teaching performance was not affected by gender. The impact of perceptions of teaching tasks on creative teaching practices was investigated, A sample of 250 faculty members in Saudi Arabia were chosen. After applying SEM, it was found that there is a significant strong and positive impact of perceptions of teaching tasks on creative teaching practices[4]. As demonstrated, there is a compelling body of research on the application of SEM in the education field, particularly to study the relationship between teacher self-efficacy and teaching practices in various countries. However, the data collected from TALIS 2018 from Saudi Arabia is yet to be explored. Specifically, the relationship between teacher self-efficacy and teacher teaching practices. This study can be considered a reference for further research in the field of application of structural equation modeling on TALIS 2018.

3. Research Aims and Objective

The primary aim of this study is to use structural equation modeling to analyze TALIS data collected from Saudi Arabia in 2018. Key objectives include:

- Study the impact of the teachers' efficacy on teacher teaching practice in the education system of Saudi Arabia.
- Test the validity and reliability of the measurement models related to teachers' efficacy and practice.
- Test the relative significance of the causal relationships between efficacy and practice.
- Test the measurement invariance across factor loadings, other estimated parameters, and regression coefficients in terms of gender.

4. Data collection

4.1. Data Collection and Sampling

The sample data was collected from TALIS 2018, which targeted lower secondary teachers and their school leaders in mainstream public and private schools. The sample was designed using stratified cluster sampling, where 20 teachers were chosen from every 200 randomly selected schools. In Saudi Arabia, 2744 lower secondary teachers and 192 leaders responded to the survey. A few missing values were replaced using time series data transformations. Owing to the large sample size, the outliers were deleted and hence, 2741 is retained for the analysis.

4.2. Variables

According to the TALIS technical report [32], three sub-constructs comprise teacher self-efficacy (classroom management efficacy, instruction self-efficacy, and student engagement efficacy), and three sub-constructs comprise teacher teaching practice (instructional practices, cognitive activation practices, and classroom management practices). This study is based on Chen et al. [15] study, which applied SEM to three constructs, for teaching practice of teachers, and two constructs, for teacher's self-efficacy. Table 1 and Table 2; show the variables in each construct.

Table 1: Teacher self-efficacy (Sub-constructs and observed variables), taken from TALIS technical report [32]

Classroom management efficacy		
In your teaching, to what extent can you do the following?		
Response options: “Not at all”, “To some extent”, “Quite a bit”, “A lot”.		
Observed Variables	Code	Data type
Control disruptive behavior in the classroom	TT2G34D	Ordinal
Make my expectations about student behavior clear	TT2G34F	Ordinal
Get students to follow classroom rules	TT2G34H	Ordinal
Calm a student who is disruptive or noisy	TT2G34I	Ordinal
Instruction Self-efficacy		
In your teaching, to what extent can you do the following?		
Response options: “Not at all”, “To some extent”, “Quite a bit”, “A lot”.		
Observed Variables	Code	Data type
Craft good questions for students	TT2G34C	Ordinal
Use a variety of assessment strategies	TT2G34J	Ordinal
Provide an alternative explanation, for example when students are confused	TT2G34K	Ordinal
Vary instructional strategies in my classroom	TT2G34L	Ordinal

Table 2: Teaching practice (Sub-constructs and observed variables), taken from TALIS technical report [32]

Clarity of instructional practices Thinking about your teaching in the target class, how often do you do the following? Response options: "Never or almost never", "Occasionally", "Frequently", "Always"		
Observed Variables	Code	Data type
I set goals at the beginning of instruction	TT3G42B	Ordinal
I explain what I expect the students to learn	TT3G42C	Ordinal
I explain how new and old topics are related	TT3G42D	Ordinal
Cognitive activation practices Thinking about your teaching in the target class, how often do you do the following? Response options: "Never or almost never", "Occasionally", "Frequently", "Always"		
Observed Variables	Code	Data type
I present tasks for which there is no obvious solution	TT3G42E	Ordinal
I give tasks that require students to think critically	TT3G42F	Ordinal
I have students work in small groups to come up with a joint solution to a problem or task	TT3G42G	Ordinal
I ask students to decide on their procedures for solving complex tasks	TT3G42H	Ordinal
Classroom management practices Thinking about your teaching in the target class, how often do you do the following? Response options: "Never or almost never", "Occasionally", "Frequently", "Always"		
Observed Variables	Code	Data type
I tell students to follow classroom rules	TT3G42I	Ordinal
I tell students to listen to what I say	TT3G42J	Ordinal
I calm students who are disruptive	TT3G42K	Ordinal
When the lesson begins, I tell students to quieten down quickly	TT3G42L	Ordinal

4.3. Methods

In this research, the Statistical Package for the Social Sciences (SPSS 24) was used to conduct the descriptive statistics, assumption checking, and to determine the framework of instructors' self-efficacy and their instructional practice. Exploratory factor analysis was tested and then reliability and validity tests were conducted. The confirmatory factor analysis and the structural equation modeling were implemented using Analysis of Moment Structures (AMOS 26) software to confirm the EFA and to model the relationship between teacher efficacy and teacher teaching practices respectively. Table 3 shows the result of descriptive statistics.

Table 3: Descriptive Statistics

Background variables	Distinction Male	Frequency	Percentage (%)
Gender	Female	1542	56.3
	Male	1199	43.7
Educational level	Did not complete high school	4	0.1
	High School	44	1.6
	Associate's degree	11	0.4
	Bachelor's degree	2518	91.9
	Master's degree	114	4.2
	Doctorate	4	0.1
Was teaching your first choice ?	Yes	2183	79.6
	No	452	16.5

5. Data Analysis and Results

The data was checked for normality assumption using skewness and kurtosis with values of skewness ranging between -2 and +2 and value of kurtosis ranging between -7 and 7 indicating a satisfactory normal distribution [18] [14] [17]. As shown in Tables 4 and 5, the skewness and kurtosis values of each item (observed variables) in both factors (teacher self-efficacy and teacher practices) indicated that all items are normally distributed since the skewness and kurtosis fulfilled the criteria.

Table 4: Descriptive Statistics for Teacher Self-Efficacy, the variables taken from TALIS technical report [32]

Code	Normality	
	skewness	kurtosis
TT2G34D	-1.02	0.335
TT2G34F	-0.617	-0.615
TT2G34H	-1.501	1.798
TT2G34I	-1.518	1.694
Code	Normality	
	skewness	kurtosis
TT2G34J	-0.878	-0.249
TT2G34K	-1.213	0.625
TT2G34L	-0.906	-0.187

Table 5: Descriptive Statistics for Teacher Practices, the variables taken from TALIS technical report [32]

Code	Normality	
	skewness	kurtosis
TT3G42B	-1.227	0. 651
TT3G42C	-1.201	0.561
TT3G42D	-1.145	0.512
Code	Normality	
	skewness	kurtosis
TT3G42E	0.123	-1.151
TT3G42F	-0.034	-1.056
TT3G42G	-0.476	-0.899
TT3G42H	-0.014	-1.053
Code	Normality	
	skewness	kurtosis
TT3G42I	-1.131	0.442
TT3G42J	-1.244	0.472
TT3G42K	-1.279	0.59
TT3G42L	-1.111	0.152

5.1. Exploratory Factor Analysis

EFA is an exploratory step used to explore the dimensional structure and to investigate the relationship between the observed and latent variables, whereas, the CFA is used to confirm EFA [52]. In EFA, the model adequacy, reliability, and validity were checked. The relationship between observed and latent variables was determined using rotation and extraction methods.Several approaches are available to assess the EFA model ade-

quacy, including the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO-test) and Bartlett's test of sphericity for assessing the overall significance of the correlation matrix [27]. The results show that the KMO test was > 0.5 for both teacher self-efficacy and teacher teaching practices [51]. In addition, the value of Bartlett's test was significant (p-value=0.000) indicating a significant correlation matrix. The EFA results revealed that teacher self-efficacy has two sub-constructs and the teacher teaching practices variable has three sub-constructs. The items were assigned to the construct (factors) based on the loading of (0.70) according to Hair [27] as they are considered indicative of a well-defined structure. Although the loading of 0.30 is still acceptable according to Hair [27], retaining such variables with loading equal to 0.3 will cause an issue when calculating the validity and reliability of the measurement model (confirmatory factor analysis). This criterion suggests deleting the items with loading less than 0.70. Hence the third sub-construct presented in the TALIS technical report "Self-efficacy in Student Engagement" was dropped from the analysis. Teacher self-efficacy has two constructs with a total exploratory variance is 61.782 %, whereas teacher teaching practices have three constructs with total explained variance of 60.457%, as shown in Table 6. The internal consistency of the scales was assessed using Cronbach alpha coefficient indicating high internal consistency among items. A summary of construct reliability measure is presented in Table 6.

Table 6: Descriptive Statistics for Teacher Practices, the variables taken from TALIS technical report [32]

Category	Construct	Reliability	Total explained variance
Teacher self-efficacy	Instruction self-efficacy	0.811	61.78%
	Classroom management efficacy	0.87	
Teacher practices	Instructional practices	0.829	60.46%
	Cognitive activation practices	0.804	
	Classroom management practices	0.852	

5.2. Structural Equation Modeling

5.2.1. Measurement Model

The researcher confirmed exploratory factor analysis by confirmatory factor analysis, which tests the measurement models, including the relationships between factors and observed variables [17]. This is the first step of the two steps approach to structural equation modeling. In confirmatory factor analysis, five basic steps were performed: model specification, model identification, model estimation, model fit, and model modification. The model is specified depending on theory and prior research [52]. Then, the model is identified as one of three cases based on the information of the sample variance-covariance matrix. The three cases are the over-identified model, the just-identified model, and the under-identified model. A model is said to be under-identified if there is not enough information from the input data to estimate the parameters. Otherwise, in the just-identified model, the parameters are estimated because there is enough information. On the other hand, it is considered over-identified if there are several ways to estimate the parameters

[52]. Following the identification step, the researcher estimates the parameters in the measurement model, including factor loadings, factor variances, covariances, observed error variances, and observed error covariances [17]. The measurement model was assessed through factor loading, reliability of measurement, convergent and discriminant validity, and fit indices. As shown in Figure (1), the measurement model was built based on the theory reported in the technical report by the TALIS technical report [32], and also based on the published research by Chen et al. [15]. The measurement model was tested, and it was found all factor loadings exceed 0.50, which indicates the strength of the connection between the latent and observed variables. Figure 1 also shows that there is a strong correlation between classroom management efficacy and instructional efficacy (0.84), which might cause collinearity between factors. To solve the issue of the strong correlation between factors (above 0.80), a higher-order construct is used according to Civelek in [17]. This means the factors of classroom management efficacy and instructional efficacy require to be combined in a high order as shown in Figure 2. It is noted that after adding the high order, the factor loadings decrease slightly but remain above 0.5, hence the relationship between the latent and observed variables is still strong. Table 7 below shows a summary of the result of the measurement model.

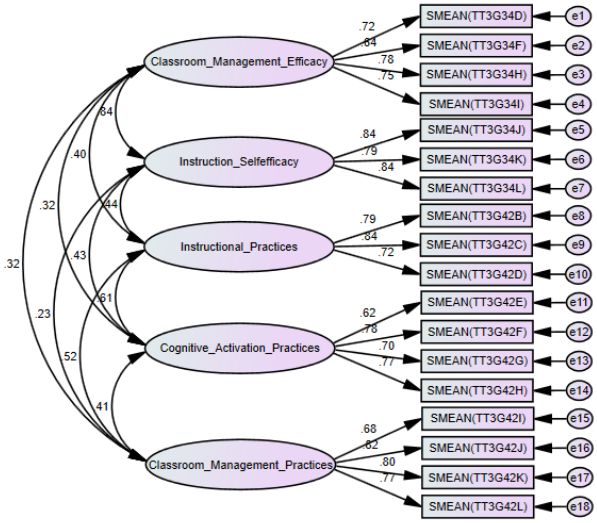

Figure 1: The Measurement Model

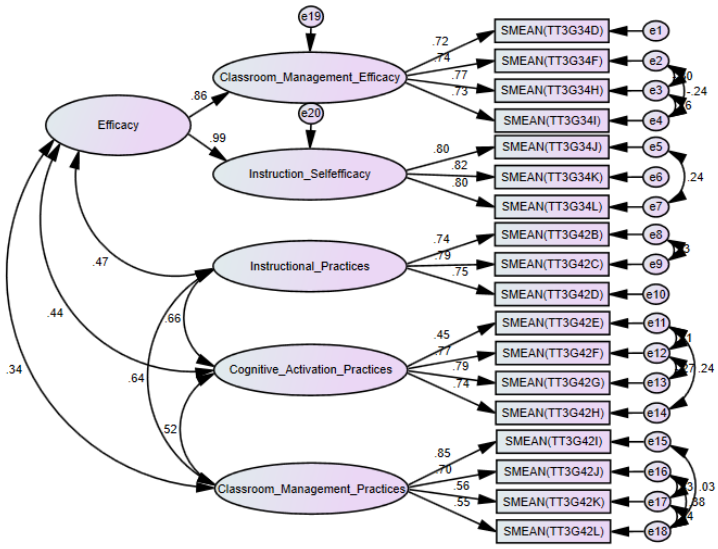

Figure 2: High Order and Modification

Table 7: Result of The Measurement Model

Construct	Item	Significance of estimated parameters				
		Unstd	S.E	Unstd/S.E	p-value	Std
Classroom management efficacy	TT2G34D	1				0.723
	TT2G34F	1.2	0.038	31.743	0	0.736
	TT2G34H	0.99	0.03	33.247	0	0.774
	TT2G34I	0.96	0.031	31.522	0	0.731
Instruction self-efficacy	TT2G34J	1				0.804
	TT2G34K	0.96	0.023	42.268	0	0.817
	TT2G34L	1.02	0.02	50.928	0	0.802
Clarity of instructional practices	TT3G42B	1				0.74
	TT3G42C	1.02	0.024	41.701	0	0.786
	TT3G42D	0.97	0.031	30.876	0	0.751
Cognitive activation practices	TT3G42E	1				0.446
	TT3G42F	1.39	0.064	21.784	0	0.767
	TT3G42G	1.5	0.079	19.116	0	0.794
	TT3G42H	1.44	0.065	21.978	0	0.736
Classroom management practices	TT3G42I	1				0.853
	TT3G42J	0.8	0.029	27.082	0	0.702
	TT3G42K	0.73	0.032	22.883	0	0.562
	TT3G42L	0.75	0.038	19.704	0	0.545

Costa and Sarmento [51] demonstrate that model fit determines whether the specified model well represents the data. According to Civelek [17], and Costa and Sarmento [51] there are common indices used to assess the model fit, and their criteria are as follows: p-value of Chisq > 0.05, Root Mean Square Error Approximation (RMSEA)< 0.08, Goodness of Fit Index (GFI) > 0.90, Comparative Fit Index (CFI)> 0.90, Normed Fit Index (NFI)> 0.90, Tucker-Lewis Index (TLI)> 0.90, and Chisq /df< 5. The resulting model can be further improved through modification indices; if the value of chi-square/ df exceeds 5; then the researcher has to correlate the high-covariance errors with each other (see Hasman in [30], Civelek in [17]). The fit indices and the modification in the model are reflected in Table 8, which shows seven trials for model modifications to reach the best fit. In the final model, the indices of absolute fit and comparative fit achieve the criteria of the model fit, and parsimony fit is almost achieved, which indicates that the model is improved.

Table 8: Model Fit After Modification

Indices	High order	Modifications						
		e11,e12	e17,e18	e3,e4	e11,e14	e2,e3	e8,e9	Final Model
GFI	0.926	0.935	0.945	0.952	0.955	0.961	0.969	0.973
RMSEA	0.069	0.064	0.059	0.056	0.055	0.051	0.044	0.043
CFI	0.932	0.941	0.95	0.955	0.958	0.965	0.974	0.976
TLI	0.918	0.928	0.939	0.945	0.948	0.955	0.966	0.968
NFI	0.927	0.936	0.945	0.951	0.953	0.96	0.969	0.972
Chisq /df	13.938	12.347	10.617	9.703	9..250	8.089	6.425	5.979

The measurement invariance, which is indicated by the equivalent in measurement properties across a group or across time (e.g., gender, race), was tested by Civelek [17]. Four basic types of measurement invariance; configural invariance, metric invariance, scalar invariance, and strict invariance. Configural invariance ensures that the same observed variables measure the same factors across groups, it can be tested through chi-square or the alternative fit indices including CFI > 0.95, RMSEA < 0.06, and SRMR < 0.08 [54],[45]. Metric invariance means that the relationship between observed variables and factors remains the same across groups [45]. According to Sokolov in [54], if there is a significant difference, then the researcher uses the difference in the configural model with the metric model in the indices; ΔCFI< 0.010, ΔRMSEA> -0.015, and ΔSRMR> -0.03. Scalar invariance achieves the equality of the factor loadings and item intercepts across groups [45], Scalar invariance can be tested using the difference of chi-square in the metric model and scalar model, if there is a significant difference, then the model is not invariant. Computing the difference between the indices: ΔCFI< 0.010, ΔRMSEA> -0.015, and ΔSRMR> -0.03 in metric and scalar models is another alternative solution [54]. Strict invariance ensures that there is the same invariance, error variances, and covariances through groups [41]. Serrano-archimi et al. [53] point out that common method bias is another essential step in CFA. The importance of this step lies in ensuring that there is no

bias between variables, and it can be computed using the difference between standardized regression weights without common method bias and standardized regression weights with common method bias. A difference of less than 0.2 indicates no common method bias. Finally, convergent validity, discriminant validity, and reliability were investigated. To test the convergent validity, we used the average variance extracted (AVE) where the value should exceed 0.05. The square root of AVE and the correlation coefficients were compared to assess the discriminant validity. Discriminant validity is achieved if the individual factor's square root of AVE is greater than the correlation coefficients between the factors [17]. The reliability was assessed through construct reliability, which should be greater or equal to 0.7 [28]. As shown in Table 9, the main model achieves the expected level of the model fit, which indicates that the data fit the model. In configural invariance, we have evaluated the fit indices RMSEA < 0.08, CFA $> .90$, and Chisq /df < 5, which means the configural model represents a modest fit to the data. In metric invariance, we evaluated the difference between alternative fit indices and found that ΔCFI< 0.010, and ΔRMSEA> -0.015, indicating that there is a metric invariance in other words the relationship between observed variables and factors remains the same across groups. In scalar invariance, we have to calculate the difference of fit indices, and we found ΔCFI< 0.010, and ΔRMSEA> -0.015, which means there is a scalar invariance (the model achieves the equality of the factor loadings and item intercepts across groups). Table 10 shows the estimation of convergent validity using factor loading and average variance extracted (AVE). Since the factor loadings exceed 0.5 and the values of average variance extracted (AVE) exceed 0.5, then there is a convergent validity. There is discriminant validity since the square root of AVE for each factor is larger than the correlation coefficients between factors. We have estimated the reliability using construct reliability (CR) since the CR is greater than 0.7; this means all factors have internal consistency.

Table 9: Measurement Invariance between Male and Female

Model	X^2	Δ X^2	Df	CFI	Δ CFI	RMSEA	Δ RMSEA	Chisq /df	p-value
Main Model	621.763	-	113	0.979	-	0.041	-	5.502	-
Configural	773.925	-	200	0.974	-	0.032	-	3.879	0
Metric	791.4	17.475	212	0.974	0	0.032	0	3.733	0.132586
Scalar	882.279	90.879	224	0.97	0.004	0.033	-0.001	3.939	0.00001

Table 10: Convergent Validity, Discriminant Validity, Reliability

Code	Factor	Loading	AVE	square root of AVE	CR
TT3G34D	Classroom Management Efficacy	0.723	0.549	0.7413	0.829785
TT3G34F	Classroom Management Efficacy	0.736			
TT3G34H	Classroom Management Efficacy	0.774			
TT3G34I	Classroom Management Efficacy	0.731			
TT3G34J	Instruction Self-efficacy	0.804	0.652	0.8077	0.849158
TT3G34K	Instruction Self-efficacy	0.817			
TT3G34L	Instruction Self-efficacy	0.802			
TT3G42B	Instructional Practices	0.74	0.576	0.7589	0.802844
TT3G42C	Instructional Practices	0.786			
TT3G42D	Instructional Practices	0.75			
TT3G42F	Cognitive Activation Practices	0.446	0.686	0.8281	0.786647
TT3G42G	Cognitive Activation Practices	0.767			
TT3G42H	Cognitive Activation Practices	0.794			
TT3G42I	Classroom Management Practices	0.736	0.458	0.677	0.765835
TT3G42J	Classroom Management Practices	0.853			
TT3G42K	Classroom Management Practices	0.702			
TT3G42L	Classroom Management Practices	0.562			
Correlation	Efficacy <->Instructional Practices	0.473			
	Efficacy <->Cognitive Activation Practices	0.443			
	Efficacy<->Classroom Management Practices	0.338			

5.2.2. Structural Model

Structural equation modeling is a statistical technique that tests the relationship between latent variables (factors) [17]. Panchenko [50] argues that the strength of SEM emerged from its ability to combine the power of other statistical tools, including correlation, multiple regression, confirmatory factor analysis, and path analysis. In practice, two widely used techniques dominate SEM: Partial Least Squares SEM (PLS-SEM) and Covariance-Based SEM (CB-SEM). The main purpose of CB-SEM, used in this research, is to test, validate, and refine the theoretical model. By assessing the degree to which a suggested theoretical model can be replicated by the covariance matrix for an observed sample dataset [29]. SEM has two essential components, the measurement model and the structural model. The measurement model describes the relationship between observed and latent variables (summarized in section 5.2.1), whereas, the structural model describes the relationship between latent variables [38]. Hair [27] argue that SEM has to rely on a solid theory in order to build the measurement and structural models. It has several advantages, including its ability to analyze complex causal and correlational relationships providing the fit analysis of various components simultaneously [17],[27],[52]. The reliability of SEM model can be tested for each latent variable [46],[57],[47]. One advantage of SEM is that it can consider measurement errors and analyze data with multicollinearity issues [27]. Hair et al. [27] indicated that SEM is conducted throughout six stages: (1) Defining the individual factors. (2) Specify the measurement model. (3) Check the assumptions. (4) Test the validity of the measurement model. If the model is valid then test the structural model. If the model is not valid then design another study. (5) Specify the structural model. (6) Test the validity of the structural model. Equation (1) shows the general structural model (see [27] for more details).

$$Y_i = \beta_i X_i + \varepsilon_i \tag{1}$$

To test the research hypothesis, that teacher self-efficacy influences teachers' teaching practices, the structural model was applied using the maximum likelihood estimation (MLE) technique. We examined the path effects and fit the model to determine whether the data support the structural equation model. As shown in Figure 3, we have built the structural model between teacher self-efficacy and teacher teaching practice. The result showed that there is a causal relationship between teacher self-efficacy and the dimensions of teacher teaching practice (clarity of instruction practice, cognitive activation practice, and classroom management practice). From Table 11 teacher self-efficacy significantly positively affects the (clarity of instruction practice, cognitive activation practice, and classroom management practice) where β are (0.59, 0.54, 0.46) respectively with p-values < 0.001. In addition, it can be shown that teacher self-efficacy explained 34.4% of clarity of instruction practice, 28.9% of cognitive activation practice, and 21% of classroom management practice. From Table 12, it can be seen that the absolute and comparative fit indices achieve the criteria of the model fit, while the parsimony fit is not achieved due to large sample data. Overall, the model shows satisfactory performance.

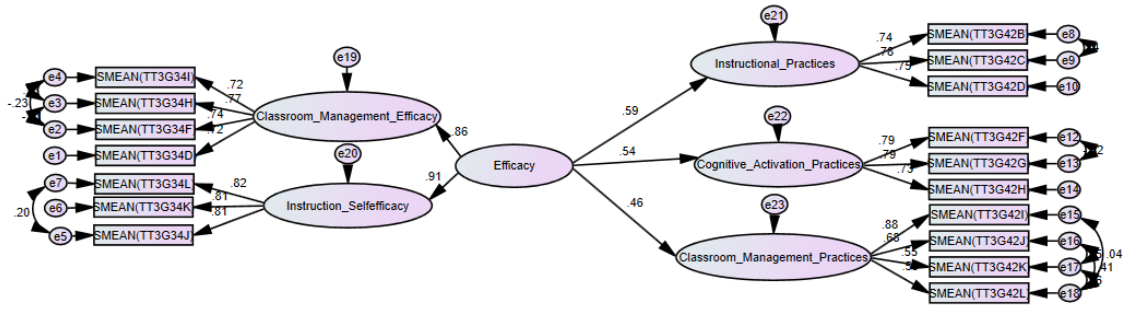

Figure 3: The Structural Model

Table 11: Structural Equation Model Analysis

Independent variable	Dependent variable	B	β^2	R^2	p-value	supported?
Teacher self-efficacy	Clarity of instruction practice	0.63	0.59	0.344	0	Supported
	Cognitive activation practice	0.716	0.54	0.289	0	Supported
	Classroom management practice	0.587	0.46	0.21	0	Supported

Table 12: Model Fit

Category			Index	Level of acceptance
Absolute Fit	GFI	GFI>90	0.924	Achieved
	RMSEA	RMSEA <.08	0.077	Achieved
Comparative Fit	CFI	CFI >.90	0.927	Achieved
	TLI	TLI >.90	0.905	Achieved
	NFI	NFI >.90	0.923	Achieved
Parsimony fit	Chisq /df	Chisq /df <5	17.046	Not achieved

6. Discussion and Conclusion

Improving the quality of education is one of the primary objectives announced by Saudi Arabian Vision 2030. Since educators play a vital role in achieving the vision's educational goals; therefore, focusing on teacher efficacy and practices is a critical research area. This research can be considered a significant endeavour in applying the structural equation model to data collected from the education sector in Saudi Arabia specifically TALIS 2018. It is intended to illustrate the causal relationship between teacher self-efficacy and teaching practices. Through the literature, it is found that no studies examine the relationship between teacher self-efficacy and teacher practices using TALIS data by applying a structural equation model in Saudi Arabia. Based on TALIS 2018 data, we constructed the study's model based on two factors; teacher self-efficacy which includes classroom

management efficacy, instruction efficacy, and teacher teaching practice (clarity of teaching practice, cognitive activation practice, and classroom management practice). It was successfully demonstrated that the research model exhibits a good fit with the data. The findings indicated a positive relationship between teacher self-efficacy and teacher teaching practice. The model coefficient β value of teacher self-efficacy (classroom management efficacy, instruction efficacy) to the (clarity of instructional practices, cognitive activation practices, and classroom management practices) are (0.59, 0.54, and 0.46) respectively with p-values equal to 0.000. This indicates that teacher self-efficacy has a positive effect on teacher teaching practice. Also, The findings demonstrated the validity of the measurement models, where the factor loadings and average variance extracted (AVE) exceed 0.5, and the square root of average variance extracted (AVE) for each factor is larger than the correlation coefficients between factors. The measurement models are reliable since the construct reliability (CR) exceeds 0.70. The result showed that there is evidence for the existence of measurement invariance through factor loadings, estimated parameters, and regression coefficients in terms of females and males. Finally, we ensured that the data of the study support the proposed model. The current results appear to be in line with the research findings by Chen et al. [15] which applied structural equation modeling using data from TALIS 2018 in Taiwan. They found that the model was valid and reliable, and the data fit the model. They also found there was a positive effect of instruction efficacy on clarity of instruction practice, cognitive activation practice, and classroom management practice. Also, they found there was a positive effect of classroom management efficacy on clarity of instruction practice, and classroom management practice, except cognitive activation practice which has a negative effect. According to TALIS technical report in [32], the most challenging is cognitive activation practice, while the most effective is clarity of instruction practice. The findings of the application on Taiwan data demonstrated that teachers who are more effective at managing the classroom set higher expectations for their student's behavior. This causes students to become more circumspect, and student's practice of cognitive activation practice by the teacher will decrease. Depaepe and König [19] showed that teacher self-efficacy has important foretelling power for teacher teaching practice, particularly for cognitive activation practice in Germany. Comparing these previous studies with our result, the effect of teacher self-efficacy on clarity instruction practice is the highest positive influence and then cognitive activation practice. Holzberger et al. [33] proved that teacher self-efficacy significantly affects teacher practice in Germany, and this is consistent with our study. Another research by Li [44] found that school climate positively affects teacher self-efficacy and teacher practice using SEM on TALIS 2018 data. He found that teacher self-efficacy has a positive effect on teacher practice. Overall, there is a positive effect of teacher self-efficacy on teacher teaching practice (clarity of instruction practice, cognitive activation practice, and classroom management practice) in Saudi Arabia, which is supported by [33],[19],[15],[44]. According to TALIS technical report [32], lifelong learners and professionals' intrinsic motivation and attitude should be taken into account while choosing candidates for teaching positions and their training programs. Based on the findings of this research, it is recommended that teacher development programs should be in line with the larger educational reform

initiatives outlined in Saudi Arabia's Vision 2030. This means placing a strong emphasis on the development of teachers through topics like creativity, and critical thinking which can enhance the teacher's self-efficacy. This might significantly improve teaching practices and student achievements. Another recommendation is to establish mechanisms to continuously monitor and evaluate the impact of these initiatives on teacher self-efficacy and student outcomes focusing on regular feedback. Additionally, the education sector may wish to invest significantly in continuous professional development opportunities focused on modern teaching methodologies and the integration of technical advancement especially after the revolution of artificial intelligence. This will help teachers to enhance their self-efficacy and feel more effective in their teaching practices. Finally, we suggest carrying out additional research utilizing the structural equation model and the TALIS 2018 data to investigate the causation between teacher self-efficacy and teacher practices, as the study is conducted in countries neighbouring the Kingdom of Saudi Arabia, to compare causal relationships between variables. In this research, the author implemented structural equation modeling (Covariance-based SEM) to test and confirm the theoretical assumption derived by Chen et al.in 2020. The goal is to model this relationship in an initial study based on data collected from Saudi Arabia. We are planing to expand this research to cover all the factors reported in the TALIS survey, hence getting deep insight into relationships between factors in Saudi Arabia. This will give the researcher the chance to help and support the decision-makers in the education sector in making the right decision based on real data.

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