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CONFIRMATORY FACTOR ANALYSIS OF LATENT SUB- SCALES OF TEACHER RESEARCH ENGAGEMENT OF PUBLIC SCHOOLS ELEMENTARY TEACHERS

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Abstract

The current study aims to find the pattern of relationship and establish factorial validity among predictors of teacher research engagement. This study employed a descriptive- correlational research design. A validated researcher-made Teacher Research Engagement Survey with three subscales was used to gather data from 612 public school teachers. The researcher then computed descriptive statistics and conducted a confirmatory factor analysis of the hypothesized measurement model and a modified measurement model. The analysis revealed that teachers have high physical research engagement with ($\bar{x}=3.1149$, $SD=0.85429$), high cognitive research engagement with ($\bar{x}=3.7145$, $SD=0.9505$) and fair emotional research engagement with ($\bar{x}=3.4513$, $SD=0.8463$). The correlation matrix presents that there is a strong positive highly significant relationship between physical research engagement and cognitive research engagement ($r=0.632$, $p>0.05$), physical research engagement and emotional research engagement ($r=0.705$, $p>0.05$), and cognitive research engagement and emotional research engagement ($r=0.830$, $p>0.05$). The modified measurement model of teacher research engagement obtained acceptable and better model fit indices of $CMIN/DF=3.939$, $CFI = 0.972$,

SRMR = 0.054, RMSEA = 0.069, NNFI/TLI = 0.955, GFI = 0.945 and PClose = 0.000. This study concludes that teachers have high physical research engagement, and high cognitive research engagement, and fair emotional research engagement. There is a significant relationship among physical research engagement, cognitive research engagement, and emotional research engagement subscales. In the confirmatory factor analysis, the modified model was able to obtain a better model fit indices, factor loadings, and covariance.

Keywords

Descriptive, Correlational, Confirmatory Factor Analysis, Research Engagement, Research Management, Educational Research, Teacher Research, Education, Philippines

1. Introduction

In the Philippines, the Department of Education (DepEd) is now emphasizing research and development. This progress was modeled from other performing educational systems like Finland's, which gives high value and attention to research in every level of their educational system, especially in the classroom level. Research in education is indeed essential for the administration, management, and implementation of the educational system. The Basic Education Governance Act of 2001 (RA9155) accentuated the role of research in the management and administration of the core education system. With this mandate, the Department has strived to strengthen the research practices of its constituents. The Department issued DepEd Orders to establish a policy development process that provides for a systematic, evidence-based and participatory mechanisms and actions for the creation, adoption, and examination of policies issued by DepEd (DO 13, s. 2015). The DepEd also encourages and capacitate the teachers and administrators to conduct educational researchers and increase their research productivity by providing research funds to eligible proponents (DO 43.s, 2015) & (DO 4.s, 2016).

DepEd stakeholders are also guided in the conduct of their research works and that the department can make use of these research results in planning, policy and program development in consonance with the vision mission and core values of the Department of Education through the Basic Education Research Agenda. DepEd likewise established the Research Management Guidelines (RMG) to guide research center managers in managing research initiatives in the central offices, regional offices, schools division offices, and school levels (DO 16, s. 2017). The

Department of Education is exerting reasonable efforts to increase research productivity among its stakeholders not only at the school level but in national as well.

Despite these efforts, there is very minimal action and educational research submission in division offices. There is also very minimal literature in research engagement of teachers as this is one of the areas that is least explored by our educational researchers. This organizational dilemma and literature gap should be filled and considered for us to establish the psychometric properties as related to reliability and validity of the teacher research engagement construct.

1.1 Teacher Research

Teacher research plays a vital role in the teaching-learning process. It serves as the backbone of the teaching approaches, strategies, technique, instruction materials, and assessment that we currently use now. Teachers involved and engaged in research and utilize research evidence as the basis for instructional and pedagogical choices are leading to having desirable effects on both the teaching and learning process. Teacher research is an ideal way for teaching professionals to explore and develop their understandings of their practices Borg (2010). As explained by Cain (2015), teachers transform theoretical knowledge into practical knowledge through developing their conceptual understanding about it. They then transmute theoretical knowledge into contextualized and personal knowledge using cases from their previous experiences. They also transformed specific insight into a broader knowledge base by creatively diffusing it into areas beyond those in the original research.

1.2 Research Engagement

This study also seeks to highlight some concepts that could examine teachers' research engagement. Research engagement needs to be explored further by multi-dimensional and empirical investigations Mehrani (2015). An awareness of these conditions is essential to the success of initiatives which aim to promote teacher research engagement Borg (2010). Assessing teachers' research engagement is vital to enable policy makers, human resource, and development division to develop interventions leading to an increase in research engagement among teachers.

The current study was anchored on the Model of Personal Engagement and Disengagement in Work of Kahn (1990). Kahn's model presents the general idea that people involve their selves physically, cognitively, and emotionally, at various degrees in work role performances. The physical aspect of employee engagement concerns with the physical energies

used by individuals to accomplish their functions. The cognitive element of employee engagement involves employees' beliefs regarding the organization, working conditions, and its leaders. The emotional aspect of employee engagement means how employees feel about each of those factors and whether they have either positive or negative attitudes toward the organization and the leaders. Khan further theorized that there are conditions at work in which individuals personally engage or express and employ their selves, and disengage or withdraw and defend their selves. The current study looked into the research engagement of the public school teachers. In connection with this theory into the context of the present study, this study looked into teaching staff' degree of involvement in doing research physically, cognitively, and emotionally, at a varying level of engagement. The current study investigated the research engagement of the teachers and hypothesized factors that affect their engagement and disengagement in research. Teachers should be motivated to perform research and other scholarly investigations in the different learning areas Borg (2012) because research is an essential part of the work of a teacher.

1.3 Purpose of the Study

The current study is motivated, through confirmatory factor analysis to find the pattern of relationship and establish factorial validity among predictors of research engagement of the public school teachers. This study also to test a measurement model of research engagement and build the psychometric properties as related to reliability and validity of the proposed measurement model. It is essential to explore the to the identification of the factors and dimensions that form the structure of the teacher research engagement may contribute necessary theoretical and practical implications, especially that research engagement is an area that only explored by the minority.

1.4 Research Questions

1.4.1 What is the level of Research Engagement of Public Schools Elementary Teachers

Regarding:

1.4.1.1 Physical Research Engagement

1.4.1.2 Cognitive Research Engagement

1.4.1.3 Emotional Research Engagement

1.4.2 Are there Significant Relationships among Relationship among Sub-Scales of Research Engagement?

1.4.3 What Measurement Model would Best Fit the Model of Research Engagement?

2. Method

The current study is based on a descriptive-correlational research design. The researcher used proportional stratified random sampling and obtained a sample of 612 public school teachers which was proportionally distributed among ten districts in the schools' division. The researcher used a researcher-made survey questionnaire "Teacher Research Engagement Survey" with three sub-constructs namely Physical Research Engagement (reliability coefficient of $\alpha=0.836$, $k=6$), Cognitive Research Engagement ($\alpha=0.932$, $k=4$), Emotional Research Engagement ($\alpha=0.908$, $k=6$). Using the method of Davis (1992), the tool was face validated by 12 experts in the field of planning and research, human resource, testing and evaluation, linguistics, psychometrics, educational leadership and practitioner teachers, all with Ph.D. degrees. The tool also obtained an overall Flesch Reading Ease score of 64.5 which falls under 8th to 9th grade in the Flesch-Kincaid Grade Level Score, which tells that the research tool is very readable as to the level of the teachers with a college level minimum educational qualification.

The researcher also followed ethical standards in data gathering such as following entry protocol and securing an informed consent form. The respondents were also given freedom to decline in the participation of the study. They were also informed of their rights, non-remuneration, and risks as respondents. The researcher also deleted and shredded the responses after encoding to ensure the confidentiality of the identity of the participants.

Before the data analysis, the researcher conducted a multilevel data screening which involved listwise deletion of missing data, exclusion of outliers as suggested by Hair, et. Al. (2012), and test for normality to ensure that the data to be used in the analysis are valid and usable. The researcher then used SPSS Version 20.0 with an extension of AMOS (Analysis of Moment Structures) in the descriptive and associational statistical analysis. In the Confirmatory Factor Analysis (CFA), the researchers used measures of model fit such as CMIN/DF, p-value, Goodness of Fit Index (GFI), Comparative Fit Index (CFI), Non-Normed Fit Index (NNFI), also known as Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA).

3. Presentation of Findings

Research Question 1.4.:

What is the level of research engagement of public schools elementary teachers regarding:

1.4.1.1 Physical Research Engagement

1.4.1.2 Cognitive Research Engagement

1.4.1.3 Emotional Research Engagement

Table 1: Descriptive Statistics of Teachers' Level of Physical Research Engagement

Indicators	Mean (\bar{x})	SD	QD
PE1: I browse research journals in the library or online for research works.	2.94	1.205	Fair Engagement
PE2: I read literature and studies about teaching and learning.	2.98	0.985	Fair Engagement
PE3: I research because it will help improve my teaching as well as solve problems in the classroom.	3.43	1.078	High Engagement
PE4: I conduct research for professional development.	2.81	1.074	Fair Engagement
PE5: I apply the theories and research findings that I have read and discovered to uplift my teaching practice.	3.11	1.001	High Engagement
PE6: I apply in my class what I learned from reading the research.	3.44	1.031	High Engagement
Overall Average Physical Research Engagement	3.1149	.8543	High Engagement
<i>Note:</i> QD Qualitative Description (4.50-5.00 Extremely High Engagement), (3.50-4.49: High Engagement), (2.50-3.49 Fair Engagement), (1.50-2.49 Low Engagement), (1.00-1.49 Poor Engagement)			

Table 1 displays the descriptives of the teachers' level of physical research engagement. It presents that on the average, teachers have high physical research engagement with ($\bar{x}=3.1149$, $SD=0.85429$). Indicator PE4: I conduct research for professional development got the lowest mean ($\bar{x}=2.81$, $SD=1.074$). On the other hand, indicator PE6: I apply in my class what I learned from reading research got the highest mean ($\bar{x}=3.44$, $SD=1.031$). This result tells us that on the average, those teachers are fairly engaged in conducting research for professional development. The teachers are most highly engaged in applying learned concepts in the classroom. This finding is affirmed and supported by the study of Gao & Chow (2011) research engagement is an essential avenue for teachers to develop their professional competence. Watkins (2006) also added that research engagement mainly helped practitioners to obtain an outsider outlook toward the practice of learning; learn what other people are doing in their professional practice; see the practical relevance of research to a classroom setting.

Table 2: Descriptive Statistics of Teachers' Level of Cognitive Research Engagement

Indicators	Mean (\bar{x})	SD	QD
CE7: I understand that reading educational research materials is essential to my profession and to the educational system.	3.70	1.039	High Engagement
CE8: I believe that conducting research can positively benefit my learners, my school, and myself.	3.73	1.096	High Engagement
CE9: I believe that doing research can help improve the leadership competence of supervisors and principals.	3.73	1.028	High Engagement
CE10: I believe that analyzing problems and doing research-based decisions and actions could help me apply better solutions.	3.70	1.047	High Engagement
Overall Average Cognitive Research Engagement	3.7145	0.9505	High Engagement
<i>Note:</i> <i>QD Qualitative Description</i> <i>(4.50-5.00 Extremely High Engagement), (3.50-4.49: High Engagement), (2.50-3.49 Fair Engagement), (1.50-2.49 Low Engagement), (1.00-1.49 Poor Engagement)</i>			

Table 2 shows the descriptive statistics of the teachers' level of cognitive research engagement. It presents that on the average, teachers have high cognitive research engagement with (\bar{x} =3.7145, SD=0.9505). The indicators CE7: I understand that reading educational research materials is essential to my profession and to the educational system (\bar{x} =3.70, SD=1.039) and CE10: I believe that analyzing problems and doing research-based decisions and actions could help me apply better solutions (\bar{x} =3.70, SD=1.047) got the lowest mean. The indicators CE8: I believe that conducting research can positively benefit my learners, my school, and myself (\bar{x} =3.73, SD=1.096) and CE9: I believe that doing research can help improve the leadership competence of supervisors and principals (\bar{x} = 3.73, SD= 1.028) got the highest mean. This results would tell us that on the average, teachers are less cognitively engaged in understanding research materials as an essential aspect of the teaching profession and to the educational system. Teachers are also less cognitively engaged in analyzing problems and doing the research-based decision making.

On the other hand, the results would also tell us that on the average, the teachers mostly believe that research can help improve the leadership competence of the schools head and that researcher can be very beneficial for the learners, the school and the teachers. This result is further supported by the Basic Education Governance Act of 2001 (RA9155) which accentuated the role of research in the management and administration of the core education system. Through reading and doing teacher research, educators become more critical, reflective, and analytical about their practice in classrooms Atay (2007). Reading and doing research can develop and improve teachers' metacognitive knowledge of teaching through the provision of different

interpretations and understanding of instruction and learning Biesta (2007). Sharp et al. (2006) also highlighted the contribution of a being engaged in research in enhancing the quality of teaching and student support and contributing to school self-evaluation for further improvement in school. The DO 39, s. 2016 also known as “Adoption of Basic Education Research Agenda (BERA)” was also issued to shed light and guide DepEd stakeholders in the conduct of their research works. Through this, the department can make use of these research results in planning, policy and program development in consonance with the vision, mission, and core values of the Department of Education.

Table 3: Descriptive Statistics of Teachers’ Level of Emotional Research Engagement

Indicators	Mean (\bar{x})	SD	QD
EE11: I encourage myself and others to read research materials for professional development.	3.37	1.046	Fair Engagement
EE12: I influence and inspire my co-teachers to read research literature.	2.97	1.054	Fair Engagement
EE13: I appreciate that research can allow me to diagnose problems and test teaching strategies for my learners.	3.47	1.008	Fair Engagement
EE14: I value the importance of studies in the personal and professional life of the teacher.	3.77	1.034	High Engagement
EE15: I reflect on how research findings may impact the teaching and learning process and the vision of the school.	3.55	0.989	High Engagement
EE16: I acknowledge that using the results of the research could improve the learning outcomes of the learners.	3.58	1.021	High Engagement
Overall Average Emotional Research Engagement	3.4513	0.8463	Fair Engagement
<i>Note:</i> QD Qualitative Description (4.50-5.00 Extremely High Engagement), (3.50-4.49: High Engagement), (2.50-3.49 Fair Engagement), (1.50-2.49 Low Engagement), (1.00-1.49 Poor Engagement)			

Table 3 presents the descriptive statistics of the teachers’ level of emotional research engagement. It shows that on the average, teachers have fair emotional research engagement with (\bar{x} =3.4513, SD=0.8463). The indicator that got lowest mean is EE12: I influence and inspire my co-teachers to read research literature (\bar{x} =2.97, SD=1.054). The indicator that got the highest mean is the EE16: I acknowledge that using results of the research could improve the learning outcomes of the learners (\bar{x} =3.58, SD=1.021). This result would tell us that on the average, the teachers are less emotionally engaged in influencing and inspiring co-teachers to read research literature. On the other hand, the result would also tell us that on the average, teachers mostly feel that utilization of research results could help improve the learning outcomes of the learners.

Research Questions No.1.4.2

Are there significant relationships among relationship among sub-scales of research engagement?

Hypotheses:

H_{01} :

There is no significant relationship between physical research engagement and cognitive research engagement. $\alpha=0.05$

H_{02} :

There is no significant relationship between physical research engagement and emotional research engagement. $\alpha=0.05$

H_{03} :

There is no significant relationship between cognitive research engagement and emotional research engagement. $\alpha=0.05$

To test these hypotheses off this research question, a correlation matrix was used to show the strength, direction, and significance of the linear association among the score of the respondents in each construct as shown below:

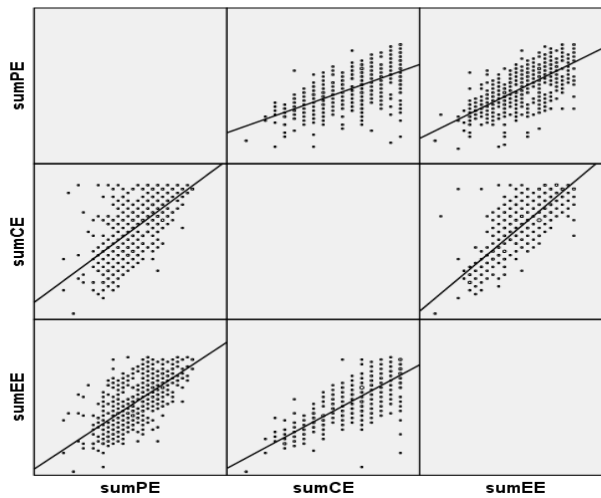


Figure 1: Scatter Plot Matrix of the Sub-scales of Research Engagement (n=612)

Table 4: Correlation Matrix of the Sub-scales of Research Engagement (n=612)

Variables	1	2	3
1.Physical Research Engagement	1		
2.Cognitive Research Engagement	0.632**	1	
3.Emotional Research Engagement	0.705**	0.830**	1

Note:
 **Correlation is considered significant at the pvalue < 0.01 level (2-tailed) *Highly Significant*.
 * Correlation is considered significant at the pvalue < 0.05 level (2-tailed) *Significant*.

Figure 1 and Table 4 presents the correlation matrix and scatterplot matrix of the subscales of research engagement. The matrix reveals that there is a strong positive highly significant relationship between physical research engagement and cognitive research engagement ($r=0.632$, $p>0.05$), physical research engagement and emotional research engagement ($r=0.705$, $p>0.05$), and cognitive research engagement and emotional research engagement ($r=0.830$, $p>0.05$). This result tells us that the subscales are much related to each other. If one sub-scale increases, the rest of the subscales will also increase, which then could lead to the inference that they are more or less measure ring the same thing, which in this case the research engagement of teachers. This result is supported by the study of Brigman et al. (2015) which states that latent variables were expected to be correlated in the measurement model for confirmatory factor analysis. This result also reaffirms Khan's (1990) Model of Personal Engagement and Disengagement in Work. This model presents the general idea that people involve their selves physically, cognitively, and emotionally, at various degrees in work role performances.

Research Questions No. 1.4.3:

What measurement model would best fit the model of research engagement?

Table 5: Goodness of Fit Measures of the Hypothesized Model

Measures	Estimate	Threshold	Interpretation
CMIN	743.890	--	--
DF	101	--	--
CMIN/DF	7.365	Between 1 and 3	<i>Terrible</i>
CFI	0.918	>0.95	<i>Acceptable</i>
SRMR	0.069	<0.08	<i>Excellent</i>
RMSEA	0.102	<0.06	<i>Terrible</i>
NNFI/TLI	0.920	>0.95	<i>Poor Fit</i>
GFI	0.849	>0.90	<i>Unacceptable</i>

Note: Interpretations are according to Hu, L., & Bentler, P. M. (1999).

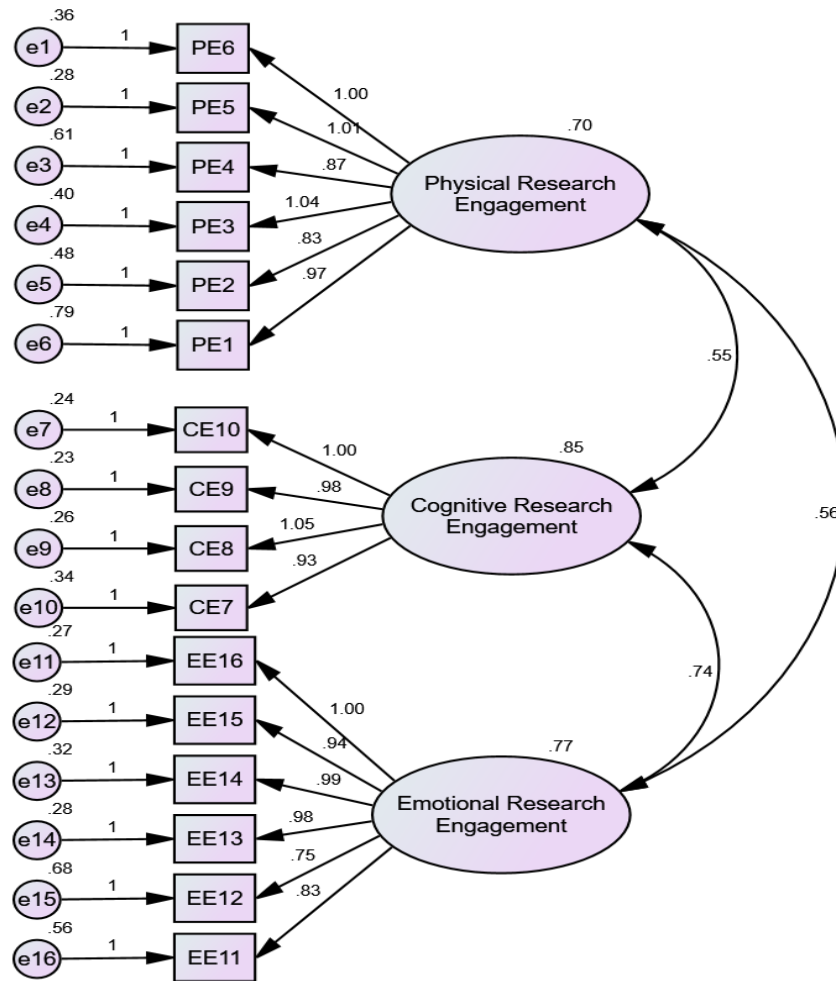


Figure 2: Hypothesized Model of Teacher Research Engagement

CFA was used to evaluate the measurement model concerning fit as well as convergent and discriminant validity Brown, T. (2006). Based on Figure 3 and Table 5, the above model obtained poor model fit indices based on the goodness of fit values. The analysis revealed CMIN/DF=7.365, Comparative Fit Index (CFI) = 0.918, Standardized Root Mean Square Residual (SRMR) = 0.069, Root Mean Square Error of Approximation (RMSEA) = 0.102, Non-Normed Fit Index (NNFI), also known as Tucker-Lewis Index (TLI) = 0.920, and Goodness of Fit Index (GFI) = 0.849. These model fit indices tell us that the model was not able to obtain a satisfactory model fit thus the model did not fit well with the observed data. There is a need to make adjustments in the specifications of the model Hu, L., & Bentler, P. M. (1999). According to Brigman et al. (2015), it is not uncommon to change the specifications of a poorly fitting

model, especially those with multiple latent variables, so the researcher then modified the hypothesized model.

Table 6: Goodness of Fit Measures of the Hypothesized Model

Measures	Estimate	Threshold	Interpretation
CMIN	295.444	--	--
DF	75	--	--
CMIN/DF	3.939	Between 1 and 3	Acceptable
CFI	0.972	>0.95	Acceptable
SRMR	0.054	<0.08	Excellent
RMSEA	0.069	<0.06	Acceptable
NNFI/TLI	0.955	>0.95	Very Good Fit
GFI	0.945	>0.90	Acceptable
PClose	0.000	>0.05	Terrible

Note: Interpretations are according to Hu, L., & Bentler, P. M. (1999).

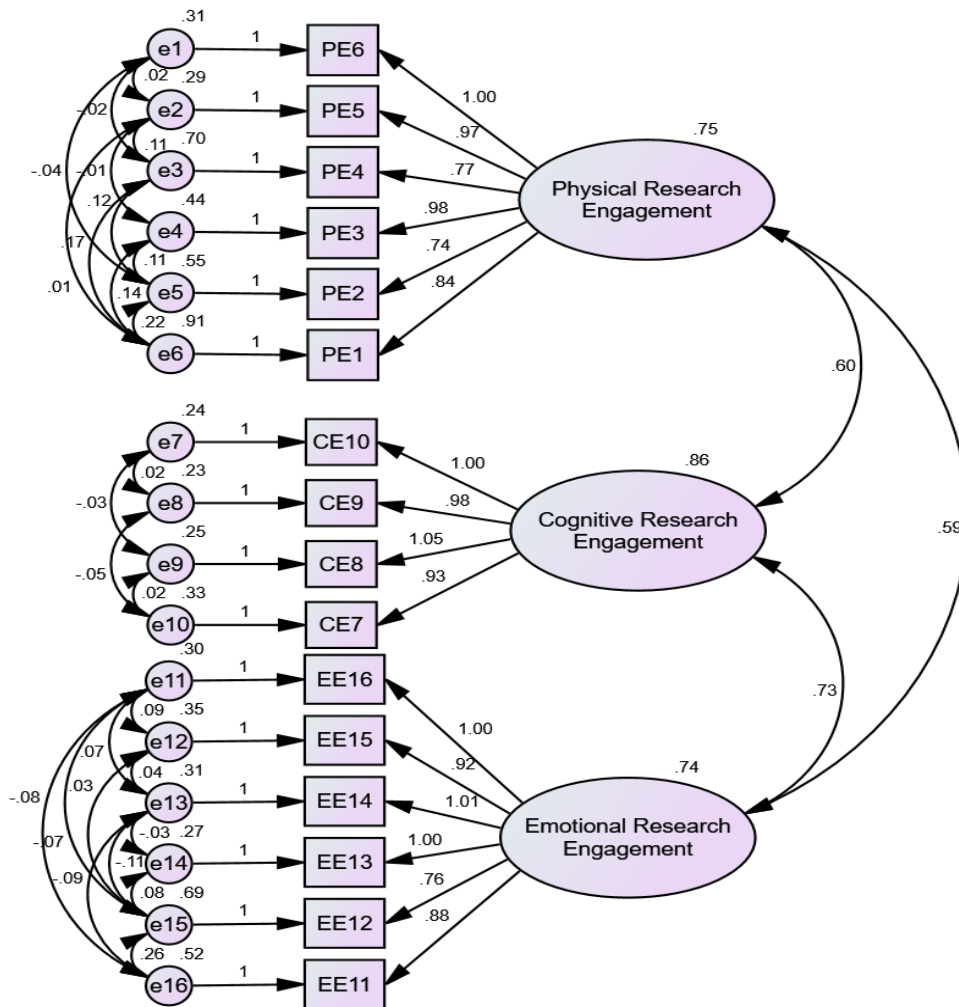


Figure 3: Modified Model of Research Engagement with Inter-Item Covariance

Considering the results of the modification indices, the researcher revised the model especially in the specification of inter-item covariance. The researcher then reruns the model and obtained an improved model fit. The analysis revealed CMIN/DF=3.939, Comparative Fit Index (CFI) = 0.972, Standardized Root Mean Square Residual (SRMR) = 0.054, Root Mean Square Error of Approximation (RMSEA) = 0.069, Non-Normed Fit Index (NNFI), also known as Tucker-Lewis Index (TLI) = 0.955, and Goodness of Fit Index (GFI) = 0.945. These model fit indices tell us that the model was able to obtain a satisfactory model fit. Thus the model is acceptable Hu, L., & Bentler, P. M. (1999). The increased model fit indices also tell us that this modified model of teacher research engagement with inter-item covariance is a better model than the hypothesized model.

It is also observable that the model obtained good to excellent factors loadings ranging from .74 to 1.05 as interpreted by Hair et al. (2006, p 128) and Tabachnick & Fidell (2007). According to Brigman et al. (2015) largely standardized factor loadings obtained by the modified model support high convergent validity. The model also obtained acceptable covariance among latent factors of the model based on standards of (Hair et al., 2010). The errors in the model represented by e in each indicator are variance in the responses that are not explained by the latent construct Schreiber (2008).

4. Discussion

This study of conducting confirmatory factor analysis of the latent sub-scales of the measurement model and reported research engagement level of public schools elementary teachers was done among 612 teachers to establish to find the pattern of relationship and establish factorial validity among predictors of teacher research engagement as a construct and proposed measurement model and test its proposed measurement model.

The results of descriptive analysis tell us that teacher respondents have, high physical research engagement, and high cognitive research engagement, and fair emotional research engagement. This study also explored the linear association of the latent sub-scales of teacher research engagement. It was found in the analysis that physical research engagement, cognitive research engagement, and emotional research engagement are significantly related to each other thus telling us that they are good measures research engagement because they somewhat measure more or less the same thing.

The study likewise hypothesized a measurement model and tested its model fit. Consequently, in the test, the hypothesized model obtained poor model fit indices. This tells us that the model is not significant and was not able to theoretically fit with the gathered data. In the light of the modification indices of the previous analysis, the researcher made some modifications of the specification of the model such as adding inter-item covariance within each construct. As a result of the process, the modified model obtained an excellent and acceptable model fit indices. The modified 3-factor measurement model of research engagement also obtained good to excellent factor loadings and acceptable covariance values thus establishing high reliability and convergent validity. Accordingly, the revised model is a better measurement model than the hypothesized model of teacher research engagement.

5. Implications

Another implication that the study could also provide to the practitioners is that educational institutions should not only focus on one aspect of research engagement because there is more than one factor that contributes to its growth. Monitoring on the physical, cognitive and emotional teacher research engagement is a necessity in an institution.

The dynamic models of this study could also provide us implication that as educational managers, we should likewise emphasize constructing items and measurement model that are deemed most appropriate and fit to their institutional data LaNasa et al. (2009). Institutions should also explore their data and hypothesize their model.

The despite good factor loadings of the tool, errors values in each indicator also imply that there are still factors or subscales that need to be explored for researchers to have a better approximation measurement model of teacher research engagement. Thus institutions should also, examine other indicators that could also measure research engagement based on the nature and dynamics of their organization.

The results and findings of this study may guide or be integrated by curriculum planners, educational leaders, research center managers, human resource specialists and policymakers in the development of action plans, training, research endeavors, policy development and management of research centers.

6. Conclusion

This study concludes that teachers have high physical research engagement, and high cognitive research engagement, and fair emotional research engagement. There is a significant relationship among physical research engagement, cognitive research engagement, and emotional research engagement subscales. In the confirmatory factor analysis, the modified model was able to obtain a better model fit indices, factor loadings, and covariance. Thus, the revised model with inter-item covariance in each of the three-factor best fit the measurement of teacher research engagement.

7. Recommendations

On the basis of the results and findings of this study, the following are recommended:

1. Quantitative-Qualitative research may be conducted to validate the measurement model.
2. This study may be replicated in other institutions and countries to test and improve the reliability and validity of the measurement model further.
3. Other educational institutions may explore other indicators that could also measure research engagement based on the nature and dynamics of their organization.
4. Researchers may explore other factors that can further be created among the current indicators, and other researchers may wish to include.
5. Training and retooling may be done among teachers to enrich and develop the research engagement of the teachers and increase research productivity.
6. Action plans, position paper training design and the module may be developed as an output of this study.

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