Validity Examination of Indicator of Technological Pedagogical Content Knowledge of Pre-service Teachers

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Abstract

Examine the Validity of Indicators Technological Pedagogical Content Knowledge of Students Practicing Teachers. This research was objective: to Examine the Validity of Indicators Technological Pedagogical Content Knowledge of Students Practicing Teachers, Faculty of Educational, Buriram Rajabhat University in the academic year 2018. There were 920 students. The research instrument was a rating scale questionnaire. The test qualities were checked Discrimination by the Pearson Product at 0.392 to 0.610 and the reliability by Alpha coefficient (Cronbach) at .597, .898, .801, 733, .899, .914 and .915, total at 0.912. The collected data were analyzed by mean, standard deviation and factor analysis. The finding were as follow: Indicator 46, 7 Factors factor loading with the statistically significant set was at the level .01 and Goodfitness index between model and the empirical data as: Concurrent validity of model.

Keywords: Validity, technological pedagogical content knowledge, vocational teacher

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Significance of the study

The 21st century is a digital age since it is an era in which digital technology has developed rapidly. The public has access to information and communication technology (ICT) more easily. In addition, communication tools such as smartphones and tablets are cheaper and have become a necessity for everyone. These tools have created a lot of information and quickly distributed to all groups of people. Access to information and various content has been easy, convenient and fast. The children born in the digital age are more ready to use and access to ICT. These changes have a profound effect on education especially the goals of educational management in the present day, which aims at the development of knowledge in the subject matter, also the development of skillful students in the 21st century. Those skills contain technology skills, learning and innovation skills, information skills, media and technology skills, and life and work skills (Thammaprathip, 2016).

During these past decades, the Pedagogical Content Knowledge (PCK) conceptual framework has been presented by an educational psychologists, Lee S. Shulman. With expertise in teaching profession, he has made notable contributions to the study of teaching especially in science, mathematics and the fields of medicine. Since 1987, it has been internationally accepted and has been used extensively in the production and development of the teaching profession in many countries. However, PCK in the curriculum for professional teacher education in Thailand is not widely known and not yet very distinct. Previously, academic scholars in Thailand have been interested and studied guidelines for developing PCK in teaching profession. Specific Thai vocabularies for PCK are used including Content Knowledge Combined Teaching Methods, Content Knowledge Integrated Teaching Methods, and Science of Content Teaching and Art of Teaching (Srisawad, 2012). At present, the PCK conceptual framework is the basic conceptual framework for the development of the conceptual framework Technological pedagogical content knowledge (TPACK or TPCK) presented by Mishra and Koehler in 2006. This is a conceptual framework about teacher knowledge in integrating technology into teaching and learning management in their responsible subjects (Koehler et al., 2014).

Professional experience training for pre-service teachers is to build students with the spirit of a teacher, to have technical, theoretical and practical knowledge as well as teaching methods. Learning skills is the most important skills of the 21st century, which is consistent with Varnish (2012) who concluded the challenges of learning management of the 21st century teachers. That was, the modern teachers should have a correct way of paradigm about teaching and learning for students to gain mastery learning and action learning. They should

prepare learners to become knowledgeable workers, and learning person. The most important skills that teachers must instill in the learners for their practical skills and personal skills is learning skills of the 21st century. As discussed, there is a current need to design TPACK measuring tools that conform to 21st century skills (Voogt and Roblin, 2012). Pre-service teachers need to have 21st century learning skills to organize all the teaching and learning activities for their students. When they graduate, most of them will become teachers and manage their teaching to produce good, smart, moral and ethical students. The researcher is mindful of the importance and interested in doing research entitled "Validity Examination of Indicator of Technological Pedagogical Content Knowledge (TPACK) of Pre-service Teachers", which will be valuable for educational management and as a path to develop learning skills for students to prepare and practice professional experiences in the Faculty of Education at Buriram Rajabhat University.

Research Objectives

The research objective was to examine the validity of the indicator of technological pedagogical content knowledge of the fourth and fifth year pre-service teachers, Faculty of Education, Buriram Rajabhat University.

Research Methodology

1. Research Population

Research population were 1,136 fourth and fifth year pre-service teachers, Faculty of Education, Buriram Rajabhat University.

2. Research Samples

Research samples were 920 fourth and fifth year pre-service teachers, Faculty of Education, Buriram Rajabhat University. The sample size was determined by the ratio of the sample unit and the number of variables 20: 1 (Wiratchai, 1999) using stratifies random sampling.

3. Research Instruments for Data Collection

The research instruments were adapted from Schmidt et al. (2009). The researcher started by creating a conceptual framework and developing TPACK measuring tools and confirmatory factor analysis (CFA) as follows:

3.1 The researcher created a conceptual framework by studying the TPACK concept of Mishra and Koehler (2006) which was classified into 7 factors as follows:

3.1.1 Technology Knowledge (TK)

3.1.2 Content Knowledge (CK)

3.1.3 Pedagogical Knowledge (PK)

3.1.4 Pedagogical Content Knowledge (PCK)

3.1.5 Technological Content Knowledge (TCK)

3.1.6 Technological Pedagogical Knowledge (TPK)

3.1.7 Technological Pedagogical Content Knowledge (TPCK)

3.2 The researcher created an eighty-item rating scale questionnaire of Technological Pedagogical Content Knowledge (TPACK) based on the 7-factor framework to cover operational definitions.

3.3 Index of Item Objective Congruence (IOC) (0.67-1.00) of the questionnaire of TPACK was examined by five experts.

3.4 The tryout of the questionnaire of TPACK was examined by 50 pre-service teachers excluding research samples. The results were used to determine the quality of each item including discrimination index of each item by using the correlation coefficient between item points and total scores (Item Total Correlation) based on Pearson's formula, and the criteria of discrimination index from 0.20-1.00. As the results, the range of discrimination index of each item was 0.392 - 0.610. The 46 selected items in 7 factors were examined Cronbach's Alpha Coefficient and found to be: 0.597, 0.898, 0.801, 0.733, 0.899, 0.914 and 0 .915, and the total value was 0.912.

4. Data Analysis

4.1 Statistical analysis used were mean, standard deviation and Pearson's correlation coefficient of each factor of indicators to identify the characteristic of indicators relationship for the suitability of the correlation matrix of indicators.

4.2 Determination of weight indicators and correlation matrix of indicators were conducted by indicators summation from empirical data analysis. Sub indicators determined weight indicators by creating factor scale (multiplying the factor score coefficient and standard score)

4.3 Goodness of fit measures and determination of sub variable weight were examined by using structural equation modeling. Statistical analysis used

were Chi–Square, Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR).

4.4 Confirmatory Factor Analysis (CFA) was done to check the structural accuracy of structural equation modeling and empirical data as three following criteria: 1) non-statistical significance of the goodness of fit indices, 2)statistical significance of individual parameter estimates for the paths in the model, and 3) reasonable magnitude and direction parameter estimates (Schumacker and Lomax, 2010). The concordance of the structural equation model and empirical data were checked by 3 goodness of fit indices: Chi–Square, Comparative Fit Index, and Root Mean Square Error of Approximation. Hypothesis (H0) was set to investigate whether the model was consistent with empirical data. Statistical analysis used were Chi–Square, GFI, AGFI, CFI, TLI, RMSEA, and SRMR. The three criteria for accepting Hypothesis (H0) were: 1) Chi-Square Statistic (df) must be less than 2, 2) Goodfitness index (GFI, AGFI, CFI, and TLI) must be greater than 0.95, and 3) Root Mean Square Error of Approximation (RMSEA and SRMR) must be less than 0.05. Goodness of fit indices were calculated by Chi–Square, degree of freedom, size of samples, and free parameter. The scope of goodness of fit indices was 0-1 (Schumacker and Lomax, 2010).

Research Results

Two areas of research results were presented as follows:

1. General information of the respondents of the samples

The percentages of 920 fourth and fifth year pre-service teachers in various majors, Faculty of Education, Buriram Rajabhat University in the academic year 2018 were presented as follows: 96 (10.40%) participants in Thai language, 76 (8.30%) participants in musical education, 56 (6.10%) participants in physics, 50 (5.30%) participants in art education, 51 (5.50%) participants in mathematics, 63 (6.9%) participants in Thai dance, 101 (11.00%) participants in technology and Computer Education, 71 (7.90%) participants in elementary education, 63 (6.90%) participants in general science, 99 (10.80%) participants in physical education, 78 (8.40%) participants in social studies, and 116 (12.60%) participants in English.

2. Confirmatory Factor Analysis

The total of 7 factors were presented in table 2.1-2.7 and figure 2.1-2.7 as follows:

2.1 Technology Knowledge (TK)

Table 2.1. Confirmatory Factor Analysis of Technology Knowledge (TK)

Item	Indicator	Factor loading	R^2
i1	I know how to solve technology problems myself	0.69	0.48
i2	It is easy for me to learn more about technology	0.74	0.54
i3	I always follow new technology	0.72	0.52
i4	I use technology regularly	0.64	0.41
i5	I have knowledge about the different kinds of technology	0.74	0.54
i6	I have necessary technology skills	0.79	0.62
i7	When there is an opportunity, I will use technology for my work	0.74	0.55

According to table 2.1, there were 7 indicators of Technology Knowledge (TK). Factor loadings were at >0 (0.64-0.79) with the statistically significant set was at the level of 0.01 and R^2 at 0.41-0.62.

Confirmatory Factor Analysis of Technology Knowledge (TK) revealed that the model was well fitted to empirical data considering goodness of fit indices: X^2 =13.76 and df = 9 and the model contained construct validity as figure 2.1.

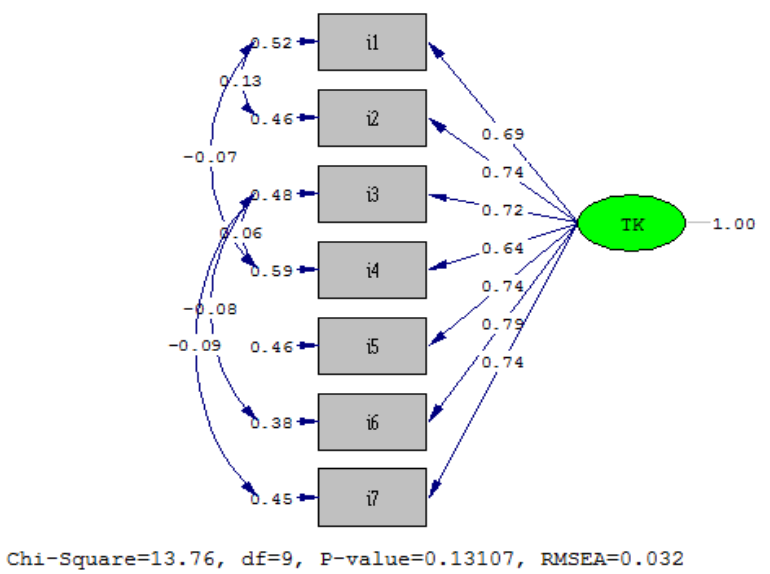

Figure 2.1: Confirmatory Factor Analysis of Technology Knowledge (TK)

2.2 Content Knowledge (CK)

Table 2.2. Confirmatory Factor Analysis of Content Knowledge (CK)

Item	Indicator	Factor loading	R^2
i8	I have sufficient knowledge of mathematics	0.52	0.27
i9	I can use mathematics as a guideline for my thinking	0.53	0.29
i10	I have guidelines and strategies to develop myself to understand mathematics	0.53	0.29
i11	I have guidelines and strategies to improve myself with an understanding of social skills	0.43	0.19
i12	I have sufficient knowledge of social skills	0.43	0.18
i13	I can use history as a guideline for my thinking	0.37	0.14
i14	I have guidelines and methods for developing myself to understand science	0.81	0.66
i15	I can use science-related matters as guidelines for my thinking	0.82	0.68
i16	I have sufficient knowledge of science	0.89	0.79
i17	I have guidelines and strategies to improve myself with an understanding of reading and writing	0.42	0.18
i18	I can use reading and writing as a guideline for my thinking	0.37	0.13
i19	I have sufficient reading and writing ability	0.39	0.15

According to table 2.2, there were 12 indicators of Content Knowledge (CK). Factor loadings were at >0 (0.37-0.89) with the statistically significant set was at the level of 0.01 and R^2 at 0.13-0.79.

Confirmatory Factor Analysis of Content Knowledge (CK) revealed that the model was well fitted to empirical data considering goodness of fit indices: X^2 =57.18 and df = 36 and the model contained construct validity as figure 2.2.

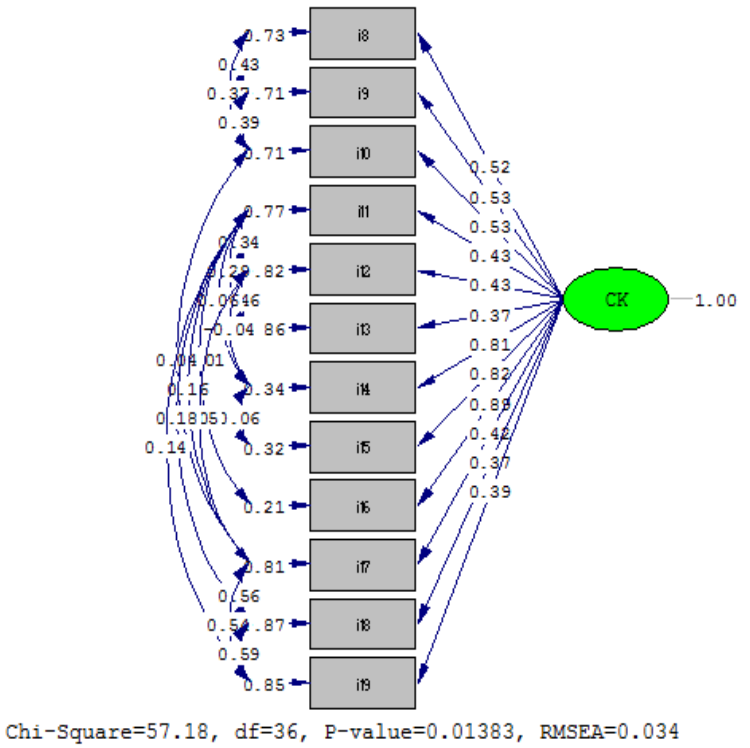

Figure 2.2: Confirmatory Factor Analysis of Content Knowledge (CK)

2.3 Pedagogical Knowledge (PK)

Table 2.3. Confirmatory Factor Analysis of Pedagogical Knowledge (PK)

Item	Indicator	Factor loading	R^2
i20	I know how to assess student performance in the classroom	0.68	0.46
i21	I can apply basic teaching techniques when students understand and do not understand the lesson	0.75	0.55
i22	I can apply teaching techniques to different learners	0.76	0.58
i23	I can assess students in many ways	0.75	0.57
i24	I can use a variety of teaching methods to organize teaching and learning in the classroom	0.82	0.67
i25	I can manage the students who understand and do not understand the content taught	0.79	0.62
i26	I know how to manage the classroom	0.76	0.58

According to table 2.3, there were 7 indicators of Pedagogical Knowledge (PK). Factor loadings were at >0 (0.68-0.82) with the statistically significant set was at the level of 0.01 and R^2 at 0.46-0.67.

Confirmatory Factor Analysis of Pedagogical Knowledge (PK) revealed that the model was well fitted to empirical data considering goodness of fit indices: X^2 =22.10 and df = 11 and the model contained construct validity as figure 2.3.

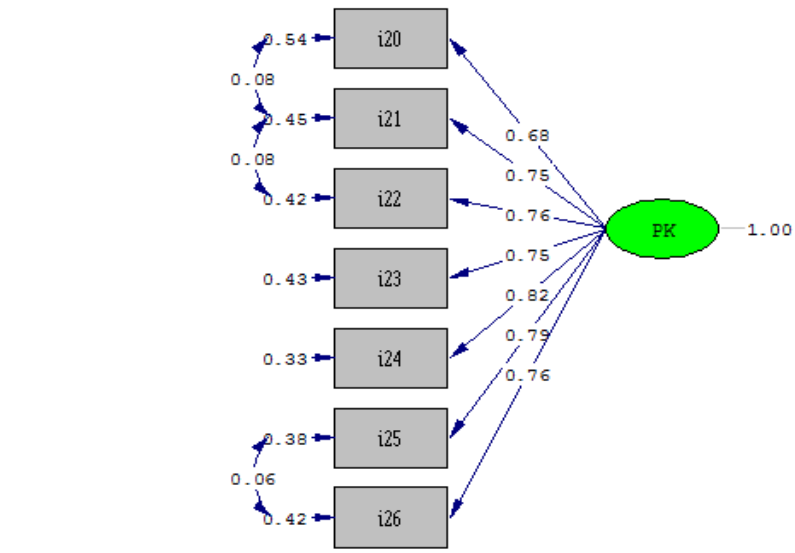

Figure 2.3: Confirmatory Factor Analysis of Pedagogical Knowledge (PK)

2.4 Pedagogical Content Knowledge (PCK)

Table 2.4. Confirmatory Factor Analysis of Pedagogical Content Knowledge (PCK)

Item	Indicator	Factor loading	R^2
i27	I knew how to choose effective teaching methods as a way to think and learn reading and writing of students	0.69	0.48
i28	I knew how to choose effective teaching methods as a way to think and learn reasoning of students	0.83	0.68
i29	I knew how to choose an effective teaching method as a way to think and learn mathematical skills of students	0.75	0.57
i30	I knew how to choose an effective teaching method as a way to think and learn social skills of students	0.70	0.49

According to table 2.4, there were 4 indicators of Pedagogical Content Knowledge (PCK). Factor loadings were at >0 (0.69-0.83) with the statistically significant set was at the level of 0.01 and R^2 at 0.48-0.68.

Confirmatory Factor Analysis of Pedagogical Content Knowledge (PCK) revealed that the model was well fitted to empirical data considering goodness of fit indices: X^2 =5.28 and df = 2 and the model contained construct validity as figure 2.4.

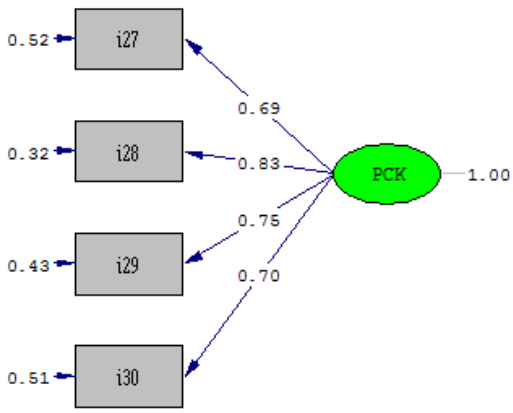

Figure 2.4: Confirmatory Factor Analysis of Pedagogical Content Knowledge (PCK)

2.5 Technological Content Knowledge (TCK)

Table 2.5. Confirmatory Factor Analysis of Technological Content Knowledge (TCK)

Item	Indicator	Factor loading	R^2
i31	I have technology knowledge that can be used to understand reading and writing	0.73	0.53
i32	I have knowledge of technology that can be used to understand the reasoning	0.75	0.57
i33	I have technology knowledge that can be used to understand computational skills	0.66	0.44
i34	I have knowledge of technology that can be used to understand social skills	0.78	0.61

According to table 2.5, there were 4 indicators of Technological Content Knowledge (TCK). Factor loadings were at >0 (0.66-0.78) with the statistically significant set was at the level of 0.01 and R^2 at 0.44-0.61.

Confirmatory Factor Analysis of Technological Content Knowledge (TCK) revealed that the model was well fitted to empirical data considering goodness of fit indices: X^2 =0.02 and df = 1 and the model contained construct validity as figure 2.5.

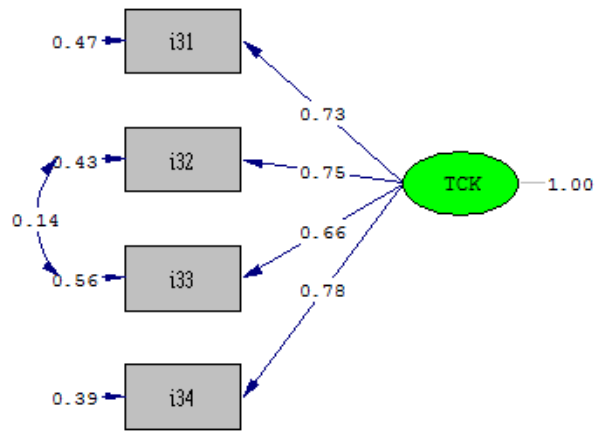

Figure 2.5: Confirmatory Factor Analysis of Technological Content Knowledge (TCK)

2.6 Technological Pedagogical Knowledge (TPK)

Table 2.6. Confirmatory Factor Analysis of Technological Pedagogical Knowledge (TPK)

Item	Indicator	Factor loading	R^2
i35	I can choose the technology that supplements my teaching methods	0.67	0.45
i36	I can choose a technology that will complement the student's learning path in the lesson	0.71	0.51
i37	Professional teaching allows me to become more aware that technology has an influence on the teaching methods I use to teach in the classroom	0.68	0.47
i38	I am fully aware of the way technology is used in the classroom	0.73	0.54
i39	I can adapt the technology that I am learning to be used in different teaching activities	0.76	0.58

According to table 2.6, there were 5 indicators of Technological Pedagogical Knowledge (TPK). Factor loadings were at >0 (0.67-0.76) with the statistically significant set was at the level of 0.01 and R^2 at 0.45-0.58.

Confirmatory Factor Analysis of Technological Pedagogical Knowledge (TPK) revealed that the model was well fitted to empirical data considering goodness of fit indices: X^2 =4.22 and df = 2 and the model contained construct validity as figure 2.6.

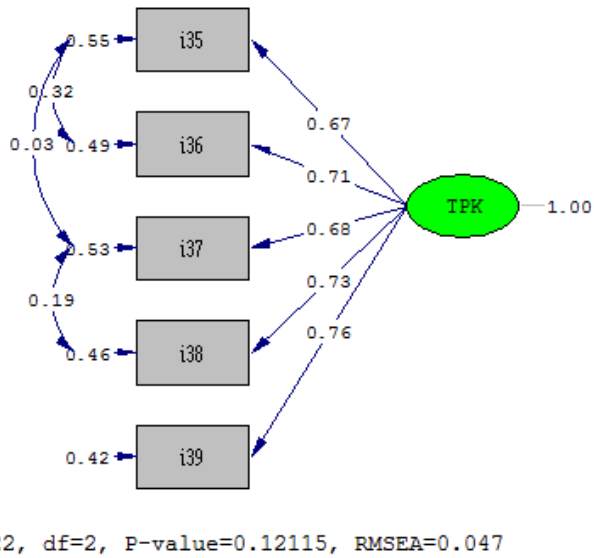

Figure 2.6: Confirmatory Factor Analysis of Technological Pedagogical Knowledge (TPK)

2.7 Technological Pedagogical Content Knowledge (TPCK)

Table 2.7. Confirmatory Factor Analysis of Technological Pedagogical Content Knowledge (TPCK)

Item	Indicator	Factor loading	R^2
i40	I can teach a suitable lesson together with the use of technology, reading, writing and teaching methods	0.80	0.64
i41	I can use a collaborative strategy in content, technology and teaching methods for the classroom	0.77	0.59
i42	I can choose the technology that will supplement the content for the lesson	0.75	0.57
i43	I can choose to use technology for the classroom that will be an extension of my teaching methods on what to teach, how to teach, and how students will learn	0.79	0.62

Item	Indicator	Factor loading	R^2
i44	I can teach suitable lessons together with the use of technology in social studies	0.71	0.51
i45	I can use leadership to help others collaborate on the use of content, technology, and teaching methods in school	0.82	0.67
i46	I can teach suitable lessons with technology in mathematics	0.62	0.38

According to table 2.7, there were 7 indicators of Technological Pedagogical Content Knowledge (TPCK). Factor loadings were at >0 (0.62-0.82) with the statistically significant set was at the level of 0.01 and R^2 at 0.38-0.67.

Confirmatory Factor Analysis of Technological Pedagogical Content Knowledge (TPCK) revealed that the model was well fitted to empirical data considering goodness of fit indices: X^2 =16.03 and df = 9 and the model contained construct validity as figure 2.7.

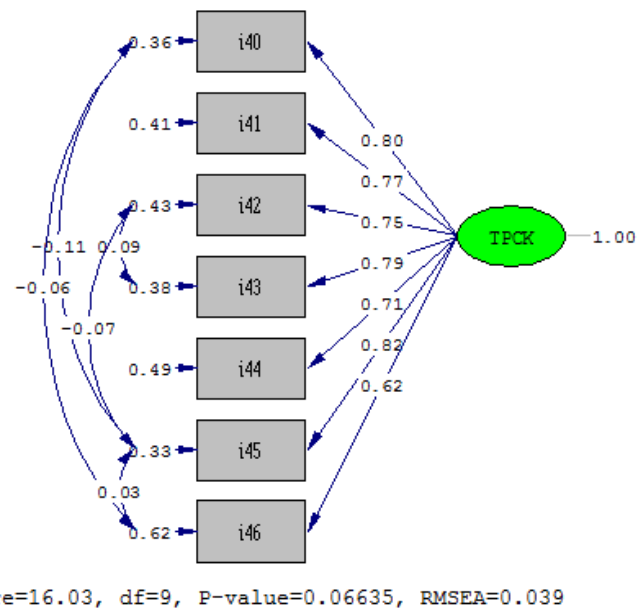

Figure 2.7: Confirmatory Factor Analysis of Technological Pedagogical Content Knowledge (TPCK)

Discussion

According to the results of the validity examination of indicator of technological pedagogical content knowledge of pre-service teachers, it revealed that indicators in each factor contained positive factor loading (>0) with the statistically significant set was at the level of 0.01. Every factor owed concordance of Goodness Fit Index (GFI) and empirical data and TPACK could be measured by all indicators. The accuracy of the results of the 7 factors was performed by using confirmatory analysis to check the validity of the model. The results were coherent with the research of Mishra and Koehler (2006) for the reasons that the pre-service teachers have adapted to current conditions and therefore it allows them to practice teaching experience with knowledge, understanding, ability and performance to achieve success with the change of circumstances. Understanding is an integration of knowledge gained or acquired with the skills process resulting in understanding and competency. It is the application of the understanding that has been developed and applied to extend to the real situation and can be resolved in a timely manner. It depends on the context of the situation including education and learning to work without limitations in basic knowledge, which is a collection of all capabilities embracing interpersonal relations and appreciation of ethical values. The results were additionally consistent with the researches of Lee and Tsai (2010), Chai et al. (2010), Koh et al. (2010) who studied the 7 structures of TPACK by using a questionnaire to investigate structural validity.

Furthermore, the results were in line with Varnish (2012) who stated the 21st century concept that, in the 21st century education, people need to be prepared to face rapid, radical, and unexpected changes. They have to have high skills in learning and adjustment. Meanwhile, they must have the skills of acting as a teacher in the 21st century. Unlike acting as a teacher in the 20th or 19th century, the skills of the 21st century is the skills that people must have and gain from kindergarten to university and throughout their lives.

Recommendations

1. Each factor contains different necessity and importance in the current teaching and learning situation, which affects different factor loadings of indicators. Therefore, the Faculty of Education should provide the examination in factors development regarding their priority for pre-service teachers who are practicing professional experience.

2. The learning skills of 21st century training package should be advanced to be used in the development of pre-service teachers to practice teaching experience aiming more teaching potential.

3. There should be comparative studies with students in every level as for information for student development in preparing to be professional teachers.

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