Structural Equation Model: Analysis of Pre-Service Elementary Teachers on Technological Pedagogical Content Knowledge (TPACK)

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Abstract. This study aims to analyze the relationship between the seven components of TPACK, namely: 1) Technological Knowledge (TK), 2) Pedagogical Knowledge (PK), 3) Content Knowledge (CK), 4) Pedagogical Content Knowledge (PCK), 5) Technological Content Knowledge (TCK), 6) Technological Pedagogical Knowledge (TPK), and 7) Technological Pedagogical Content Knowledge (TPCK). The research method used is quantitative with a descriptive, explanatory type of research. The research subjects consist of 80 pre-service elementary teachers. The research sample was obtained using a proportional random sample technique. The pre-service elementary teachers are students of the Madrasah Ibtidaiyah Teacher Education study program at the University of Islam Malang in semester seven who have carried out Field Experience Practice (PPL). The research instrument was a closed questionnaire in which answers to each question were provided with alternative solutions according to the Likert scale criteria. The criteria for the Likert scale consist of: strongly agree (SS) = score 5; agree (S) = score 4; undecided (R) = score 3; disagree (TS) = score 2; strongly disagree (STS) = score 1. Descriptive statistical analysis and Structural Equation Modeling (SEM) were used as data analysis methods. Data analysis was carried out with the help of SPSS 24 and AMOS 24. The results showed that the TPACK competency variable for pre-service elementary teachers was in the high category. Furthermore, based on the results of hypothesis testing, it shows that: there is a positive relationship between TPK and TK, PCK and PK, TCK and TK, TCK and CK, TPCK and TPK, TPCK and TCK, TPCK and PK, and there is no relationship between TPK and PK, PCK and CK, TPCK and PCK, TPCK and TK, TPCK and CK.

Keywords: Pre-service elementary teachers, structural equation model, TPACK.

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1 Introduction

The 21st century is marked by the faster development of digital technology, where Education and technology are also interrelated and intertwined. Using technology as a tool for increased learning among students, cultivating an understanding of more topics well, and encouraging the development ability think the level tall student make integration of technology in Education as something needs [1] Consequently, in this 21st century, the teacher should integrate technology inside class. Studies earlier showed that integration technology in classroom learning could help students in the work profession house more efficiently than just using method traditional [2]. Besides that, the use of technology in learning too increases the preparation and presentation of material in class [3]. Teachers also need to understand the importance utilize technology in practice besides which technology will be combined and how to do it [4]. This makes integrating technology into the teacher's learning becomes necessary.

Madrasah Ibtidaiyah Teacher Education Study Program at the University of Islam Malang is one of the study programs that concentrate print competent and professional pre-service elementary teachers' needs and demands Public as the impact of development science as well as technology. Pre-service elementary teachers 21st century must be capable utilize technology in learning. Prospective teachers take advantage of various technology in planning, implementation, and assessment of their learning do [5]. As prospective professional teachers in the digital era, they are needed to combine various types of knowledge. The framework is theoretical for understanding the required teacher knowledge for integrating successful technology, known as Technological Pedagogical Content Knowledge (TPACK). The TPACK framework explains relationships and complications Among three-part base knowledge (technology, pedagogy, and content) [6].

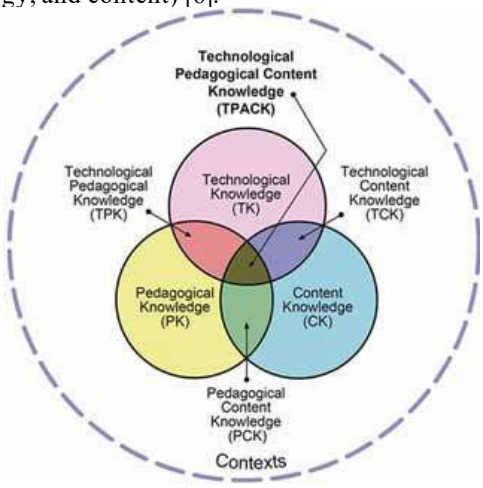

Fig. 1. TPACK Framework [6]

TPACK framework consists of six components, that is Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), Pedagogical Content

Knowledge (PCK), Technological Content Knowledge (TCK), and Technological Pedagogical Knowledge (TPK) [6]. TPACK competency is a required competency owned by pre-service elementary teachers to support professional development in today's digital age. TPACK will help the teacher handle the diverse interests, understanding, abilities, and experiences of students with learning in the 21st century [7] [8]. TPACK competence of prospective teachers can influence the performance to teach and base belief that they integrate ICT in learning. Pre-service teacher beliefs in using ICT was formed through the hope that they will improve enhancement performance of teacher [9].

Moment this, research related to TPACK is still conducted playfully, and many new inventions have been generated from studies. However, research on the teacher's TPACK or pre-service elementary teachers still needs to be found. The utilization of technology and how it is used to study teaching must become topics mainly discussed by pre-service teachers [10]. Clear that To do a new study involving some pre-service elementary teachers, they must reveal their TPACK competence and analyze connections from the TPACK dimensions. As for the question, this will be answered in a study: 1) How do pre-service elementary teachers TPACK competency?; 2) How is the connection between the TPACK variable for pre-service elementary teachers?

2 Method

Study this use method study quantitative with type study descriptive explanatory. Study descriptive explanatory attempted to understand, describe, and explain the connection between variables [11]. The destination of the study is to reveal the level of pre-service elementary teachers' TPACK competencies and analyze the connection between the seven components of TPACK, namely: 1) Technological Knowledge (TK), 2) Pedagogical Knowledge (PK), 3) Content Knowledge (CK), 4) Pedagogical Content Knowledge (PCK), 5) Technological Content Knowledge (TCK), 6) Technological Pedagogical Knowledge (TPK), and 7) Technological Pedagogical Content Knowledge (TPCK).

The subject study consists of 72 pre-service elementary teachers. Sample study was obtained with the use technique sample random proportional. The pre-service elementary teachers are students in Madrasah Ibtidaiyah Teachers Education study program semester seven which has doing Practice Experience Field (PPL). Study this use instrument developed by [12]. The instrument form questionnaire closed which answers from every question has provided the alternative answer in accordance criteria scale Likert. As for the criteria from the scale, Likert consists of: strongly agree (SS) = score 5; agree (S) = score 4; undecided (R) = score 3; no agree (TS) = score 2; very not agree (STS) = score 1. Before being used, the instrument was tested for its validity and reliability for getting quality data. The grid instrument is explained as follows.

Table 1. Grid TPACK Instrument

Variable	Code	Indicator or component	item number
Technological Pedagogical Content Knowledge	TK	*Technological Knowledge*	1,2,3,4
	PK	*Pedagogical Knowledge*	5,6,7,8,9,10,11
	CK	*ContentKnowledge*	12,13,14,15
	TCK	*Technological Content Knowledge*	16,17,18,19
	PCK	*Pedagogical Content Knowledge*	20,21,22,23
	TPK	*Technological Pedagogical Knowledge*	24,25,26,27
	TPCK	*Technological Pedagogical Content Knowledge*	28,29,30,31,32

Statistical descriptive and Structural Equation Modeling (SEM) is used as a method of data analysis. Data analysis was performed, assisted by SPSS 24 and AMOS 24.

3 Results and Discussion

Current pre-service elementary teachers face the consequences of the 21st century, which requires literate technology and the capability to integrate technology into learning. As prospective professional teachers in the digital era, they must combine various knowledge types. The framework is theoretical for understanding the required teacher knowledge for integrating booming technology, known as Technological Pedagogical Content Knowledge (TPACK). Knowledge pedagogical has the most significant role, and the results highlight an aspect of knowledge possible pedagogy _ addressed for creating TPACK inside teacher [13]. The TPACK framework explains relationships and complications Among three-part base knowledge (technology, pedagogy, and content [6].

Study this attempted reveal level pre-service elementary teachers' TPACK competencies and analyze the connection between the seven components of TPACK, namely: 1) Technological Knowledge (TK), 2) Pedagogical Knowledge (PK), 3) Content Knowledge (CK), 4) Pedagogical Content Knowledge (PCK), 5) Technological Content Knowledge (TCK), 6) Technological Pedagogical Knowledge (TPK), and 7) Technological Pedagogical Content Knowledge (TPCK). As for the answer data, respondents can be served in the following table.

Table 2. Analysis Results Distribution TPACK frequency

Question items	Answer Score Respondents										Means
	1		2		3		4		5		
	f	%	f	%	f	%	f	%	f	%	
TK1	0	0	1	1.4	14	19.4	51	70.8	6	8.3	3.86
TK2	0	0	1	1.4	12	16.7	41	56.9	18	25	4.06
TK3	0	0	7	9.7	30	41.7	27	37.5	8	11.1	3.50
TK4	0	0	4	5.6	17	23.6	40	55.6	11	15.3	3.81
PK1	0	0	6	8.3	8	11.1	43	59.7	15	20.8	3.93

PK2	0	0	5	6.9	18	25	42	58.3	7	9.7	3.71
PK3	0	0	6	8.3	13	18.1	36	50	17	23.6	3.89
PK4	0	0	6	8.3	11	15.3	37	51.4	18	25	3.93
PK5	0	0	6	8.3	19	26.4	34	47.2	13	18.1	3.75
PK6	0	0	2	2.8	16	22.2	46	63.9	8	11.1	3.83
PK7	0	0	4	5.6	13	18.1	39	54.2	16	22.2	3.93
CK1	0	0	3	4.2	7	9.7	46	63.9	16	22.2	4.04
CK2	0	0	3	4.2	5	6.9	46	63.9	18	25	4.1
CK3	0	0	2	2.8	16	22.2	44	61.1	10	13.9	3.86
CK4	0	0	4	5.6	11	15.3	47	65.3	10	13.9	3.88
TKC1	0	0	3	4.2	15	20.8	39	54.2	15	20.8	3.92
TKC2	0	0	1	1.4	17	23.6	43	59.7	11	15.3	3.89
TKC3	0	0	1	1.4	9	12.5	39	54.2	23	31.9	4.17
TKC4	0	0	4	5.6	13	18.1	36	50	19	26.4	3.97
PCK1	0	0	3	4.2	13	18.1	37	51.4	19	26.4	4
PCK2	0	0	5	6.9	12	16.7	40	55.6	15	20.8	3.9
PCK3	0	0	1	1.4	18	25	41	56.9	12	16.7	3.89
PCK4	0	0	1	1.4	14	19.4	38	52.8	19	26.4	4.04
TPK1	0	0	2	2.8	4	5.6	52	72.2	14	19.4	4.08
TPK2	0	0	5	6.9	22	30.6	33	45.8	12	16.7	3.72
TPK3	0	0	6	8.3	17	23.6	37	51.4	12	16.7	3.76
TPK4	0	0	5	6.9	15	20.8	41	56.9	11	15.3	3.81
TPCK1	0	0	6	8.3	9	12.5	45	62.5	12	16.7	3.88
TPCK2	0	0	7	9.7	18	25	44	61.1	3	4.2	3.6
TPCK3	0	0	6	8.3	12	16.7	44	61.1	10	13.9	3.81
TPCK4	0	0	7	9.7	23	31.9	40	55.6	2	2.8	3.51
TPCK5	0	0	7	9.7	21	29.2	40	55.6	4	5.6	3.57
				Means							**3.86**

Table 2 above showing that the whole indicator in the category is tall, with a mean of 3.86. this describes competent Technological Pedagogical Content Knowledge (TPACK) pre-service elementary teachers in the category of high and already. According to Şen (2022), TPACK helps teachers understand the connection Between technology, pedagogy, and knowledge content. During teaching, of course, competence is also needed by pre-service elementary teachers to support professionalism them. While doing the practice experience field (PPL), pre-service elementary teachers use technology in their learning. Experience the impact on their TPACK competence. Opinion Shinas et al (2015) that increasing the TPACK of pre-service teachers' statistics influenced in a manner significant by experience field.

Next, the research model used an analysis Structural Equation Model (SEM) for analysis and testing. The test results are presented below.

3.1 Stage First

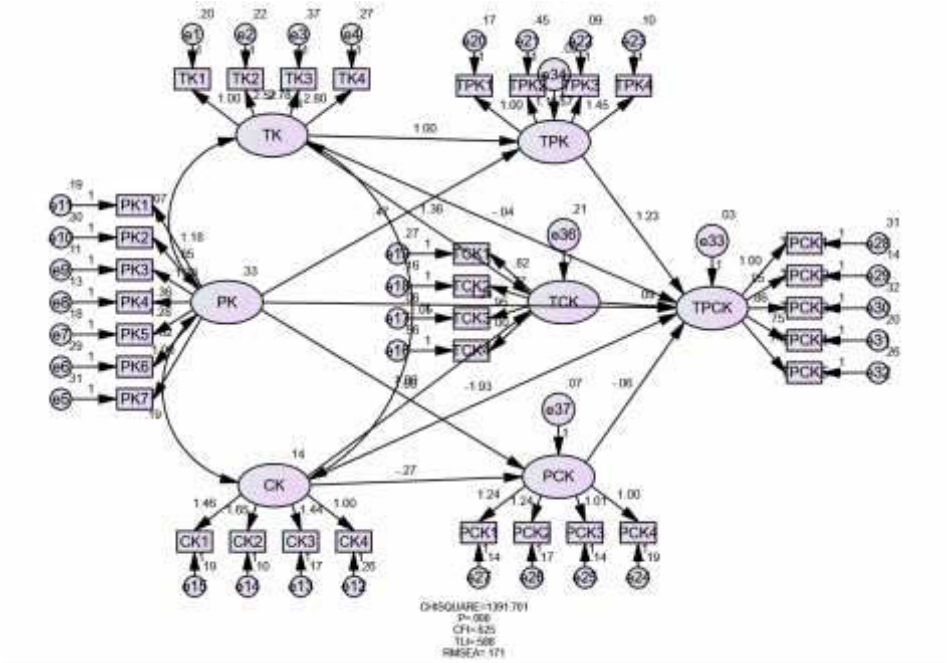

Fig. 2. Analysis Full Model Structural Equation Model (SEM) Stage First

Table 3. Stage SEM Full Model Test Results Firs*t*

Criteria	Cut of value	Results	Evaluation
X ² Chi-square	< 403.7077	1391,701	poor
Probability	≥ 0.05	0.000	poor
CMIN/DF	≤ 2.00	3,079	poor
RMSEA	≤ 0.08	0.171	poor
GFI	≥ 0.90	0.519	moderate
AGFI	≥ 0.90	0.438	moderate
TLI	≥ 0.95	0.588	moderate
CFI	≥ 0.95	0.625	moderate

The table above shows that the model developed needs to be more capable Fulfill the requirements of the goodness of fit. Because that is, the comprehensive analysis of the stage model must be conducted based on the analysis Step first.

3.2 Stage Second

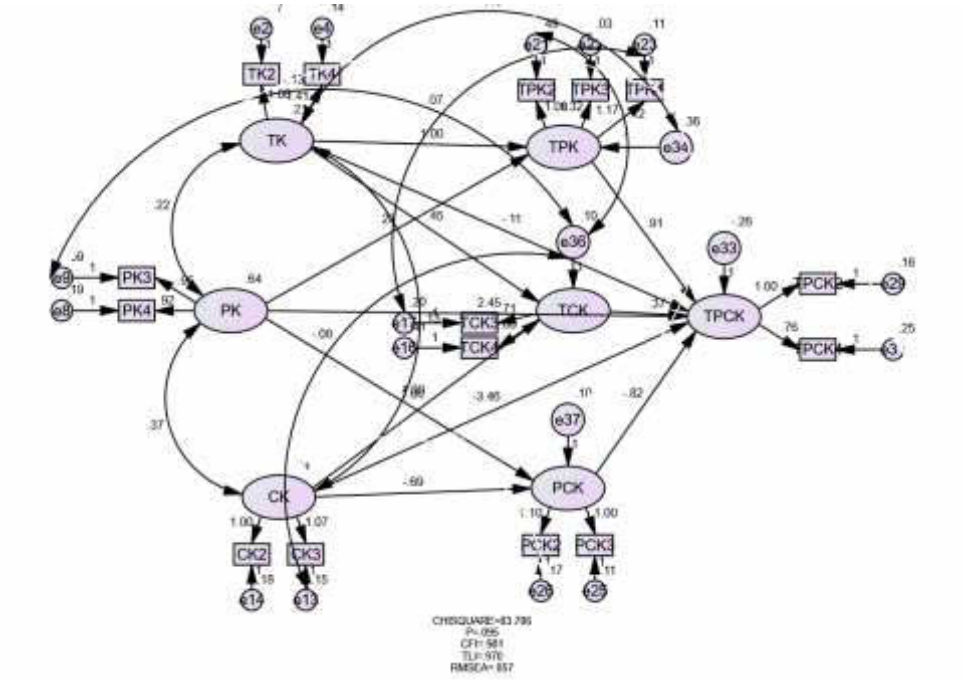

Fig. 3. Analysis Full Model Structural Equation Model (SEM) Stage Second

Table 4. Stage SEM Full Model Test Results Second

Criteria	cut of value	Results	Evaluation
X ² Chi-square	< 92.13376	83,706	fit
Probability	≥ 0.05	0.095	fit
CMIN/DF	≤ 2.00	1,231	fit
RMSEA	≤ 0.08	0.057	fit
GFI	≥ 0.90	0.882	moderate
AGFI	≥ 0.90	0.792	moderate
TLI	≥ 0.95	0.970	fit
CFI	≥ 0.95	0.981	fit

Statistical data in table 3 shows that the criteria goodness of fit has been fulfilled. The value of the chi-square table is 83.706, CMIN/DF 1.231 with probability 0.095, RMSEA 0.057, TLI 0.970, and CFI 0.981. Model feasibility test included in category " good /fit". This means analysis model confirmatory exogenous Step second could use for analysis of the whole model SEM with remove indicators TK1, TK4, PK1, PK2, PK5, PK6, PK7, CK1, CK4, TCK1, TCK2, TPK1, PCK1, PCK4, TPCK1, TPCK3, and TPCK5.

For the test hypothesis, the probability value was compared to P <0.05. If the results data analysis complied with the requirements, the hypothesis could consider accepted. Following is the results analysis hypothesis.

Table 5. Hypothesis Test Results Study

			P	Estimates
TPK	<--	TK	0.021	0.767
TPK	<--	PK	0.122	0.371
PCK	<--	PK	0.013	1,356
PCK	<--	CK	0.188	-0.573
TCK	<--	CK	0.004	0.696
TCK	<--	TK	0.020	0.291
TPCK	<--	TPK	0.005	0.805
TPCK	<--	TCK	0.033	0.383
TPCK	<--	PCK	0.204	-0.712
TPCK	<--	TK	0.737	-0.074
TPCK	<--	CK	0.23	-2,513
TPCK	<--	PK	0.002	2,889

Table 5 shows that from seven TPACK builders, connection positive direct is shown significantly by TK to TPK, PK to PCK, CK to TCK, TK to TCK, TPK to TPCK, and TCK to TPCK. At the same time, no positive or significance is shown by PK to TPCK through PCK. Furthermore, there is a connection between PK to TPK, CK to PCK, PCK to TPCK, TK to TPCK, and CK to TPCK.

Based on the results of data analysis, only TPK and TCK have connection direct in a manner positive and significant against the TPCK. That is, the teacher's mastery in TPK and TCK components will increase along with mastery in TPACK. as results study from [16]shows exists a strong relationship between TPK and TPACK. More TPK describes deep teacher knowledge use of technology on learning in general. In research conducted on prospective teachers, the TPK component, TPK is the highest component owned by prospective teachers [17]. More carry on [13] put forward that TPACK is described prospective teachers as an area of trust or challenge is TPK. Technological Pedagogical Knowledge (TPK) is knowledge about the presence, components, and capabilities of various technology as used in Settings study teach, and conversely, know-how teaching could be changed as a result of the use of technology specific [6].

Next is Technological Content Knowledge (TCK). Knowledge includes knowing the approach to teaching, what fits with content, and how element content could be arranged for more practical teaching [6]. TCK covers understanding the application of the right technology at a time to create source power in learning [18]. TCK is information about method work interacting with technology and content one each other [19]. TCK is positively related to CK and Kindergarten. It means that CK and PK influence the TCK competence of pre-service elementary teachers. If the CK and TK of pre-service elementary teachers increase, they will increase the TCK of pre-service elementary teachers.

Many pre-service elementary teachers use ICT in learning During practice experience field at school. Teacher education must help pre-service teachers create a

design strategy encouraging lesson ideation and iteration for the increased impression they have about TPACK [20]. Besides that, so that prospective teacher succeeds in integrating ICT into learning, the teacher education program should be allowed to make their TPACK alone [21]. TPACK is helpful for teacher ICT [22]. Prospective teachers improve their belief in ICT integration in learning and awareness investigation scientific through practice design [23].

4 Conclusion

Competence Technological Pedagogical Content Knowledge (TPACK) pre-service elementary teachers in the category high and already ok. While doing the practice experience field (PPL), pre-service elementary teachers use technology in their learning. Experience the impact on their TPACK competence . from seven TPACK builders, connection positive direct is shown significantly by TK to TPK, PK to PCK, CK to TCK, TK to TCK, TPK to TPCK, TCK to TPCK. At the same time, no positive and significant is shown by PK to TPCK through PCK. Furthermore, there is no connection between PK to TPK, CK to PCK, PCK to TPCK, TK to TPCK, and CK to TPCK.

Study this is still limited to the TPACK competency of pre-service elementary teachers. A study to front can also focus on other factors influencing integration technology of pre-service elementary teachers in learning during PPL. Study next too researching more about performance integration pre-service elementary teachers qualitative.

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