The Influencing Factors of ICT Use in Online Learning during Covid-19 Pandemic in Indonesia

Pahrudin Pahrudin, *Member IAENG*, Li-Wei Liu*, Chia-Ying Chang

***Abstract*—Most countries in the world are facing new situations due to the corona pandemic or COVID-19. Online learning is a new method of teaching and learning process in education during the COVID-19 period to avoid the spread of virus. The study examines and determines the lecturer's perception of using Information, Communication and Technology (I.C.T) based on the Technological Pedagogy and Content Knowledge (TPACK) framework in the teaching and learning process during the COVID-19 pandemic. The study built eleven hypotheses. The study used online questionnaire to collect data with 228 sample respondents who had taught at higher education in Indonesia. Data analysis used Partial Least Squared-Structural Equation Model (PLS-SEM) with Exploratory Factor Analysis (E.F.A). The result showed that all Technological Pedagogy and Content Knowledge (TPACK) variable on Use of Information, Communication, and Technology (UICT) variable had significant effect except for Content Knowledge (CK) Variable on Technological Content Knowledge (TCK) variable and Technological Content Knowledge (TCK) variable on Use of Information, Communication, and Technology (UICT) variable. Overall, the TPACK components are connected and valid model to explain Indonesian lecturers at use of Information, Communication and Technology (UICT) in online learning during the COVID-19 pandemic.**

***Index Term*— UICT, Online Learning, Higher Education, Covid-19.**

I. INTRODUCTION

Covid-19 has an impact on all sectors, including education sector. The COVID-19 outbreak first appeared in China and spread throughout the world. Furthermore, Covid-19 gives health impact and there are significant impacts on economy, such as economic losses for households, companies and government as well as disruption to life [1]. The accumulated number of Covid-19 cases increase from time to time until it reaches the peak curve [2]. Covid-19 hampers face-to-face learning process in the classroom. The learning carried out by lecturers during the pandemic has changed from conventional learning into online learning. In the implementation, online learning provides challenges to lecturers, institutions and students. In practice, lecturers must prepare skills in the teaching process so that students can receive learning well. Lecturers must understand and know about skills in technological knowledge and the process of online learning.

Lecturers can use various platforms in online learning during the COVID-19 pandemic, either a Learning Management System (LMS) or video conference. Lecturers can use learning management systems, such as Zoom applications, Google Meet, Microsoft Teams, and others. Online learning such as Massive Open Online Course (MOOCs) is one media in online learning that supports autonomous learning [3].

Epidemic, Pandemic or disease outbreak are part of non-natural hazard [4]. Pandemic Covid-19 or novel coronavirus disease (COVID-19) firstly found in 2019 in Wuhan, China. Most of the countries in the world restricted the spread of coronavirus by imposing lockdown, applying social and physical distancing, and avoiding face-to-face teaching. The first coronavirus disease in Indonesia was reported in March 2020 and continued to increase. In the middle of August 2020, Indonesia reported 139,549 active cases, 93,103 recovered, and 6,150 death cases [5]. In order to avoid the spread of corona virus, Indonesia applied physical distancing, including in the education sector. Started in the middle of March, Indonesian students did online learning in the teaching and learning process.

The Covid-19 pandemic has a significant impact on the education sector, especially on lecturers' learning methods. During work from home, lecturers teach online using a learning management system or learning platform [6]. The COVID-19 outbreak has changed the learning system using digital platform, such as online class/lectures, teleconferencing, digital open books, online examination, and interaction at virtual environments [7], [8]. Based on reports related to the impact of the COVID-19, it was stated that online learning during pandemic had changed the learning method and student performance [9].

Online learning is a process of teaching students using technology integration. Nowadays, the teaching process in class is being replaced by online learning to avoid the increasingly rapid spread of the virus. Online learning is a part of educational technology that sets technology to transfer students' knowledge in the teaching and learning process. Educational technologies in online learning

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research are TPACK and UICT. TPACK (Technological Pedagogy and Content Knowledge) is a teachers' concept in teaching and learning process to find out the material or content of learning and knowledge about the use of technology in the learning process. On the other hand, UICT (using information and communication technology) is the lecturers' use of information, communication and technology in the learning process optimally. Research on educational technology conducted in various contexts and settings led to a universal consensus about the complicated process of technology integration in education.

One of the studies on educational research is Technological Pedagogy and Content Knowledge (TPACK) that emerges as a framework combining all of the teaching and learning process components by using technology [10]. TPACK has recently been used in technology-based teaching. Moreover, it is used by teachers in the teaching and learning process or analysis that combines the technology and pedagogy [11]–[14]. However, some research instruments and analysis on TPACK have been expanded and discussed for their interconnection and integration in the learning process [10], [15], [16] that applies in numerous settings. An in-depth investigation of the link between TPACK and UICT remains restricted [17], [18]. As we tend to engage on this study, the importance of interaction between several TPACK elements and technology integration was reported between Pedagogical Knowledge (P.K) and I.C.T integration [17], TPACK and the intention to use internet or Web 2.0 [19], and PK, Technological Knowledge (T.K), and technology integration [20].

However, this study examined the impact the lecturers' use of ICT during the COVID-19 pandemic in Indonesia. This study is integrating the use of I.C.T in the online learning context. Therefore, the purpose of this study to investigate the lecturers' perception of using I.C.T during online learning in the COVID-19 pandemic period. The study variables are Content Knowledge, Pedagogic Knowledge, Technological Content Knowledge, Technology Knowledge, Technological Pedagogic and Content Knowledge, Technological Pedagogic Knowledge and Use of Information and Communication Technology (UICT) during the teaching and learning process in the COVID-19 pandemic period.

II. Literature Review and Hypothesis.

This study conducted in the teaching and learning process based on knowledge of technology, pedagogical, and content knowledge which lecturers did during the COVID-19 pandemic. TPACK has an essential role in the teaching and learning process within the integration of I.C.T. Many studies have addressed to discuss all of the components of TPACK. On the other side, some research explored some parts of TPACK in integration with technology. However, the integration of TPACK and its impact on the integration of technology have not much been discussed. Therefore, this research aimed to expand the relationship between all TPACK components with technology integration from lecturers' perspective in the teaching and learning process during online learning in the COVID-19 pandemic. The designed hypotheses include seven variables, namely TK, CK, PK, TCK, TPK, TPACK, UICT.

A. Technological Pedagogy and Content Knowledge.

The origin of TPACK was supported by Shulman's Pedagogic Content Knowledge (P.C.K) conception [21]. Within the discussion, they were concerned about P.C.K [22]. They discussed the distinction plan of teaching content with general pedagogic approaches and teaching with content-specific pedagogy. Concerning these essential principles of P.C.K, TPACK was introduced as a frame describing the parts of the effective integration of technology in education activities [16], [21]. These appropriate means of technology integration at this framework encourage academics to conceptualization that takes into account the interactions between components, technology, content, and pedagogy [23].

Meanwhile, technology, content, and pedagogy may illustrate various information bases, interactions, and interrelationships among core ideas. It is the essence of the whole framework [10]. TPACK consists of seven information bases, three of which are the core information bases; Technology Knowledge (T.K), Pedagogical Knowledge (P.K), and Content Knowledge (C.K). Four different parts are established from the interactions between the core bases, namely Technological Content Knowledge (TCK), Pedagogical Content Knowledge (P.C.K), Technological Pedagogical Knowledge (T.P.K), and TPACK.

B. Technology Knowledge, Content Knowledge and Pedagogical Knowledge.

Technology is a part of the infrastructure informatics (computer) in educational content and the teaching and learning process [24]. Technology knowledge is defined as the knowledge of lecturers on how to use different technologies in the context of the teaching and learning process. Technology knowledge is considered to have a significant impact and correlation with T.C.K and T.P.K [12], [25]–[27]. From researcher [12], it is known that between T.K, C.K and P.K is not significant. Meanwhile, [25] assumed that T.K had a significant effect on T.C.K and T.P.K. Likewise, research from [26] said that there is a strong effect between P.K and T.C.K, as well as P.K and T.P.K. In another study from [27], there is a strong effect of T.K on T.C.K and T.K on T.P.K. In connection with the T.K study in predicting T.C.K and T.P.K, two hypotheses are proposed in this study:

Hypothesis H1: TK will have a significant impact on T.C.K.
Hypothesis H2: TK will have a significant impact on T.P.K.

Content knowledge in this research is knowledge of lecturers about subject matter or courses that are essential in teaching and learning process in predicting two second-level knowledge bases, namely T.C.K and P.C.K [12], [25], [26]. The research from [12] said that CK was not a predictor for both TCK and PCK. Meanwhile, [25] reported that C.K has significantly impacted T.C.K. [26] stated that T.C.K and P.C.K were significantly related to C.K. Two hypotheses are built regarding the role of CK:

Hypothesis H3: C.K will have a significant impact on TCK.
Hypothesis H4: C.K will have a significant impact on PCK.

Similar to Technology knowledge and content knowledge, Pedagogical knowledge that is outlined as data of various teaching and learning approach has been reported to affect T.P.K and/or P.C.K significantly [12], [14], [25], [26]. According to [12] informed that in their study, there are relations between P.K and T.P.K. Research from [26] showed that P.K was also informed to be significant for T.P.K. However, [25] said that P.K significantly influenced both T.P.K and P.C.K.

Hypothesis H5: P.K will significantly impact T.P.K.

Hypothesis 6: P.K will significantly impact T.C.K.

C. Technology Pedagogy Knowledge, Technology Content Knowledge, Pedagogy Content Knowledge, Technological Pedagogy and Content Knowledge.

T.P.K is explained as knowledge about how content experts received by the respondents apply information communication technology. Several previous studies have discussed the relationship between T.P.K and T.P.C.A.K [12], [25]–[27]. A study from [26] said that TPK affected TPACK. [27] in their research said that T.P.K had a strong influence on T.P.A.C.K. On the other hand, [12], [25] said that T.C.K had no significant effect on TPACK in their research findings. Regarding UICT, there are several limitations of studies that discuss T.P.K and UICT. A study from [28] in his study using a quantitative method said that T.P.K has a high impact on technology integration. With UICT, we proposed hypotheses in regarding T.P.K:

Hypothesis H7: T.P.K has a significant impact on TPACK.

Hypothesis H8: T.P.K has a significant impact on UICT.

Technology content knowledge deals with lecturers' knowledge regarding how to use content of technology to develop teaching and learning process. Regarding to T.C.K, few studies discuss the relation between TCK and UICT. However, many studies discuss T.C.K and TPACK and have strength impact [12], [25], [26]. The study from [26] said that T.C.K and TPACK have a significant correlation. On the other side, [12] found that there is no correlation between TCK and TPACK. In the same case, a study from [25] found that T.C.K had a positive impact on TPACK. Based on this explanation, we compile two hypotheses based on T.C.K as the moderator of TPACK and UICT.

Hypothesis H9: T.C.K has a significant impact on TPACK.

Hypothesis H10: T.C.K has a significant impact on UICT.

TPACK in this study refers to knowledge about how to combine different areas and how pedagogical approach can accept the content and the use of I.C.T in the teaching and learning process. Some studies said that TPACK has been concluded to predict the incorporation or integration of technology [19], [29], [30]. Other researchers said that TPACK had significant effect on internet intention or web 2.0 in mainland China. A study [30] also found that TPACK and the use of technology had a strong impact. On the other hand, [29] said that TPACK did not significantly predict the intention to use technology in the teaching and learning process. Based on the explanation of the relationship between TPACK and UICT, we were proposed a hypothesis in this research:

Hypothesis H11: TPACK has a significant impact on UICT

Figure 1 below is a theoretical model in developing hypotheses based on the theory development.

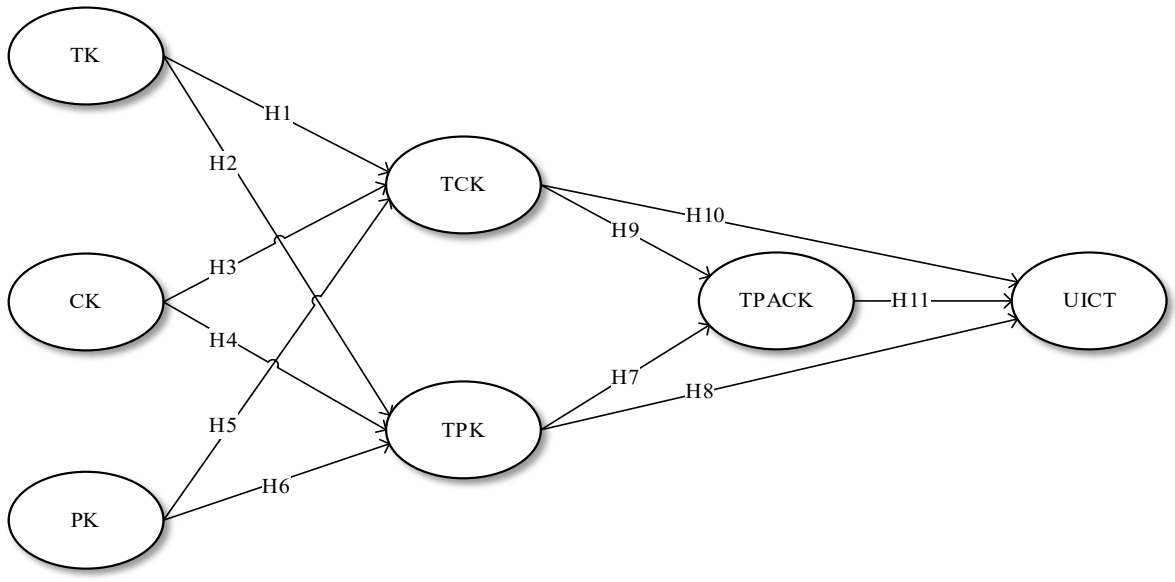

Fig. 1. Theoretical and Hypothesis Model.

III. Research Methods

This study was conducted from April to July 2020 utilizing survey as a data collection method. The study based on the previous study and assessment of validity and reliability instruments. Model Partial Least Squares Structural Equation Model (PLS-SEM) was applied for assessment in the study.

A. Data Collection

This study provides a quantitative or numerical description of trends, attitudes, or opinions of a population by studying a sample population [31]. The respondents were lecturers who used technology in the teaching and learning process during the COVID-19 pandemic at universities in Indonesia. TPACK and UICT were component variables that were examined in this study. The samples were the lecturers at the universities in Indonesia who used technology in the teaching and learning process during COVID-19 pandemic. A digital version of the questionnaire was distributed by e-mail, social networks, or online platform to get the data. The reasons why this research used an online survey had in the advantages pointed out by [32], which regarded to the geographical coverage and the possibility of identifying specific audiences and respondent. The other reasons to use online survey in this study was to avoid the spread of COVID-19 virus during the pandemic.

B. Study Instrument.

The study used questionnaire to collect data. The questionnaire was designed in English and Indonesian language. The scale in this research used five scales which based on the previous study. All items in this study were measured using five scales (scale 1: disagree and scale 5: agree). The instrument in this study was developed with regard to the previous study. The descriptive statistic used in this study includes gender, age, education background, teaching duration, and a total of the ICT use in teaching and learning process during COVID-19 pandemic.

The instrument constructs and sources were developed regarding the previous studies. TK indicator refers to knowledge of appearing technology for I.C.T integration during teaching and learning process from the source of [16]. C.K refers to knowledge of teaching process, such as teaching method in online learning, teaching principles, teaching strategy, and classroom management in the teaching online learning from the source [15], [33]. PK Knowledge is about subject matter, such as scientific, social, language, and natural science knowledge in the teaching and learning process from the source of [16]. T.C.K Knowledge of mixing emerging technology is to make sure that subject matter knowledge which included pedagogical aims in teaching and learning process from source [16]. T.P.K refers to pedagogic and technology knowledge to integrate the teaching and learning process with the source [15], [33]. TPACK refers to applying technologies in teaching and learning process to enhance students' understanding of the subject matter with the source [16], [33]. UICT refers to teaching practice reflected on their integration analysis throughout actual placement with the source [17].

C. Data Analysis

The data collection was conducted from April to July 2020 with an online questionnaire. The data were then analyzed using Exploratory Factor Analysis and Partial Least Squared-Structural Equation Modelling (PLS-SEM). The results of the analysis were tested to ensure the validity and reliability of data. E.F.A was then used to summarize and reduce the data into a smaller number of grouped variables (factors) that were highly interrelated [34]. PLS-SEM was used to search for underlying patterns in the data as there was a little prior knowledge of how the variables were related [34]. Therefore, the study from [35] used the S.E.M model for investigating factor of an accident affecting safety performance. Therefore, all the data were inputted into the Statistical Package for Social Science (SPSS) IBM version 21.0 for descriptive statistical analysis.

IV. Results and Discussion

The data collection of the valid questionnaires was analyzed using the following statistical analysis procedure, namely: 1) SPSS for Windows 21.0 was adopted to analyze the distribution of the demographic variable with frequency distribution and percentage of descriptive statistics; 2)The partial least squares (P.L.S) of the Smart PLS 3.0, similar to the advanced statistics of LISREL, was used to analyze the reliability and validity of the study with five scales and to analyze the causal relationship among the hypothesis models.

A. Descriptive Sample

The study sample was lecturers who taught the students in the universities using an online learning during COVID-19 pandemic in Indonesian context. Based on these criteria, the sample in this study was lecturers from all regions in Indonesia. The number of respondents obtained in this study were 228 lecturers. Those lecturers collected the data using an online survey (via google form). The data showed that the number of respondents consists of 102 men (44.7%) and 126 women (55.3%). With the most extensive range, the respondents' age was between the ages of 30-35 year by 39.5%. Viewed from the most prominent education background for university teaching, the respondents came from social science by 39.5%. The teaching experience of the lecturers was as long as 1-5 years. The number of lecturers in using I.C.T during COVID-19 pandemic was as many as 2-3 online platforms or 68.4% using 2-3 ICT during teaching and learning process. Respondents characteristic are summarized in Table I.

TABLE I
RESPONDENTS CHARACTERISTIC

Variable	Value	Frequency	Percent (%)
Gender	Male	102	44.7
	Female	126	55.3
Age	<30 years	60	26.3
	30-35 years	90	39.5
	40-45 years	48	21.1
	>45 year	30	13.2
Education Background	Social Science	90	39.5
	Math and Natural Science	65	28.5
	Language and Humanities	17	7.5
	Education Science	44	19.3
	Health Science	12	5.3
Teaching duration	1-5 year	114	50.0
	6-10 year	48	21.1
	11-15 year	42	18.4
	>15 year	24	10.5
Number of UICT in Teaching	1 UICT	18	7.9
	2-3 UICT	156	68.4
	>3 UICT	54	23.7

B. Confirmatory Factor Analysis

In order to check the validity and reliability of this study, internal consistency was used and measured using Composite Reliability (C.R) score. Three indicators were tested each item's reliability to determine according to the suggested factor loadings that should be above 0.50 [36]. In respect of each potential variables, it should approach above 0.70 to composite reliability [37], above 0.70 of Cronbach's alpha value [37], [38], and above 0.50 of Average Variance Extracted (AVE) [37], [39]. In respect of the validity test, the AVE of each potential variable needs to be greater than 0.50 to be determined as convergent validity, and the test standard of the square root of AVE is over 0.70 to be determined as the discriminate validity.

The value standard of Composite Reliability was 0.70, and all constructs were higher than 0.70, which ensured the internal reliability of items in this study. As given in table 4.2, the value of Composite Reliability of this study can be seen on the table. To ensure the validity of latent variables, we assessed both convergent and discriminant validity. The first, convergent validity was assessed by examining both the Average Varian Extracted (AVE) score and loading factors of each indicator related to construction. A Confirmatory Factor Analysis was adopted to compute the factors loading. The result showed that the value of AVE ranged from .619 to .839, which were above .50 of the standard value. The factor loading ranged from .702 to .945. It means that all variable supports convergent validity.

In this study, the AVE root of the individual potential variable was brought up by [40] to test the discriminate validity that should be greater than the common variate relationships of other potential variables of the potential variables and models. Researchers suggest that the test standard of AVE root should be at least equal to or greater than .70. In this case, the result value of AVE was at least equal to .70 [41].

Discriminant validity was assessed by comparing the square root of the AVE for each construct against the inter construct correlation. As shown in table II, all the diagonal element, which were the square root of the AVE, exceeded the inter construct correlations, thereby satisfying the discriminant validity.

TABLE II
DISCRIMINANT VALIDITY ANALYSIS

	CK	PK	TCK	TK	TPACK	TPK	UICT
CK	.787						
PK	.777	855					
TCK	.673	776	916				
TK	.572	607	776	890			
TPACK	.725	830	819	687	897		
TPK	.684	737	824	713	914	885	
UICT	.337	477	409	504	487	400	821

C. Structure Model

To test the hypothesis, we measured the explained variance (R^2) of the dependent variable path coefficient (*Beta*) and their significant level (t-value), which was obtained from bootstrapping with resampling (500 resamples) to assess the significance of the hypothesized relationship. The summarized hypothesis testing results showed that all the hypotheses in our research model are supported. The result of structure model in the table III.

D. Hypothesis Testing

The measurement model was developed in this study with criteria of the validity and reliability of the model, and the validity and reliability of the structure of the study. There were two critical perspectives for testing and analyzing the structural model with the P.L.S. The first perspective was to standardize the path coefficient. Meanwhile, the second was to determine the explanatory model with *R* [34], [37]. Each potential path coefficient among variables and the result of the R-value revealed the level of goodness of Fit, the structural model, and the empirical data.

The standardized path coefficient had to approach statistical significance; R was applied to determine the analytical capability that the higher the R-value, the better analytical capability. A path coefficient represented the strength and the orientation of the relationships among the research variables; the test of a path coefficient should show the significance and the predicted orientation in the research hypothesis to establish the relationships among the predictive and validity index variables.

The Smart PLS 3.0 was adopted in the study to test the structural model; the Structural Equation Modelling (S.E.M) (path analysis), and the results are presented in Table IV. The underlined values are the standardized regression coefficients (β values). The description of the analysis of overall research hypotheses in the Table IV.

E. Explanatory Capability

The R values represents the research models predictive ability, namely the percentage of the variance of external variables that can explain internal variables. In respect to causal analysis (the constructed model), it depends on whether the coefficient of the standard route approach statistical significance, and the explanatory capacity of the R square determination model [34], [37]. Table V shown the result of R square.

TABLE V
R SQUARE

	R-Square	Consideration	Goodness of Fit
TCK	0.75	High	
TPACK	0.849	High	0.543
TPK	0.667	Moderate	
UICT	0.252	Weak	

The Goodness of Fit index is a single measure of performance model and the structural model. The Goodness of Fit value is obtained from the square root of the average community index multiplied by the average value of the R^2. The Goodness of Fit value is from 0-1 with interpretations of value: .1 (Small Goodness of Fit), .25 (Moderate Goodness of Fit), and .36 (Large Goodness of Fit). From the table, the value of Goodness of Fit obtained 0.543 or 54.3%.

We conclude that the value of R square variable of T.C.K was .750 or 75% variable TCK explains the model. TPACK variable obtained .849 or 84.9% variable TPACK explains the model. TPK variable was 0.667 or 66,7% variable TPK explain the model and UICT variable by .252 or 25.2% to explain the model. Figure 2 explains the result of structural

testing model and the result of hypothesis testing of each variable.

TABLE III
STRUCTURAL TESTING MODEL

	Original Sample	Standard Deviation	T Statistics	P Values
CK1 <- CK	0.702	0.059	11.885	0.000
CK2 <- CK	0.828	0.017	48.300	0.000
CK3 <- CK	0.824	0.026	31.624	0.000
PK1 <- PK	0.889	0.018	49.375	0.000
PK2 <- PK	0.888	0.018	50.305	0.000
PK3 <- PK	0.757	0.034	22.062	0.000
PK4 <- PK	0.892	0.011	81.823	0.000
PK5 <- PK	0.856	0.012	69.548	0.000
PK7 <- PK	0.841	0.017	48.496	0.000
TCK1 <- TCK	0.918	0.010	87.649	0.000
TCK2 <- TCK	0.914	0.013	71.927	0.000
TCK3 <- TCK	0.914	0.014	63.952	0.000
TK1 <- TK	0.831	0.036	23.118	0.000
TK2 <- TK	0.890	0.017	52.222	0.000
TK3 <- TK	0.945	0.008	117.634	0.000
TPACK1 <- TPACK	0.911	0.012	73.018	0.000
TPACK2 <- TPACK	0.887	0.019	46.975	0.000
TPACK3 <- TPACK	0.856	0.020	42.662	0.000
TPACK4 <- TPACK	0.932	0.007	131.253	0.000
TPK1 <- TPK	0.870	0.016	53.701	0.000
TPK2 <- TPK	0.899	0.014	65.781	0.000
TPK3 <- TPK	0.906	0.015	58.544	0.000
TPK4 <- TPK	0.863	0.029	29.296	0.000
UICT2 <- UICT	0.753	0.040	18.607	0.000
UICT4 <- UICT	0.839	0.032	26.146	0.000
UICT6 <- UICT	0.868	0.015	56.725	0.000
UICT7 <- UICT	0.750	0.039	19.265	0.000
UICT9 <- UICT	0.886	0.013	69.514	0.000

TABLE IV
HYPOTHESIS TESTING

	Original Sample (O)	Sample Mean	Standard Deviation (STDEV)	T Statistics	P Values
CK -> TCK	0.058	0.059	0.040	1.459	0.145**
CK -> TPK	0.183	0.185	0.037	4.989	0.000***
PK -> TCK	0.443	0.440	0.057	7.753	0.000***
PK -> TPK	0.357	0.358	0.075	4.759	0.000***
TCK -> TPACK	0.206	0.211	0.042	4.889	0.000***
TCK -> UICT	0.104	0.114	0.128	0.811	0.417**
TK -> TCK	0.474	0.476	0.050	9.435	0.000***
TK -> TPK	0.391	0.388	0.056	7.003	0.000***
TPACK -> UICT	0.694	0.700	0.125	5.551	0.000***
TPK -> TPACK	0.744	0.740	0.039	19.144	0.000***
TPK -> UICT	-0.320	-0.334	0.149	2.149	0.032***

***Significant at the *p<0.05 level (two tailed).*

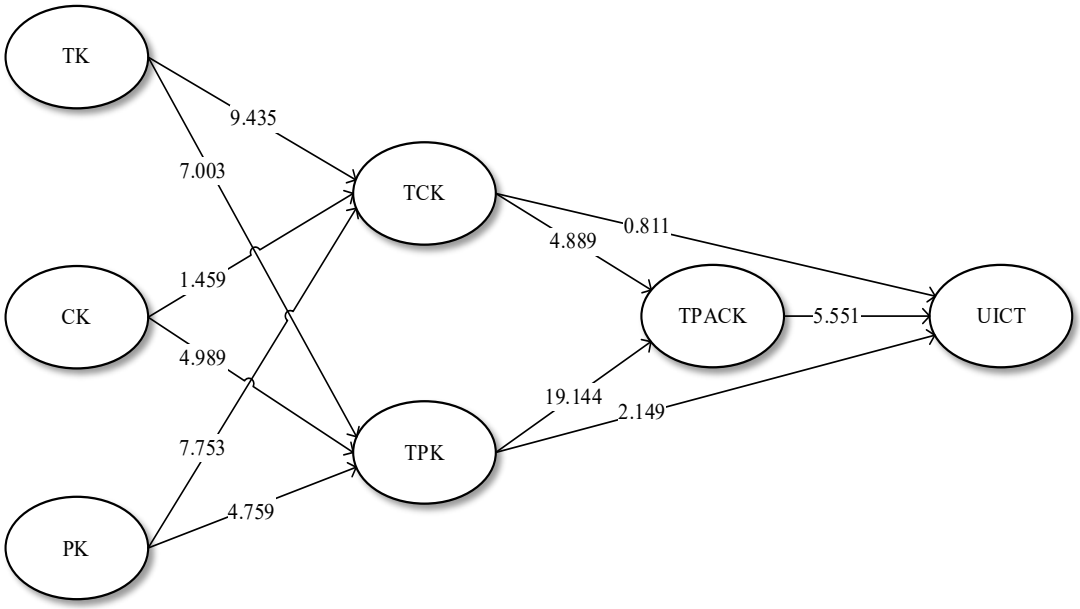

Fig. 2. The Structural Testing Model Result

F. Discussion

This study is about using Information, Communication and Technology (I.C.T) in the education sector, especially in the teaching and learning process during the Covid-19 pandemic. The education sector has entered with new age because of the development of internet technology [42]. This study aims to determine the role of the I.C.T use, which consists of TPACK and its effect on UICT. This study explained the role of TPACK in I.C.T in the teaching and learning process at universities in the COVID-19 pandemic. Before identifying the roles of TPACK on UICT, researchers investigated the components of TPACK, which aims to comprehensively minimize the bias of the proposed model [43]. All TPACK components are used to examine the process, both the validity and reliability. Based on statistic result, it can be concluded that the variable of Content Knowledge (C.K) on Technology Content Knowledge (T.C.K) and the variable of Technology Content Knowledge (T.C.K) on the Use of Information and Communication Technology (UICT) was not significant in this study. The variable of content knowledge on the T.C.K in this study was not significant because the statistic result showed that the content knowledge value for T.C.K variable was more than 0.05 or 0.145. Therefore, the T.C.K variable towards UICT in this study was not significant since the variable value was more than 0.05 or 0.417.

Based on the data analysis result, the component of TPACK variable had substantial effects on UICT during COVID-19 pandemic. The lecturers applied the skill of teaching and learning process using technology because of learning activity from home in the COVID-19 pandemic. The study results said that the average lecturers use of the technology, such as Learning Management System (L.M.S) platform, Learning Video Technology, Zoom, Google Meet, and other online platforms. It means that the lecturers had skills in using technology to give students material or content to students in the teaching and learning process. Based on the study, the lecturers were using the various platform for online learning, study material sharing, and learning evaluation, such as Google Meet, Zoom Apps, Google Classroom, and WhatsApp. The result also showed that most of the lecturers used more than one platform in online learning.

The results showed that the lectures could achieve the similar impact on TPACK development. This study showed that the relationships of all TPACK components were complex involving nine significant hypotheses. The results also showed that UICT played essential roles in teaching and learning process during the pandemic to prevent the spread of virus in educational institutions. The model had also been developed with valid and statistically reliable results. The model informed that the TCK and TPK influenced the TPAC as a component.

From the statistical results, TPACK was highly expected by T.P.K and T.C.K, while PK was the highest predictor of T.P.K. Likewise, PK predicted PCK with the first positive coefficient. Meanwhile, TCK was usually predicted by TK. Several correlations were similar to previous studies. However, some of them were totally different. For instance, [26] found that the different results on the variable affect TPACK with TCK as TPACK. Besides, they reported that PK strongly predicted TPK. Similar to this study, TK was informed as the most reliable predictor of TCK and PK for PCK. In contrast, [12] informed that TPACK was not predicted by TPK, TCK, and PCK. However, PK and CK were found to be related to TPACK. The study from [33] revealed in an article coding other constructs' term for the TPACK components; technology, pedagogy, and content, have reported that the components have a significant relationship among all constructs.

Several studies discussed the relationship between TPACK and the use of technology integration in the teaching and learning process. Therefore, in this study, the aims are to fill the gap by examining TPACK and their roles on predicting UICT during online learning in the COVID-19 pandemic. In determining UICT during teaching and

learning process, TPACK is the strongest predictor, followed by TPK and PCK. However, in this study, the relation between TCK and UICT does not correlate. This finding is similar to the findings of [19], [30] and [29] that mention TPACK as a significant predictor for the intention of technology use in education. Study from [17] revealed the significant relation between PK and UICT during teaching and learning process. However, [29] reported that TPACK was not related to the intention of technology use.

V. Conclusion

The Covid-19 pandemic has disrupted the education sector in the world. Nowadays, the educational institutions use online learning in the teaching and learning process. This study main objective is to examine the use of TPACK and UICT in the teaching and learning process during the COVID-19 pandemic. The result showed that all the variables support the hypotheses set, except CK to PCK and PCK to UICT. This study highlights the importance of ICT use during pandemic COVID-19 in the teaching and learning process.

Additionally, the role of TPACK and UICT on the Covid-19 pandemic is essential on giving students the lesson material without attending the teaching and learning process in the conventional classroom. Online learning plays an essential role in online learning in this pandemic period to ensure that the students can avoid the spread of the Covid-19. Additionally, the role of all TPACK component variables has a significant impact on UICT in this study. It means that lecture's role is essential to prepare the lesson material, teaching method, and ICT skills in online learning during COVID-19 pandemic.

Based on the result of the analysis, the variable of TPACK has a strong impact on UICT except for the variable of CK on TCK and variable of TCK on UICT. The result indicates that the lecturers perceived the impact of technology use in COVID-19 pandemic on the development of TPACK. This study suggests that the relation among TPACK components is involved in developing eleven hypotheses in this study.

This study has limitations. The sample of this study was small in the context of Indonesian lecturers in higher education. The majority of the lecturers in this study came from eastern part of Indonesia. Besides, the result of this study has a limitation in the methodology. This study focused on quantitative methods. A Study on qualitative approach is recommended for further research to inform the relationship of all the component of online learning, and to get information about online learning during the Covid-19 pandemic.

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