Investigating of the Relations among TPACK Components of Economic Teacher Candidates in Sebelas Maret University (UNS) in 2020: A Structural Equation Modeling

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Abstract: This study examines the structural relationship between the components in TPACK. The sample of this study was 98 economics teacher candidates at Sebelas Maret University Surakarta, Indonesia. This research design is quantitative with structural equation modeling (SEM) analysis techniques. The results of this study indicate that the questionnaire is valid and reliable and the hypothesis shows that there is a significant influence between the TPACK components except TK, PK, and CK on TPACK. The results of the study can be used as reference material for future research using instruments that have been tested for validity and reliability in teachers who have taught during the pandemic to determine the TPACK of post-Covid-19 teachers who carry out online learning.

Keywords: Covid-19, Economic Education, Teacher Candidates, TPACK

1. Introduction

Economics is one of the core subjects and is also important for building 21st century skills [1] which serves to equip students to solve problems related to meeting the needs of life in the future [2]. Then, the expansion of technology integration in teaching and learning has increased from time to time and has become an important part of teaching and learning activities [3]; [4]. Technology became very important during the covid-19 pandemic because of government policies to lockdown in Indonesia and require distance learning. Other countries also require that students be sent back to their respective homes with plans, evaluations, and learning which are replaced with online systems [5]. Covid-19 is a unique opportunity that challenges and forces teachers to leave their comfort zone by using available technology, as a channel and means of communication during a pandemic like today [6]; [7]. After the end of the pandemic, it is expected that the use and integration of technology into culture and investment in the future, not a substitute for traditional learning but a tool to complement and strengthen existing education [8]; [9]; [10]. Currently technology integration is an important part of the 21st century [4] and enables students to build 21st century skills because technology is used as a means of obtaining future jobs in order to meet the needs of life [11]. Before integrating technology, teachers must understand technology pedagogy and content knowledge (TPACK). TPACK is knowledge that must be possessed by teachers consisting of technological, pedagogical, and content knowledge [12]. So that learning with the TPACK framework can help prepare students to learn and master 21st century skills [12]. Supported by UU 14/2005 article 20 which requires that in addition to having standard competencies, which include pedagogical competence, personal competence, social competence, and professional competence obtained through professional education, teachers are also obliged to improve and develop technology. Professional competence is the teacher's ability to master the subject matter broadly and deeply.
Figure 1 about the nomological network of TPACK shows previous studies that examined TPACK as the main issue classified into constructs, related variables, target groups, subject domains, and research purposes. Respondents in this study were prospective teachers in economics, because no one has researched this subject yet, supported in Figure 1 in the subject domain and supported by the opinion of [13] that there is no study that measures the level of social science teacher TPACK. Prospective teachers and teachers alike need to improve their knowledge and skills at TPACK [14] and there is no problem with the research being carried out on women or men because there are no significant differences based on gender and age of the prospective teachers on the ability of TPACK [15]; [16] so that they can complement previous studies.

| Hypothesis | Supported? |
|------------|------------|
| CKa>TKCK   | No         |
| CKa>PCK    | No         |
| PKa>TPK    | Yes**      |
| PKa>PCK    | No         |
| Tk>TPK     | Yes***     |
| Tk>TCK     | No         |
| CKa>TPACK  | Yes        |
| PKa>TPACK  | No         |
| Tk>TPACK   | Yes***     |

Table 1. Gap of Research Result
For research purposes, it consists of validity and hypothesis test. This study tested the hypothesis test in which there is a validity test, but there are gaps in the research results shown in table 1 regarding the gap of research results. So, the aim of this study is to investigate the relationship between TPACK components to support previous studies.

2. Research question

Covid-19 is a unique opportunity that challenges and forces teachers to leave their comfort zone by using available technology, as a channel and means of communication during a pandemic like today [6]; [7]. After the end of the pandemic, it is expected that the use and integration of technology into culture and investment in the future, not a substitute for traditional learning but a tool to complement and strengthen existing education [8]; [9]; [10]. Currently technology integration is an important part of the 21st century [4] and enables students to build 21st century skills because technology is used as a means of obtaining future jobs in order to meet the needs of life [11]. Before integrating technology, teachers must understand technology pedagogy and content knowledge (TPACK). TPACK is knowledge that must be possessed by teachers consisting of technological, pedagogical, and content knowledge [12]. So that learning with the TPACK framework can help prepare students to learn and master 21st century skills [12]. Supported by UU 14/2005 article 20 which requires that in addition to having standard competencies, which include pedagogical competence, personal competence, social competence, and professional competence obtained through professional education, teachers are also obliged to improve and develop technology. Professional competence is the teacher's ability to master the subject matter broadly and deeply.

Based on the background, this formulation of the problem of this study can be breakdown as follows: (1) How the relationship between TPACK components to support previous studies? And the purpose of this study is: (1) This study examines the structural relationship between the components in TPACK. (2) to investigate the relationship between TPACK components to support previous studies.

3. Methods

The design of this study was quantitative using the SmartPLS version 3.0 analysis tool to process the data and then the results were obtained to analyze the validity and reliability of the TPACK instrument for economic subject teacher candidates at UNS Surakarta. In this study, 98 respondents were obtained. Instrument development is carried out by: (1) collecting items from previous research surveys, (2) translation, (3) expert reviews, and (4) validity and reliability testing [17]. The data collection technique used a questionnaire with a 6-scale likert (1 = strongly disagree to 6 = Strongly Agree) and was carried out online via google form as a substitute for paper considering the covid-19 pandemic period to reduce mobility. Links are disseminated and sent via social media to be filled in by respondents to obtain primary data which is done voluntarily until they get enough data to be processed and researched around 5 August - 23 September 2020 and this research is also the self-assessment survey that is most widely used in research to measure the actual condition of a person [18]; [19]; [20]; [21]; [22]; [23]; [24]).
4. Results and Discussions

4.1 Results

This study aims to develop the TPACK framework which is carried out on 38 statement items.

![Diagram](image)

Table 2. Communality, AVE and Square Root of AVE

| Constructs | Communality | AVE   | Square Root of AVE |
|------------|-------------|-------|--------------------|
| TK         | 0.626260    | 0.626260 | 0.791366          |
| CK         | 0.583814    | 0.583814 | 0.764077          |
| PK         | 0.612952    | 0.612952 | 0.782913          |
| TPK        | 0.713880    | 0.713880 | 0.844914          |
| TCK        | 0.670290    | 0.670290 | 0.818712          |
| PCK        | 0.644543    | 0.644543 | 0.802834          |
| TPACK      | 0.764558    | 0.764558 | 0.874390          |

Table 3. Latent Variable Correlations

|        | CK     | PCK    | PK     | TCK    | TK     | TPACK   | TPK     |
|--------|--------|--------|--------|--------|--------|---------|---------|
| CK     | 1.000000 |        |        |        |        |         |         |
| PCK    | 0.581178 | 1.000000 |        |        |        |         |         |
| PK     | 0.548819 | 0.689922 | 1.000000 |        |        |         |         |
| TCK    | 0.689369 | 0.673338 | 0.741182 | 1.000000 |        |         |         |
| TK     | 0.585851 | 0.514258 | 0.698286 | 0.713631 | 1.000000 |         |         |
| TPACK  | 0.659747 | 0.741204 | 0.757082 | 0.794864 | 0.666068 | 1.000000 |         |
| TPK    | 0.663417 | 0.671077 | 0.769488 | 0.730536 | 0.698180 | 0.790287 | 1.000000 |
Table 4. Cronbach’s Alpha, Composite Reliability and R-Square

|       | Cronbach’s Alpha | Composite Reliability | R-Square |
|-------|------------------|-----------------------|----------|
| TK    | 0.876924         | 0.910207              | -        |
| PK    | 0.874253         | 0.904539              | -        |
| CK    | 0.849729         | 0.892875              | -        |
| TPK   | 0.922501         | 0.941866              | 0.642610 |
| TCK   | 0.899438         | 0.925683              | 0.621327 |
| PCK   | 0.822221         | 0.873002              | 0.534695 |
| TPACK | 0.90663          | 0.926567              | 0.766301 |

Table 5. Original Sample and T-Statistics

| Supported? | Original Sample (O) | T-Statistics (O/STERR) |       |
|------------|---------------------|------------------------|-------|
| Yes        | 0.413057            | 4.49254                |       |
| Yes        | 0.289835            | 3.117361               |       |
| Yes        | 0.550274            | 5.102514               |       |
| Yes        | 0.530856            | 5.826774               |       |
| Yes        | 0.313931            | 3.23129                |       |
| Yes        | 0.471641            | 5.435531               |       |
| No         | 0.065607            | 0.741183               |       |
| No         | 0.121758            | 0.937945               |       |
| No         | 0.035331            | 0.382259               |       |
| Yes        | 0.265257            | 2.566714               |       |
| Yes        | 0.284747            | 2.829551               |       |
| Yes        | 0.231163            | 2.30709                |       |

4.2 Discussions

4.2.1 Convergent Validity Test

Validity to be good if the AVE and Communality values are > 0.5, besides that the loading factor value > 0.7 or the loading factor value > 0.5 can be categorized as having good validity [25]; [26]. Table 2 in this research shows that the value of AVE and communality > 0.5 and in Figure 2 shows that the value of the loading factor is > 0.5 so that the validity can be said to be good.

4.2.2 Discriminant Validity Test

Validity to be good if the cross loading value is > 0.7 [26] and at the indicator level the correlation between indicators and their variables > correlation between indicators and other variables, while at the variable level in the square root of AVE > Correlation between variables [27]. The cross loading value in this study is > 0.7 and the indicator level of the correlation between indicators and their variables > correlation between indicators and other variables can be seen in appendix 5, while at the variable level in the square root of AVE > Correlation between variables is shown in the table 2 and table 3.
4.2.3 Reliability Test

Instrument reliability was Cronbach's alpha > 0.7 and composite reliability > 0.7 [26] and a value of 0.6 was still acceptable [27]. The results of the research instrument are reliable, it can be seen in Table 4 that Cronbach's alpha and composite reliability > 0.7.

4.2.4 Hypothesis Test

Provisions for acceptance of the hypothesis have a positive and significant effect if the beta coefficient (original sample) is positive and the t-value > t-table is 1.65 (significance level 10%) [26]. Sarjono and Julianita [28] suggest that the error rate for social research can be 10%. The relationship between TPACK variables was positive and significant, except TK, PK, and CK toward TPACK where the t-value < t-table (1.65) was 0.74, 0.94, and 0.38, respectively. Can be seen in Figure 3.

![Fig. 3: T Statistics Value (Bootstrapping Output)](image-url)
5. Future trends and Conclusions

The results of this study support the results of research by [29], where TK, PK, and CK have no significant effect on TPACK. Supported by research by [30], [31], [32], and [13] that CK has no significant effect on TPACK. Research [34], [30], [32], [13], and [33] research that PK does not have a significant effect on TPACK. Research [34], [30], [32], [13], and [33] that TK has no significant effect on TPACK. This is because TPACK is influenced by the intersection of TPK, TCK, and PCK supported by research by [30], and [29]. Future research can use the results of research instruments that have been tested for validity and reliability, besides that, it is also used to determine the TPACK domain of economic teachers who have taught online during the Covid-19 pandemic to determine the level of knowledge of these teachers. Then it becomes a strategic step to develop teacher skills and professionals for teaching in the future by creating modules or training by interested parties such as teachers themselves, schools, teacher education institutions, or the government.

6. Supplementary data

Appendix 1. Nomological Network of TPACK (Link: https://tinyurl.com/y2rmfowe)
Appendix 2. Data Tabulation (Link: https://tinyurl.com/y6krhx2w)
Appendix 3. Questionnaire (Link: https://tinyurl.com/y3aakhxc)
Appendix 4. Output SmartPLS 3.0 (Link: https://tinyurl.com/y5tm15ou)
Appendix 5. Cross Loading Value (Link: https://tinyurl.com/yxde3rhu)
Appendix 6. References of TPACK’s Nomological Network (Link: https://tinyurl.com/y6rfztho)

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