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Profile of Technological Pedagogical Content Knowledge (TPACK) on Pre-Service Teachers in Higher Education

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Abstrak:

This study aims to determine the Technological Pedagogical Content Knowledge (TPACK) profile of pre-service teachers at the Economics Education Study Program at Universitas Jenderal Soedirman. This study used quantitative method with a survey research design. The sample of population were 111 respondents from 3rd, 5th, and 7th-semester. To measure TPACK, 50 statements were formulated based on the indicators of each TPACK component, categorized as valid and reliable. Data were analyzed using descriptive statistics. The research results showed that the seven components of TPACK were categorized as good, two components are more prominent, namely Technological Knowledge (TK) and Technological Content Knowledge (TCK), while the lowest component was Content Knowledge (CK). These results suggest that during lectures, it's important to emphasize both mastering the material and integrating technology into learning.

Keywords: TPACK; Pre-service Teacher; Higher Education

INTRODUCTION

Education is the most important source of quality human resources (HR) for the continued existence and development of a country. The higher the level of education, the more reliable the human resources will be. Higher education is meant to develop skilled people in response to society's demand Besides that, higher education is expected to produce professional graduates as pillars of the nation's future in carrying out educational development. One of the professional workers produced by higher education is professional workers in the field of education. Producing professional teachers must adapt to the demands and dynamics of social, economic, cultural life and advances in science and technology of the 21st century.

In the era of Society 5.0, teachers need strong skills in technology, subject mastery, and teaching delivery to prepare students for 21st-century demands. The ability of teachers in the use of technology has a positive impact on the use of learning media. Learning media is useful for attracting students' interest in the learning material presented, thus increasing students' understanding of the material presented, thus increasing students' enthusiasm for learning (Ainiyah, 2023). The combination of these abilities is known as Technological Pedagogical Content Knowledge or often abbreviated as TPACK. TPACK development began with Pedagogical Content Knowledge (PCK) which was first introduced by Shulman (1986) in the mid-1980s with relatively limited reach and resources. Based on Shulman's ideas regarding PCK, Mishra, P., & Koehler, M. J. (2006) added technology items to PCK, and described TPACK as an integration of content knowledge, pedagogy, and technology. TPACK is a connection and intersection of content, pedagogy and technology.

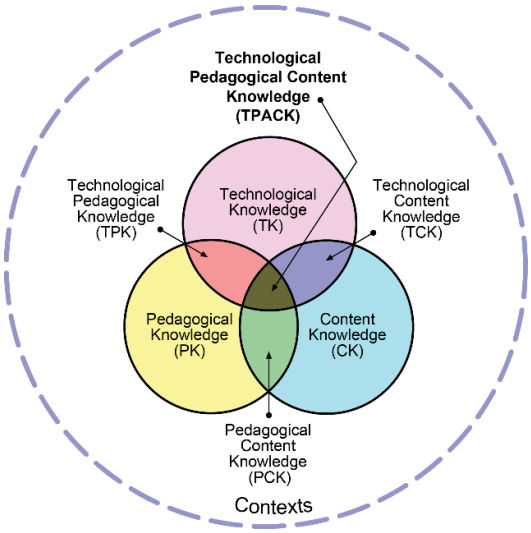

Figure 1. Pedagogical Content Knowledge technological framework (Koehler, 2011)

TPACK is the basis of good teaching with technology and requires an understanding of

concept representation using technology; pedagogical techniques that use technology in constructive ways to teach content; knowledge about what makes concepts difficult or easy to learn and how technology can help fix some of the problems students face; knowledge of students' previous knowledge and epistemological theories; and knowledge about how technology can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones. Mishler and Koehler (2006) developed a TPACK model as an epistemic framework to describe teachers' knowledge of technology integration across disciplines.

The three fundamental knowledge sources that make up TPACK are technological knowledge, pedagogical knowledge, and content knowledge. However, how teachers connect these to create the intermediary knowledge forms of technological content knowledge (TCK), technological pedagogical knowledge (TPK), and pedagogical content knowledge also has an impact on TPACK (Abad-Segura et al., 2020). Technology advancement and instruction should go hand in hand (Lisa et al., 2021), and teachers must be able to integrate knowledge of technology with pedagogical and content knowledge (Tan et al., 2023). Prior research has highlighted the significance of digital competences in motivating and preparing educators from the outset to become proficient in maximizing the use of technology in the classroom (Brevik et al., 2019; Ulayyah & Rosy, 2022).

The first step to form a teacher's TPACK is to start at an institution that has a program to produce teacher candidates because teacher educators' technology competencies maybe related to their academic disciplines and their experience levels (Carpenter et al., 2020). Universitas Jenderal Soedirman aims to produce high-quality teachers, but there's limited information on the TPACK of Economic Education students. Current data only focus on related courses and don't capture the overall integration process. Recognizing the significance of TPACK for future economics teachers, a study is needed to assess it. Researchers aim to profile the TPACK of prospective pre-service teachers in higher education.

METHODS

This study used descriptive research and survey research methods. According to Sugiyono (2018) the descriptive method is used to study the value of independent variables, either one or more variables (independent), without making comparisons/ relationships with other variables. This study was conducted among pre-service economic education teachers in Economic Study Program at Universitas Jenderal Soedirma, Indonesia. The population in this study was 142 students for the classes of 2020, 2021 and 2022. The sample size was determined

using the G*Power application version 3.1.9.7 and the results were 111 students as samples in this study.

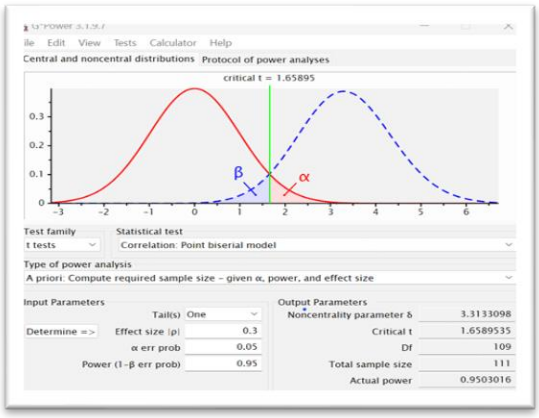

Figure 2. Total sample measurement results using G*Power

Standardized self-report rating scales, open-ended surveys, interviews, and performance assessments, including evaluations of actual instruction, lesson plans, or standardized test scores, are methods used to measure TPACK. (Su & Foulger, 2019; Willermark, 2018). This research uses the self-report method and is currently one of the most frequently used approaches because it appears to be an easy and cost-effective way to collect quantitative data (Miguel-Revilla et al., 2020; Schmid et al., 2020; Valtonen et al., 2017). The questionnaire was adopted from a questionnaire developed by Schmid et al (2020). This questionnaire measures all seven dimensions validity and reliability (see Table 1).

Table 1 Descriptive statistics of TPACK.xs items and subscale validity

Item		M	SD	Pearson Correlation
TK1	I know how to solve technical problems that occur on my own computer/laptop	3.405	.9083	.608
TK2	I can learn various technologies easily	3.874	.7022	.665
TK3	I keep up to date with new technologies that are important to me	4.171	.6449	.658
TK4	I often tinker with technological devices to find out more	3.486	.9132	.517
TK5	I know many different types of computer/laptop technology	3.180	.8862	.625
TK6	I know various computer/laptop hardware (example: mother-board, RAM) and their functions	3.243	.9650	.599
TK7	I know various computer/laptop software (example: Windows, Media Player) and their functions	3.793	.8646	.765
TK8	I know how to use word processing programs (example: Microsoft Word)	4.243	.7163	.781
TK9	I know how to use column processing programs (example: Microsoft Excel)	4.054	.8403	.701
TK10	I know how to use presentation presentation programs (example: Microsoft PowerPoint)	4.297	.7335	.815

TK11	I know how to use image processing programs (example: Adobe Photoshop)	3.063	1.0382	.510
TK12	I know how to use communication applications on the internet (example: Email)	4.423	.6113	.714
TK13	I know how to use social media applications on the internet (example: Facebook, Instagram)	4.604	.5095	.540
TK14	I can store data in digital form (example: CD, DVD, Flash Disk)	4.252	.7320	.765
TK15	I can save and change data in various formats (example: convert MS.Word files to PDF)	4.586	.5636	.616
TK16	I can use printers, projectors, scanners and digital cameras.	4.225	.7590	.760
	TK subscale	**3.931**	**.7743**	
PK1	I know how to plan learning in class	3.748	.7801	.871
PK2	I know the general procedures for implementing learning in class	3.838	.7925	.835
PK3	I know how to organize and manage a class	3.739	.7712	.898
PK4	I can adapt my teaching style to students who have different characters	3.631	.7854	.801
PK5	I can adjust my learning process based on what students already understand and don't understand	3.739	.7712	.784
PK6	I can use various models, approaches, strategies, methods, media, techniques and learning tactics in class	3.550	.8283	.845
PK7	can find out students' misconceptions about a concept or material	3.423	.8040	.774
PK8	I can assess student learning using various types of assessments	3.649	.7937	.756
	PK subscale	**3.664**	**0.791**	
CK1	I have good knowledge of economic material	3.640	.6149	.752
CK2	I have various ways and strategies to develop my understanding of Economics material	3.721	.6898	.804
CK3	I can use social science thinking	3.820	.7769	.754
CK4	I follow scientific developments and the latest issues in the economic field	3.577	.7574	.745
CK5	I know prominent economic scientists in Indonesia	3.279	.8546	.775
CK6	I follow the development of the latest books on Economics material	3.171	.8515	.879
CK7	I take part in seminars or similar activities with an economic theme	3.622	.7634	.572
	CK subscale	**3.547**	**0.758**	
TCK1	I know various technologies that I can use to study Economics material	3.586	.9092	.845
TCK2	I can use certain computer/laptop applications to make it easier for me to understand economic material	3.631	.8194	.839
TCK3	I can use a computer/laptop well to develop (compose papers and make presentation slides) Economics material	3.505	.8076	.861
TCK4	I use technology in the form of the internet as a learning resource to search for Economics material	3.577	.8372	.914

TCK5	I use communication technology such as WhatsApp, BBM, Line, and others to discuss Economics material with colleagues	3.532	.8182	.844
TCK6	use social media such as Facebook, Instagram, Twitter, blogs, and others to post and express my understanding of Economics material	3.865	.8032	.835
TCK7	I use social media such as Facebook, Twitter, Linked-in, and others to connect with leading economic scientists in Indonesia	3.739	.8709	.808
	TCK subscale	**3.633**	**0.838**	
TPK1	I can choose technology that can improve learning strategies in the classroom	3.748	.7683	.856
TPK2	I think more deeply about how technology can impact the learning strategies I use in the classroom	4.063	.6912	.801
TPK3	I can choose technology that can increase student interest during the learning process in class	4.216	.6929	.769
TPK4	I think critically about how to use technology in classroom learning	4.270	.6459	.760
TPK5	I can adapt the use of technology to various learning activities in class	4.297	.6687	.812
TPK6	I can choose technology that can be used to improve learning outcomes in the classroom	3.847	.8655	.836
TPK7	I can help other teachers to use technology in classroom learning	3.505	.9618	.748
	TPK subscale	**3.992**	**0.756**	
TPACK1	can use the right technology in appropriate learning strategies to deliver economic material effectively in the classroom	3.820	.7032	.799
TPACK2	I can choose the right technology to improve students' understanding of the economic material that I teach using certain learning strategies in the classroom	3.739	.7225	.899
TPACK3	I can choose the right technology to assess student learning outcomes in the economics subjects that I teach using certain learning strategies in the classroom	3.811	.6254	.874
TPACK4	I can carry out good learning by combining the use of appropriate technology and appropriate learning strategies in economics subjects in the classroom	3.667	.7548	.830
TPACK5	I can help other teachers to use the right technology in learning strategies that suit certain economic material in classroom learning	3.820	.6902	.811
	TPACK subscale	**3.766**	**.7001**	

In the validation test, the total correlation value (pearson correlation) of the modified items is also called $r_{observed}$, and the decisions in the validation test are based on the following decision criteria: 1) If $r_{observed} > r_{table}$, the questionnaire is valid, 2) If $r_{observed} < r_{table}$, then the questionnaire is in-valid, 3) r table for one-way test with a sample of 111 respondents = 0.1555.

Based on table 1, $r_{observed} > r_{table}$. So, it can be concluded that of the 50 statement items that were developed/compiled, all statement items were declared valid. The validation validity test using IBM SPSS Statistics Version 22.0. The reliability is calculated using the Cronbach

Alpha coefficient with SPSS. The reliability results for the entire TPACK measurement instrument were more than 0.60. The weight scale for the competency questionnaire is presented in Table 2.

Table 2. The weight scale for the competency questionnaire

Category	Score
Strongly agree	5
Agree	4
Undecided	3
Disagree	2
Strongly disagree	1

(Morrisan, 2015)

Data processing and analysis used descriptive statistics, computing percentages for student responses per question, calculating average and standard deviation for TPACK variables, and categorizing student scores into low, medium, and high levels.

Table 3. TPACK Score Grouping Criteria

No.	Value Interval (mean value)	Criteria
1.	> 4,20 – 5,00	very good
2.	> 3,40 – 4,20	good
3.	> 2,60 – 3,40	enough
4.	> 1,80 – 2,60	not enough
5.	1,00 – 1,80	very less

RESULTS AND DISCUSSION

The TPACK instrument was distributed to 111 pre-service teachers in Jenderal Soedirman University in the 3rd, 5th and 7th semester of the Economics Education Study Program. The data were analyzed to see the profile of prospective economics teachers in each TPACK component. Table 4 shows that there were 12 male respondents (10.8% of the total), and 99 female respondents (89.2% of the total). This indicates that women made up the majority of responders. Of the 58 respondents, or 52.3% of the total, the majority were between the ages of 20 and 21. The majority of respondents had never taken IT training, according to IT training data.

Table 4. Respondent Characteristics

Characteristics	Criteria	Number (respondent)	Percentage (%)
Gender	Male	12	10.8
	Female	99	89.2
Age (years)	< 20	49	44.1
	20 – 21	58	52.3
	22 - 23	4	3.6
IT Training	Yes	9	8.1

No	102	91.9

The statistical measurement of the research outcome were commonly described using descriptive statistics analysis, with the results shown in Table 5 about the TPACK profile of pre-service teachers.

Table 5. The results of the descriptive statistics analysis on the TPACK pre-service teachers

No	Indikator	Mean	SD	Kriteria
1	Technological Knowledge (TK)	3.931	.7743	Good
2	Pedagogical Knowledge (PK)	3.664	.791	Good
3	Content Knowledge (CK)	3.547	.758	Good
4	Pedagogical Content Knowledge (PCK)	3.633	.838	Good
5	Technological Content Knowledge (TCK)	3.992	.756	Good
6	Technological Pedagogical Knowledge (TPK)	3.777	.709	Good
7	Technological Pedagogical and Content Knowledge (TPACK)	3.733	.724	Good

The research results as presented in table 5 show that in general their abilities are in the components of Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical and Content Knowledge (TPACK) are good. This indicates that mastery of technology, content, technology-content, and technology-pedagogy, as well as technology-pedagogy-content is good. Of the total seven components that make up TPACK, there are two components that have the highest average value, namely technological knowledge and Technological Content Knowledge (TCK). The component with the lowest average value is Content knowledge (CK).

These findings show he relationship between components, indicating that high Technological Knowledge (TK) influences high Technological Content Knowledge (TCK) and Technological Pedagogical Knowledge (TPK). Mastering these abilities is crucial, as difficulty in doing so will also impede their integration into learning. The effect of this lack of CK mastery is that the material received by students is not optimal and, furthermore, it can have the effect of creating misconceptions or wrong concepts. A conceptual error is a very fatal mistake. Research results show that errors or lack of understanding of concepts will result in students failing to solve problems or students will make mistakes in answering questions (Alqurashi et al., 2017).

However, despite Content Knowledge (CK) scoring low, the average score for Technological Content Knowledge (TCK) includes the two highest components. This suggests that prospective teachers can effectively integrate technology with various economic materials, even though their content abilities are relatively lower compared to other skills.

CONCLUSION

TPACK is an important skill for prospective teachers, especially in the era of society 5.0 as a requirement for 21st century learning. The TPACK profile of prospective economics teacher in the economics education study program, Universitas Jenderal Soedirman is at a good level. In detail, of the seven TPACK components, there are two components that are more prominent, namely Technological Knowledge (TK) and Technological Content Knowledge (TCK). Meanwhile, the lowest component is Content Knowledge (CK).

These findings are expected to guide study programs and lecturers in designing learning processes across various courses to support TPACK aligned with the demands of learning in the era of Society 5.0 and 21st-century skills. For future research, research can be done not only limited to the (theoretical) knowledge of prospective pre-service teacher regarding TPACK but also examine their ability to apply TPACK in learning, for example in microteaching courses or in implementing Field Experience Practices (PPL)/Educational Internships. Future research can also develop self-assessment instruments for economics pre-service teachers so that the assessments carried out can more precisely measure the TPACK of prospective economics teachers.

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