Star Wars: The Role of Technology Infrastructure in Equalizing Prospective Educator Competence

Yogi Dwi Satrio
Universiti Kebangsaan Malaysia

Sheerad Sahid
Universiti Kebangsaan Malaysia

Muhammad Hussin
Universiti Kebangsaan Malaysia

The education quality is reflected in the achievement of the distribution of the 21st-century educator competency trilogy. This paper is focused on the identification of the differentiation in the median of TPACK components, including technology (T), pedagogy (P), and content knowledge (CK) in economics education, both separated or integrated, based on gender and universities of the economics education department students. This research is essential to evaluate the development of students' TPACK competency post-pandemics of COVID-19 as they are intensely engaged with technology. This research involved 1058 students in Indonesia using the two-way post hoc ANOVA to identify the differentiation between students' TPACK components, both separated and integrated based on gender and universities. The research results discovered a collection of significant differentiations in TPACK components, both separated and integrated. The specific differentiation indicated that the TPACK components might be helpful for the universities to evaluate the learning process they have conducted. This research expected facilitators and constitutional bodies to take strategic steps in executing and developing the education-supporting infrastructure and to answer the fundamental questions about the technology integration quality and its utilization efficiency.

Keywords: TPACK, gender, university, economic education, technology

INTRODUCTION

The Covid-19 pandemic accelerates the implementation of TPACK-based learning in education. The technology integration process in learning is required more when the situation requires students to have an online meeting. The changes due to Covid-19 undergone by the education world make conventional and classical learning less effective and efficient (Bond et al., 2021; Toquero, 2020). However, not all students and educational institutions can quickly adapt to this new educational pattern known as online learning (Noori, 2021). The education infrastructure that is supposed to support the online learning process can be

said to face many problems in several emerging and developing countries (Basilaia & Kvavadze, 2020; Gudi & Tiwari, 2020; Sintema, 2020; Tiwari et al., 2021).

Technology, pedagogy, and content knowledge are essential factors in learning. However, there are some differences in how students learn based on their gender and their educational institution (Kurt et al., 2021). According to the studies, men and women have the same learning capacity but different ways of absorbing and applying information. Male students favor learning through practical and problem-solving activities, while female counterparts like learning through discussion and sharing (Gómez-Trigueros, 2021). Technology can help fill this gap by providing various learning methods that fit personal needs. For instance, a video tutorial that provides practical steps might help male students learn, while applying online forums can facilitate the discussion to assist female students (Lin & Wang, 2018).

Pedagogy plays an important role in influencing the way someone studies. The learning approach focused on direct experience and problem-solving fits the male students better, while the one focused on discussion and teamwork suits female learners better (Bragg et al., 2021). Content knowledge is an essential learning factor. Each university usually has a different content knowledge focus. For instance, technology universities focus on technical knowledge, while social universities focus on literature knowledge. The approach influences the way students study and understand the materials. Therefore, technology, pedagogy, and content knowledge play a vital role in learning, particularly in teaching and learning economics education close to daily life. However, the differentiations in gender and institution also influence the way students study and absorb information. Hence, it is essential to recognize those differences to provide proper learning methods that fit individual needs to ensure learning success.

TPACK as the Trilogy of Competencies in Learning

TPACK is a learning concept focusing on the connection between technology, pedagogy, and content knowledge in teaching and learning. Technology refers to tools and resources such as computers, tablets, and educational software to support the teaching and learning process. Pedagogy refers to the theory and practice of teaching and learning, including methods and approaches to facilitate learning. Content knowledge refers to learning materials, including concepts, facts, and skills students learn. TPACK frameworks show that the effective use of technology in education requires understanding how those three fields intersect and how they can integrate to support the teaching and learning process (Demissie et al., 2022). According to previous studies, technology, pedagogy, and study subjects have a direct or indirect link (Susanti et al., 2022). This demonstrates that the research is accurate enough to describe the interplay of TPACK's cross-relationship with other factors.

Related to the teachers, according to the previous studies, TPACK can help teachers keep studying and developing their skills to master effective learning through technology (Sailer et al., 2021; Virtanen et al., 2021). This can encourage prospective teachers to keep studying and developing themselves as they feel more competent and trained to manage effective learning thanks to technology. Besides, technology enables prospective teachers to deliver a better learning experience to raise students' motivation, which will gradually boost the teachers' motivation to keep managing effective learning.

TPACK can affect students' motivation in choosing their careers as a teacher (Oberrauch et al., 2021). The way TPACK can affect students' motivation is by developing students' interest in the lesson delivered. Utilizing the right technology can help create more interesting and understandable material to raise students' interest in the lesson (Koehler & Mishra, 2009). Besides, certain learning approaches that apply technology can also improve students' motivation to learn and develop their skills.

Gender Development in Education

Some studies have discovered the differentiation between male and female students learning interests. However, those differentiations are not always seen in different age groups or learning contexts. Few studies have found that gender differentiation can influence students' career interests and choices. Male students are more attracted to fields deemed "traditional", such as mathematics and science, while female students favor "non-traditional" fields, such as language and art (Dodourova et al., 2020; Lent and Hackett, 1994). Some studies have also learned that female students tend to have higher interests in writing and teaching

skills, while male students tend to be interested in technology and science learning (Ayu et al., 2019; Ergen, 2019; Lohbeck and Frenzel, 2022). This research also discovers that gender differentiation can influence students' motivation to pursue a career in teaching. Male students are more interested in higher salaries and better careers, while female students are more interested in the opportunity to help students and develop their skills (Hoff et al., 2021).

However, some studies also don't find significant differences between male and female students learning interests. Differences in learning interests might be influenced by many factors, such as the difference of interests due to biological differences, experience, and social background, and how males and females are prepared and supported to learn in schools and other educational institutions. It is worth remembering that interest in learning is not always static and can fluctuate due to the learning context and many other factors. Therefore, teachers must keep evaluating and developing effective learning strategies to raise students' interest in learning.

To bridge the differences, it is important (Lent and Hackett, 1994) to change the attitudes toward education and eliminate gender stereotypes that might limit students' interests and choices (Frawley, 2005; Hoff et al., 2021; Sadker and Sadker, 1994). Besides, it is also essential to provide equal opportunity for male and female students to learn fields that are deemed "traditional" and "non-traditional" (Alam, 2022). After taking those measures, gender inequality can be solved by providing equal opportunity and eliminating the barriers that might be faced by male and female students when choosing the career that they want to pursue.

The Role of University in Motivating the Career Choice as an Economics Teacher

Universities play a significant role in preparing students for their professional life. Research has discovered that universities can influence students' career interests and choices through course offers, connections to industry, and working opportunities after graduation (Feldman and Newcomb, 2020). As educational institutions, universities are responsible for delivering quality education; provide sufficient facilities supporting the teaching and learning process (Kemensetneg, 2003). Besides, related to soft skills development: Universities can provide training and opportunities for students to develop their leadership, communication skills, and teamwork.

A previous study has discovered that universities can influence students' career interests and choices through activities they provide, such as internships and partnership programs with industry (Gordon and Steele, 2015). Such activities can give working experience and widen students' knowledge of professional careers that can influence their career choices after graduation (Kolesnichenko et al., 2020; Zain, 2021). Universities that offer a degree program that students want can increase their students' interest in working in fields related to their subject after graduation (Ahmed et al., 2017; Daniali et al., 2022; Malin et al., 2017). Besides, universities with a strong connection with the industry can offer work opportunities to students after graduation, and it will raise students' motivation to choose a career in that industry (Kamens, 1971). Universities play essential roles in influencing student learning interests and career choices through the subjects they offer, their connections, working opportunities, and the post-graduation activities they provide. Therefore, universities can help increase students' motivation to improve their skills as prospective teachers and bridge the industry's needs and the student's interests.

Based on the reasons above, the main topics this research would answer are: RQ1) Is there any gender differentiation in the students' median of TPACK Sub-Constructs registered in the economics education program? RQ2) Is there any median differentiation of the TPACK Sub-Construct between students of the economics education departments in different universities? RQ3) Is there any median differentiation in the TPACK Sub-Construct between the interactions of the universities and the genders registered in the economics education program? These study results are expected to contribute to the development of human resource competencies in economics and education, provide suggestions to educational institutions in the distribution of education-supporting infrastructure, and offer consideration for further research in developing and distributing the 21st education competency trilogy.

METHOD

The research design is a causal-comparative study with a quantitative approach that compares the mean of two independent variables and one dependent variable, covering the combinations of the seven main factors that make the variable (Kim, 2015; Salkind, 2010). This research objective is to find the effect of gender and university (independent) variables on TPACK by comparing the mean of each group. This research would evaluate the TPACK competency (Technology, Pedagogy, and Content Knowledge) of the economics education department students based on gender and their universities. The research would test the differentiation of the TPACK competency levels between male and female students and the differentiation among universities that own the economics education department. The sample is taken from economics education department students who have studied for more than four semesters, as many as 1,058 students from 10 universities in Indonesia.

The seven testing instruments of TPACK are adopted from established instruments (Bahador et al., 2018; Bingimlas, 2018), with 41 items representing students' ability and understanding on TPACK. The contexts adopted, among others, are the economics lesson material, learning media, and contexts of statements that take the point of view of economic education department students. These research instruments apply a 1-7 measurement scale to determine respondents' attitudes toward statements related to Technology, Pedagogy, and Content Knowledge-Economics.

The data were collected using a survey method where the questionnaire is distributed to students of economics education departments through online forms. The research applies a closed questionnaire consisting of seven options on the Likert scale. The respondents are voluntary and anonymous. The National University of Malaysia Research Committee has gained the ethical agreement for the whole aspects of this research. The two-way ANOVA testing is applied with JASP analytical tool to answer the research hypothesis regarding the mean of students' TPACK competency post-pandemic of Covid-19 based on gender and their universities.

RESULTS AND DISCUSSION

In this section, it is explained the results of the research and, at the same time is, given the comprehensive discussion. Results can be presented in figures, graphs, tables, and others that make the reader understand easily (Baier et al., 2019), (Flanagan et al., 2020). The discussion can be made in several sub-sections.

Respondent Description

Equations should be placed at the center of the line and provided consecutively with equation numbers in parentheses flushed to the right margin, as in (1). The use of Microsoft Equation Editor or MathType is preferred. The whole data collected represent the demography of the respondents. Based on the analysis, the data gained is presented below.

TABLE 1
RESPONDENT DEMOGRAPHY

No.	Characteristics	Frequency	Percentage
1.	**Age**	**1058**	**100**
	18 years old	274	25.90
	19 years old	267	25.24
	20 years old	260	24.57
	21 years old	257	24.29
2.	**Sex**	**1058**	**100**
	Female	567	54
	Male	491	46

3.	**University**	**1058**	**100**
	Universitas Negeri Jakarta (UNJ)	125	11.81
	Universitas Negeri Semarang (UNNES)	119	11.25
	Universitas Negeri Malang (UM)	106	10.02
	Universitas Pendidikan Indonesia (UPI)	112	10.59
	Universitas Negeri Yogyakarta (UNY)	117	11.06
	Universitas Pendidikan Ganesha UNDIKSHA)	108	10.21
	Universitas Negeri Surabaya (UNESA)	115	10.87
	Universitas Pattimura	80	7.56
	Universitas Negeri Manado (UNM)	90	8.51
	Universitas Negeri Medan (UNIMED)	86	8.13

The data comprises three main characteristics of the respondents, including their age, sex, and their university. Table 1 shows the distribution of students' age in the four age groups with almost similar means. Referring to the gender characteristics, female respondents' contributions were 567 (54%) more than that of their male counterparts. Based on the respondents' responses, it is known that they are the economics education department students in ten leading universities in Indonesia. The highest percentage of respondents is UNJ, with 125 respondents (11.81%), while the lowest is UNIMED, with 86 respondents (8.13%).

Multivariate Basic Assumption

Before performing differentiation testing, the data normality testing has already been conducted using an approach developed by Kline (2011) dan Zainudin (2014), stating that the value of absolute tilting must be lower than eight or about the absolute value of 1.0 to indicate that the data distributed normally.

TABLE 2
NORMALITY DATA

	Valid	Mean	Std. Deviation	Skewness	Kurtosis	Min.	Max.
T	1058	38.601	6	-0.282	-0.484	23	49
P	1058	38.194	6.2	-0.106	-0.675	22	49
CK	1058	31.469	5.4	-0.093	-0.385	18	42
TP	1058	27.646	4.3	-0.102	-0.738	18	35
TCK	1058	32.654	5.1	-0.087	-0.608	19	42
PCK	1058	26.506	4.6	-0.024	-0.609	14	35
TPCK	1058	27.286	4.5	-0.177	-0.689	15	35

Based on the statistical testing, the result of skewness and kurtosis is <1.0. Therefore, the data is normally distributed. This is followed by ANOVA testing to measure the mean differentiation between TPACK components based on gender and university.

Homogeneity

The result of the homogeneity test presented in Table 3 shows that, on the whole, the data of each subconstruct of TPACK has a P-value higher than 0.05. Hence, the general data is homogenous and feasible for Two-Way ANOVA Testing.

TABLE 3
DATA HOMOGENEITY

Test for Equality of Variances (Levene's)				
Variable	**F**	**df_1**	**df_2**	**p**
T	1.137	19	1038	0.307
P	0.633	19	1038	0.883
CK	0.94	19	1038	0.532
TP	0.675	19	1038	0.847
TCK	0.967	19	1038	0.499
PCK	1.028	19	1038	0.425
TPCK	1.128	19	1038	0.351

Based on the homogeneity testing, it can be known that each subconstruct of TPACK has a P-value > 0.05. Therefore, the analysis can proceed with Two-Way ANOVA Testing.

Result of Analysis

Two-Way ANOVA analysis has been applied to test if there is a significant mean differentiation of two or more groups in two or more independent variables. A set of data can be said to have mean differentiation if the p-value of two-way ANOVA has a significance value of (p)<0.05 (Salvatore and Reagle, 2002). In this research, two-way ANOVA testing determines the interaction between variables of gender and universities that own the Department of Economics education due to the variation in the TPACK variable. The interaction between two independent variables is displayed in Table 4 below.

TABLE 4
THE RESULTS OF TWO-WAY ANOVA TESTING FOR TPACK COMPETENCIES

Factor	Group	SS	df	Mean Square	F	p-values	Significance
(T) Technology	• **Gender**	13.189	1	13.189	0.372	0.542	Not Significant
	• **University**	605.528	9	67.281	1.898	0.049	Significant
	• **Gender ✻ University**	232.568	9	25.841	0.729	0.683	Not Significant
	• **Residuals**	36789.9	1038	35.443			
(P) Pedagogy	• **Gender**	31.048	1	31.048	0.826	0.364	Not Significant
	• **University**	862.544	9	95.838	2.55	0.007	Significant
	• **Gender ✻ University**	433.293	9	48.144	1.281	0.243	Not Significant
	• **Residuals**	39015.14	1038	37.587			
(CK) Content Knowledge (Economics)	• **Gender**	74.61	1	74.61	2.579	0.109	Not Significant
	• **University**	676.215	9	75.135	2.597	0.006	Significant
	• **Gender ✻ University**	318.824	9	35.425	1.224	0.276	Not Significant
	• **Residuals**	30032.15	1038	28.933			

(TP) Technology Pedagogy	• **Gender**	**49.109**	**1**	**49.109**	**2.64**	**0.105**	**Not Significant**
	• **University**	263.045	9	29.227	1.571	0.119	Not Significant
	• **Gender ✻ University**	265.137	9	29.46	1.584	0.115	Not Significant
	• **Residuals**	19309.33	1038	18.602			
(TCK) Technology Content Knowledge (Economics)	• **Gender**	230.412	1	230.412	9.091	0.003	Significant
	• **University**	570.12	9	63.347	2.499	0.008	Significant
	• **Gender ✻ University**	277.599	9	30.844	1.217	0.280	Not Significant
	• **Residuals**	26308.35	1038	25.345			
(PCK) Pedagogy Content Knowledge (Economics)	• **Gender**	21.878	1	21.878	1.036	0.309	Not Significant
	• **University**	410.049	9	45.561	2.157	0.023	Significant
	• **Gender ✻ University**	179.225	9	19.914	0.943	0.487	Not Significant
	• **Residuals**	21921.03	1038	21.119			
(TPCK) Technology Pedagogy Content Knowledge (Economics)	• **Gender**	63.844	1	63.844	3.17	0.075	Not Significant
	• **University**	396.633	9	44.07	2.188	0.021	Significant
	• **Gender ✻ University**	356.743	9	39.638	1.968	0.04	Significant
	• **Residuals**	20905.53	1038	20.14			

A relevant p-value is measured with a trust interval of 95%. From the result of two-way ANOVA testing above, it can be known that the P-value of each subconstruct of TPACK based on majority gender has the value of p>0.05 while only the subconstruct of TCK with a P-value of 0.003<0.05 that significantly has mean differentiations. While the P-value of each subconstruct TPACK based on the majority of universities has a significant value of p<0.05, while only the subconstruct of TP has a P-value>0.05 or 0.199>0.05. It can be concluded that most TPACK subconstructs in each university have mean differentiation. Referring to the result analysis, gender and university do not have significant differentiation in most TPACK sub-constructs, except the TPACK sub-constructs with a P-value<0.05.

Post-Hoc Analysis

The objective of the post hoc analysis is to know the detailed mean differentiation of TPACK variables based on gender and university. Considering the number of comparisons based on gender and university, the result of post-hoc testing displayed is the only significant comparison, just like the results of post-hoc testing shown in Table 5, Table 6, and Table 7. Only Ptukey significant values are on display. The rest can be accessed on demand. The result of post hoc testing is as follows.

TABLE 5
THE RESULT OF POST-HOC TESTING OF TPACK COMPETENCY BASED ON GENDER

		Mean Difference	**SE**	**t**	**Cohen's d**	**p_{tukey}**
(TCK) Technology Content Knowledge-Economics						
Female	Male	-1.06	0.312	-3.391	-0.209	< .001***

* p < .05, *** p < .001

The results of the post hoc test on the TPACK competencies based on gender indicate mean differentiation in the combination of the competencies of technology and content knowledge in the economy. The significance Ptukey of <0.001 with mean differentiation between male and female students of 1.06 points. On the other hand, the other subconstruct of TPACK competencies did not have significant mean differentiation based on gender. Next, there are mean differentiations in the competencies of each subconstruct of TPACK based on gender.

TABLE 6
THE RESULTS OF POST- HOC TESTING OF THE COMPETENCIES OF TPACK BASED ON UNIVERSITY

		Mean Difference	SE	t	Cohen's d	p_{tukey}
(T) Technology Knowledge						
Universitas Negeri Malang	Universitas Pattimura	3.367	0.881	3.824	0.566	0.005**
(P) Pedagogy Knowledge						
Universitas Negeri Malang	Universitas Pendidikan Indonesia (Bandung)	3.262	0.832	3.921	0.531	0.004**
	Universitas Pattimura	3.009	0.909	3.309	0.49	0.033*
(CK) Content Knowledge-Economics						
Universitas Negeri Surabaya	Universitas Pattimura	2.745	0.785	3.498	0.509	0.018*
Universitas Negeri Malang	Universitas Pattimura	2.547	0.798	3.190	0.472	0.047*
(TP) Technology Pedagogy There are no significant differences (TABLE 4)						
(TCK) Technology Content Knowledge-Economics						
Universitas Negeri Malang	Universitas Pattimura	2.648	0.75	3.531	0.523	0.016*
Universitas Pattimura	Universitas Negeri Manado	-2.576	0.778	-3.312	-0.509	0.032*
(PCK) Pedagogy Content Knowledge- Economics						
Universitas Negeri Malang	Universitas Pattimura	2.392	0.681	3.515	0.521	0.017*
Universitas Pattimura	Universitas Negeri Manado	-2.389	0.706	-3.383	-0.52	0.026*
(TPCK) Technology, Pedagogy, Content Knowledge-Economics						
Universitas Negeri Surabaya	Universitas Pattimura	2.199	0.657	3.346	0.487	0.029*

*** p < .05, ** p < .01**, Note. P-value adjusted for comparing a family of 10

The result of mean differentiation testing of TPACK competencies based on universities indicated few mean differentiations in each subconstruct of TPACK with a significance value below p<0.05. Meanwhile, the mean differentiations involve two universities in Java Island (Universitas Negeri Malang) and Celebes Islands (Universitas Pattimura). Next, there are significant mean differentiations in the competencies of each subconstruct of TPACK based on the universities.

TABLE 7
THE RESULTS OF POST-HOC TESTING OF TPACK COMPETENCIES BASED ON INTERACTIONS BETWEEN GENDERS AND UNIVERSITIES

		Mean Difference	SE	t	Cohen's d	p_{tukey}
(TPCK) Technology Pedagogy Content Knowledge-Economics						
Female at Universitas Negeri Medan - Female	Male at Universitas Negeri Surabaya	-3.909	0.893	-4.377	-0.871	0.002**
Male at Universitas Negeri Surabaya	Male at Universitas Pattimura	4.237	0.994	4.26	0.944	0.004**

** p < .01

The results of post hoc testing of TPACK competencies based on the interactions between gender and university reveal the mean differentiation in the competency combinations of technology, pedagogy, and content knowledge in economics. With a Ptukey significance value of <0.002, with mean differentiation of 3.909 points involving the gender of females at a state university in Sumatera (Universitas Negeri Medan) and males in Java Island (Universitas Ngeri Surabaya). The mean differentiation between males from (Universitas Negeri Surabaya) and males from (Universitas Pattimura) is significant, with a value of 4,237 points. Next, there is no mean differentiation of competencies in each TPACK subconstruct based on gender interactions and university.

Discussion

One of the major problems developing countries suffer is supporting educational infrastructures that are far behind the developed countries, which have complete educational supporting infrastructures (Derbel, 2017; Wardoyo et al., 2021). Indonesia is an archipelago that, in general, has equal infrastructure development. This affects educational development, particularly in the capacity development of teachers and students in technology integration in education. The Covid-19 pandemic in the last two years has been a tough test for the Indonesian education system. Many educational institutions are starting to adapt and suit themselves to technology. The research findings conclude that the development of TPACK in Indonesia based on gender and university is as follows.

Differentiation of Students on TPACK Competency Level Based on Gender

This research gains significant results where students of the economics education department in Indonesia have a satisfactory mean score in mastering the trilogy of prospective economic teachers' fundamental skills. Although there are few combinations of skills to mean differentiation, they are not crucial as they can involve external elements (in this case, it might be infrastructure problems) to solve it. Slightly different from studies that found that gender differentiation might influence students' academic interests (Dodourova et al., 2020; Lent and Hackett, 1994), this research discovers that male and female students in Indonesia tend to have an equal mean in understanding the competency trilogy of economics education. This can be proven by the equal absence of mean value differentiation in fundamental knowledge of TPACK, that is technology, pedagogy, and content knowledge economics competencies.

The mean differentiations happen when three trilogies of competencies of prospective teachers are combined, especially combinations of technology and economics knowledge understanding. The research discovers that male students, on average, are more skillful in combining technical mastery with knowledge of economics. The mean differentiations support the findings of previous studies, which state that female students tend to have a higher interest in skills of learning and teaching, while male students tend to get interested in technology and science learning (Ayu et al., 2019; Ergen 2019; Lohbeck and Frenzel, 2022).

This condition shows that after the Covid-19 pandemic, differentiations still exist, and the development of learning patterns is required considering the essential role of the combinations in raising students' interests and their learning outcomes (Alabbasi, 2017; Lam and Tou, 2014; Wardoyo et al., 2021).

Differentiation of Students on TPACK Competency Level Based on University

Almost all sub-constructs of TPACK based on the comparison between universities show significant mean differentiation. Therefore, we cannot only discuss from a single perspective of educators, but we need to discuss the whole instrument. Like it or not, educators' competencies, students' capacity, and the completeness of the supporting tools impact the achievement of the education target of technological integration (Olszewski and Crompton, 2020). Some studies identify the challenges related to the mastery of technological tools, curriculum adaptation, and teaching techniques that integrate new educational tools on all levels (Johnson et al., 2016). The dichotomy made by previous research on TPACK drives this research to the tendency that there is a disparity of TPACK competencies. The research results also show a lot of mean differentiation of each subconstruct of TPACK. The three fundamental TPACK competencies of technology, pedagogy, and content knowledge in the economy owned by students of the economics education department in Java Island are found to be significantly higher compared to those from outside the island, especially in the technology competency (Demissie et al., 2022; Moses et al., 2012). We should not find someone to blame, as many must fix ourselves to catch up. Under the policy stated by the National Education System of Indonesia, the government and universities are expected to collaborate again to improve their roles as educational facilitators, especially in improving and distributing educational infrastructures (Kemensetneg, 2003).

Differentiation of Students on TPACK Competency Level Based on the Interaction Between Gender and University

Based on the results of this study, there is a mean differentiation in TPCK, and the highest mean is in males and females from Java and outside of Java Island. The researchers underline that the teachers' internal and external elements can hinder successful technology integration in the classroom. An example of an external barrier is the need for institutional revitalization. It is also essential to tackle general problems in education, such as access, training, and technology support (Johnson et al., 2016). As reported by this research, the internal problem is reflected in the gaps in students' ability to integrate technology. Even when students enthusiastically adopt digital tools in class, they require decent facilities and competent teachers to help them master the technology and find the most suitable tool for learning (Demissie et al., 2022). According to Moses et al. (2012), using technology in learning cannot be done if the ICT infrastructure does not support it. The researchers note that teachers and students need internet access and computer accessories, such as a printer, digital camera, projector, and TV, to support their learning (Olszewski and Crompton, 2020). It is common sense that after the pandemic, the 21st century educators, the era of skills, at least need to master the integration of technology and pedagogy as fundamental teaching skills (Cattaneo et al., 2022; Demissie et al., 2022; Lehmann, 2021; Owens, 2017).

CONCLUSION

The scope of this research is limited to Indonesia, with the object of observation of postgraduate students with economic interests. The results show a mean differentiation in some sub-constructs of TPACK, particularly in integrating technology and pedagogy and understanding the contexts of economics science based on gender and university. This condition shows the need to improve the learning system using the TPACK approach in economics education in Indonesia. As facilitators and constitutional institutions, the government and universities need to take several strategic steps to conduct and improve the supporting educational infrastructures to explore the objectives of the education revolution in the digital era of the 21st century. Next, further studies are expected to see the correlation between the more subjective steps of TPACK, the kind of technological integration of other factors, and how this construction is transformed among other subjects in economics education. Besides answering the fundamental question of technological

integration and its quality, further research is expected to examine the problems regarding the effectiveness of technology use. Next, it needs to check the predictive use concerning other steps, such as teachers' beliefs or other background variables, such as the variables of students, infrastructure, technics, education in the family, or culture in the university or school.

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