

ANALYSIS OF FACTORS AFFECTING INTELLIGENT-TPACK IN THE FACULTY OF ECONOMICS AND BUSINESS LECTURERS STATE UNIVERSITY OF SURABAYA

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Abstract

This research analyses the factors influencing Intelligent-TPACK (Technological Pedagogical Content Knowledge with AI) in FEB lecturers at the State University of Surabaya. This research uses a quantitative descriptive approach. The research population consisted of 155 respondents, and 112 respondents were taken as samples using a simple random sampling technique, which was calculated using the Slovin formula with an error rate of 5%. The research questionnaire used was adapted from the Intelligent-TPACK scale. Primary research data was obtained directly from questionnaires distributed to the sample, and secondary data was obtained from literature reviews of previous research and other relevant reading sources that supported the research. Data analysis was carried out using PLS-SEM with the help of SmartPLS 4.1 software to test the outer and inner models and the significance of hypothesis support. The research results show that five factors influence Intelligent-TPACK in FEB UNESA lecturers, including Intelligent-TK (lecturer's knowledge of AI tools and systems), Intelligent-TPK (lecturer's understanding of the pedagogical role of AI tools), Intelligent-TCK (lecturer's knowledge regarding the use of AI tools in their teaching field), ethics (lecturers' assessment of ethical aspects in using AI tools), and Intelligent-TPACK (lecturers' knowledge and skills in integrating AI pedagogically and ethically in teaching). The findings of this research show that Smart-TK has a positive and significant influence on Smart-TPK, Smart-TCK, and Ethics. Intelligent-TPK and Intelligent-TCK both make positive and significant contributions to Intelligent-TPACK, and Ethics assessments have a positive and significant influence on Intelligent-TPK, Intelligent-TCK, and Intelligent-TPACK for FEB lecturers at the State University of Surabaya.

Keywords

Artificial Intelligence (AI), Intelligent-TPACK, Lecturer, PLS-SEM



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INTRODUCTION

An intelligent machine, another name for *Artificial intelligence* (AI), is a computer capacity designed to simulate human intellectual abilities (Rosemary et al., 2022). Currently, AI is used in all fields, one of which is education (Wahyudi, 2023). The entry of AI will change the world of education, especially the learning landscape. Its rapid ability to process and analyze data opens the door to more personalized, adaptive, and interactive learning experiences (Zhang & Aslan, 2021 Pendi, 2023). AI cannot be explicitly interpreted, and experts are still debating and need help defining it (Rose Luckin et al., 2016 Holmes et al., 2022). AI is a computer system that can interact with users through its intelligent behavior for specific purposes, such as making predictions, making recommendations, and using voice recognition (Holmes et al., 2022). However, the use of AI in education still needs to catch up with other sectors, such as business and health Celik et al., 2022). One reason is that the role of educators in integrating education with AI-based tools needs to be addressed (Seufert et al., 2021). So, it can be concluded that the application of AI in education explicitly changes the application of learning pedagogy.

Educators who better understand how to interact with AI-based tools better understand AI's role in education (Celik, 2023). For example, the more educators realize the benefits of AI-based tools, the more often they use them to increase learner participation and motivation (Brändle et al., 2023 Naila et al., 2023). Educators who better understand AI have skills in selecting AI-based tools best suited for teaching purposes. Therefore, educators who understand AI can use AI-based tools for personalized learning (Zawacki-Richter et al., 2019). The ability of educators to integrate technology pedagogically significantly contributes to the effectiveness of teaching and learning (Vasodavan et al., 2019). AI-based educational tools offer new pedagogical opportunities for teaching and learning purposes (L. Chen et al., 2020) (Sharma & Kaur, 2021). As a promising opportunity, for example, implementing AI-based tools such as chatbots could help educators solve academic questions (Chocarro et al., 2021). AI also makes it easier for educators to identify learners' cognitive and emotional needs (X. Chen et al., 2021). Educators can also automatically assess student assignments and structure learning materials in an engaging and fast manner (Princess et al., 2023). For example, the use of ChatGPT makes it easier for educators to create instructional content and act as educators *Online* by answering questions (Gill et al., 2024).

The presence of AI in education is not considered to replace educators in the future (Rose Luckin et al., 2016). Instead, AI plays a vital role in supporting students' learning experiences and assisting educators in learning (Holstein et al., 2019; Ng et al., 2023). This is because the interaction of educators with students is irreplaceable in the progress of learning and the development of individual students. However, due to its advancements, AI and its sub-fields will adorn learning and teaching environments (Ng et al., 2021). Therefore, understanding how to interact with AI-based tools pedagogically and content is very important for educators. Framework *Technological Pedagogical and Content Knowledge* (TPACK) can help educators understand what they need to integrate technology into teaching and learning (Suyamto et al., 2020).

TPACK is a framework that describes the knowledge and skills an educator requires to effectively integrate technology into teaching practice (Mishra & Koehler, 2006). The framework consists of three main components, namely CK (*Content Knowledge*), PK (*Pedagogical Knowledge*), and TK (*Technological Knowledge*). These three components interact and influence each other in the context of teaching with technology. TPACK is considered a flexible framework that supports various technological tools and pedagogical approaches (Koehler & Punya Mishra, 2013; Valtonen et al., 2017). Previous research suggests that the TPACK approach and model *problem-based learning* provide students with many opportunities to learn with technology-based learning media that can improve students' numeracy skills (Rahayu & Agustika, 2023). Previous research states that prospective educators with good TPACK skills will be better equipped to design and implement effective learning (W. K. Dewi & Pahlevi, 2023). However, frameworks that provide information about educators' digital competencies in teaching and learning are lacking (Ng et al., 2023). Past research shows that the Intelligent-TPACK is a powerful framework for pedagogically and ethically explaining educators' skills in AI-based teaching (Celik, 2023). The Intelligent-TPACK framework consists of the components of Intelligent-TK, Intelligent-TPK, Intelligent-TCK, and Intelligent-TPACK, as well as ethics. Because it is intended to measure educators' knowledge and skills in effectively integrating AI-based tools in learning, the knowledge components of PK, CK, and PCK are eliminated in the Intelligent-TPACK framework (Celik, 2023).

Besides the opportunities and positive benefits of AI-based tools in teaching and learning, they also have ethical issues to consider (Rose Luckin et al., 2016). Given how AI computing systems work, using algorithms that learn from historical (previous) data allows decisions to be made to be biased [66] and legalize inequality (race and gender), which results in injustice, thus violating the

inclusivity of education (Memarian & Doleck, 2023). Some AI-based language learning applications fail to recognize the voices of different genders (Selin Akgun & Christine Greenhow, 2021). Because of the ethical gaps associated with AI decision assessments, there is limited empirical evidence on educators' instructional skills in using AI associated with ethical assessments. Therefore, an understanding of how educators are needed to assess, evaluate, and understand the ethical aspects of AI-based tools in teaching is needed (Shin, 2020). This suggests that ethics plays a vital role as a component of factors on the scale *Intelligent-TPACK* created (Celik, 2023). Therefore, in this study, ethics is considered an essential factor in the scale rather than just an intervening variable.

On the other hand, Sinau Digital UNESA (SIDIA) is an AI-based LMS owned by the State University of Surabaya (UNESA). This AI intelligence tool can carry out personalized, integrated learning online. It has a dashboard board feature that can send real-time alerts (or notifications) to students regarding lecture times and schedules. So, this notification allows lecturers to meet student needs simultaneously. In this study, researchers focused on collecting data from FEB UNESA lecturers who used the *platform* SIDIA and other AI-based tools such as ChatGPT, Canva AI presentation, and Perplexity to support the teaching and learning process. This is because the highest number of users of LMS SIDIA UNESA in 2023/2024 is FEB UNESA, which reached 13,491 users (<https://sindig.unesa.ac.id/kuliah/login>). Therefore, it is essential to know the knowledge and skills of FEB UNESA lecturers in using AI-based tools in teaching and learning practices. Previous research stated that there was a gap in lecturer knowledge on the use of learning technology (Fabian et al., 2019). Technological knowledge and pedagogy are crucial for successfully integrating technology into education (Mishra & Koehler, 2006).

Because AI-based teaching is still developing, little research is investigating educators' knowledge about using AI-based tools pedagogically and ethically (Celik et al., 2022). For example, previous research has successfully established a positive relationship between ethics and the components of *Intelligent-TPACK* (TPK, TCK, and TPACK). Still, there is a research gap in a detailed examination of how ethical considerations influence educators' implementation of AI-based tools in education (Celik, 2023). In addition, previous research was also found only to provide insight into the specific competencies that educators need to teach AI effectively to students (Kim et al., 2021). Previous research also only discussed lecturers' TPACK in higher education environments by considering various factors (Fabian et al., 2019), so in-depth investigations must be needed that highlight the contribution of technology for educators in teaching and learning practices (Bates et

al., 2020). Therefore, this research will explore Intelligent-TPACK lecturers' integration of AI-based tools into teaching and learning practices in higher education. Thus, this research aims to identify the factors influencing Intelligent-TPACK in lecturers, especially at the Faculty of Economics and Business, State University of Surabaya.

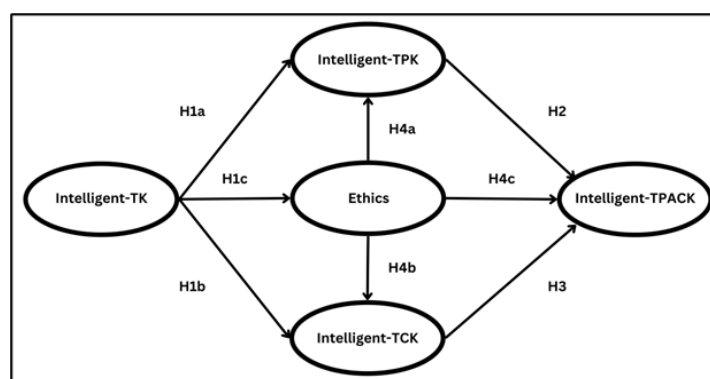
METHOD

This study used a quantitative descriptive approach. Quantitative research is a research method that focuses on numbers and the results of statistical analysis to test hypotheses (Sugiyono, 2016). The population of this study is FEB lecturers of the State University of Surabaya, which amounted to 155 people. The sampling technique *was simple random sampling*, calculated using the Slovin formula with an error rate of 5%, resulting in a sample count of 112 people. Primary data were collected through a questionnaire using the five-point Likert scale (1=strongly disagree to agree 5=strongly) consisting of 27 statement items adapted from the Intelligent-TPACK scale. Before the questionnaire link (Google Forms) was distributed to the sample, the 27 questionnaire statement items were tested for validity and reliability on 30 FEB lecturers at the State University of Surabaya outside the research sample to ensure all items were accurate and consistent. Thirty respondents outside the study were chosen because they were sufficient to produce a distribution of values close to a normal curve (Sugiyono, 2016). As a result, 27 items were valid statements with Cronbach alpha reliability of 0.975.

The research data was analyzed using the PLS-SEM approach with the help of SmartPLS 4.1 software. PLS-SEM analysis consists of *the outer model* to test the validity and reliability of the model and *the inner model* to see the influence between latent variables and the significance of the hypothesis support (Ghozali, 2021). If the result of the measurement of convergent validity at AVE value is >0.5 and discriminant validity at *Cross loading* > 0.7 , then each latent variable is declared valid. Meanwhile, the construct reliability value is declared reliable if the value *Composite Reability* >0.7 and the value *Cronbach's Alpha*-its >0.7 . Meanwhile, to assess the predictive strength of the structural model seen from R-squares, a value of 0.67 indicates the influence of exogenous latent variables on endogenous latent variables in structural models, including the category of robust models, a value of 0.33 influences *moderate* and 0.19 has a weak influence (Chin 1998 in Ghozali, 2021). In hypothesis testing, the t-value (2-tailed) is considered significant if it is greater than 1.96, with a significance level of 5%. The study had 8 hypotheses (H1a: Intelligent-TK has a positive and significant influence

on Intelligent-TPK among FEB lecturers at the State University of Surabaya, H1b: Intelligent-TK has a positive and significant influence on Intelligent-TCK among FEB lecturers at the State University of Surabaya, H1c: Intelligent-TK has a positive and significant influence on Ethics among FEB lecturers at the State University of Surabaya, H2: Intelligent-TPK has a positive and significant influence on Intelligent-TPACK among FEB lecturers at the State University of Surabaya, H3: Intelligent-TCK has a positive and significant influence on Intelligent-TPACK among FEB lecturers at the State University of Surabaya, H4a: Ethics has a positive and significant influence on Intelligent-TPK among FEB lecturers at the State University of Surabaya, H4b: Ethics has a positive and significant influence on Intelligent-TCK among FEB lecturers at the State University of Surabaya, and H4c: Ethics has a positive and significant influence on Intelligent-TPACK among FEB lecturers at the State University of Surabaya) illustrated in the research model in Figure 1. PLS-SEM was chosen because it is the best for small sample sizes (Hair et al., 2017). This approach is very appropriate for research to develop theories (Ghozali, 2021).

Figure 1. Research model with hypothesis



FINDINGS AND DISCUSSION

Findings

PLS-SEM analysis on the outer model produces a valid and reliable model for the Intelligent-TPACK component, which consists of five factors (Intelligent-TK, Intelligent-TPK, Intelligent-TCK, Intelligent-TPACK, and Ethics) with AVE values in convergent validity, respectively -row is 0.735; 0.712; 0.741; 0.721; 0.696 which indicates > 0.5 and the Cross Loading value for discriminant validity for all (27) items for the construct is > 0.7 (ITK1 = 0.823; ITK2 = 0.856; ITK3 = 0.829; ITK4 = 0.884; ITK5 = 0.894; ITPK1 = 0.821; ITPK2 = 0.847; ITPK3 = 0.875; ITCK1 = 0.867; 892; ITPACK2 = 0.893; ITPACK4 = 0.892; ITPACK5 = 0.794; E3 = 0.783; Meanwhile, the results of the Cronbach's Alpha and Composite Reliability values for the five factors are > 0.7 as explained in table 1. Thus, the Intelligent-TPACK

model, which consists of the five factors, is declared reliable.

Table 1. AVE, Composite Reliability, and Cronbach's Alpha Results

Latent variables	AVE	Composite Reliability	Cronbach's Alpha
Intelligent-TK	0.735	0.933	0.910
Intelligent-TPK	0.712	0.945	0.932
Intelligent-TCK	0.741	0.919	0.883
Intelligent-TPACK	0.721	0.947	0.935
Ethics	0.696	0.901	0.854

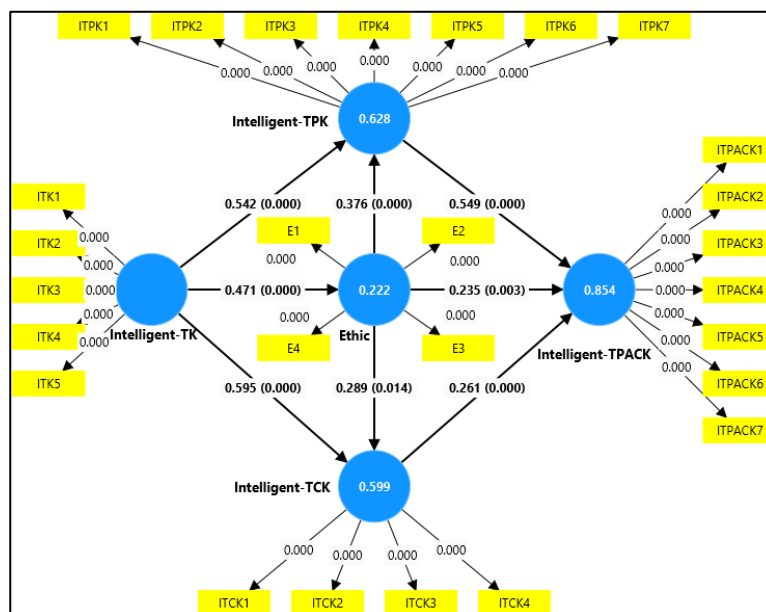
Source: data processed by researchers

The results of PLS-SEM analysis on *the inner model* for the value of R-Squares in interpreting the effect of the strength of the Intelligent-TK exogenous variable model on the endogenous variables of research (Intelligent-TPK, Intelligent-TCK, Intelligent-TPACK, and ethics) were 0.628; 0.599; 0.854; 0.222. As illustrated in Table 2, *Intelligent-TK* influences *Intelligent-TPK* of 0.628 with an adjusted R-Squares value of 0.621. Thus, it can be explained that Intelligent-TK affects *Intelligent-TPK* by 0.621 or 62.1%. Because the adjusted R-Square is less than 67%, the effect of Intelligent-TK on Intelligent-TPK is in the moderate category. The R-Square *Intelligent-TK* value influences *Intelligent-TCK* of 0.599 with an adjusted R-Squares value of 0.592. Intelligent-TK influences Intelligent-TCK by 59.2%, and other variables outside the study influence by 40.8%. Because the R-Square adjusted value is less than 67%, the influence of Intelligent-TK on Intelligent-TCK is included in the moderate category. Furthermore, the R-Square *Intelligent-TK* value affects the *Intelligent-TPACK* by 0.854 with an adjusted R-Square value of 0.850. This shows that Intelligent-TK influences Intelligent-TPACK by 85%, and other variables outside the study influence the rest. It has an adjusted R-Square value of more than 67%, indicating that Intelligent-TK strongly influences Intelligent-TPACK. Finally, the R-Square *Intelligent-TK* value affects ethics of 0.222 with an adjusted R-Square value of 0.215. In other words, Intelligent-TK only influences ethics by 21.5%, and its R-Square adjusted value is less than 33%. Therefore, the influence of Intelligent-TK on ethics is a weak category.

Table 2. R-Square and R-Square Values Adjusted

Items	R-Square	R-Square adjusted
Intelligent-TPK	0.628	0.621
Intelligent-TCK	0.599	0.592
Intelligent-TPACK	0.854	0.850
Ethics	0.222	0.215

Source: data processed by researchers

Figure 2. Bootstrapping Test Results

The bootstrapping test was carried out by researchers using SmartPLS 4.1 software to see the research hypothesis's positive and significant influence, as seen in Figure 2. As explained in Table 3, the influence of Intelligent-TK on Intelligent-TPK was found to have a significant relationship with the t-value. They are amounting to $6.685 > 1.96$. The relationship between Intelligent-TK and Intelligent-TPK is also positive, with an original sample value of positive 0.542. These findings show that Intelligent-TK positively and significantly influences Intelligent-TPK among FEB lecturers at the State University of Surabaya. Thus, H1a is accepted.

Then, it was found that the t-value of the relationship between Intelligent-TK and Intelligent-TCK was $6.514 > 1.96$. This means that Intelligent-TK directly has a significant influence on Intelligent-TCK. Apart from that, the original sample value was positive at 0.595, which indicated that Intelligent-TK's influence on Intelligent-TCK was positive. Therefore, it can be concluded that H1b is accepted because Intelligent-TK has a positive and significant influence on Intelligent-TCK among FEB lecturers at the State University of Surabaya.

The t-value for the Intelligent-TK relationship with ethics is 5.831, greater than 1.96. This shows that Intelligent-TK's influence on ethics is significant. The original sample value has a positive meaning of 0.471, which means that the Intelligent-TK relationship positively influences ethical judgment. So, it can be concluded that Intelligent-TK positively and significantly influences ethics, and H1c is accepted.

Furthermore, the influence of Intelligent-TPK on Intelligent-TPACK was also found to have a significant relationship. This is based on the t-value, which is $6.487 > 1.96$. Meanwhile, the original sample value of this relationship was also found to be positively related at 0.549. This means that Intelligent-TPK influences Intelligent-TPACK positively and significantly on FEB lecturers at the State University of Surabaya, and H2 is accepted.

Table 3 explains that Intelligent-TCK has a positive relationship with Intelligent-TPACK of 0.261. This means that Intelligent-TCK directly positively influences Intelligent-TPACK. It was also found that Intelligent-TCK had a significant effect on Intelligent-TPACK, based on the t-value of $3.693 > 1.96$. Thus, it is concluded that the Intelligent-TCK relationship positively and significantly influences Intelligent-TPACK in FEB lecturers at the State University of Surabaya, so H3 is accepted.

Having a t-value of 4.776 means that ethics significantly influences Intelligent-TPK. Apart from that, from this relationship, it was also found that the resulting original sample value was positive, 0.376, which means that the relationship between Ethics and Intelligent-TPK has a positive influence. The discovery of a positive and significant influence between ethics and Intelligent-TPK in FEB lecturers at the State University of Surabaya shows that h4a in this research is accepted.

Next, the t-value of the ethical relationship to Intelligent-TCK was greater than 1.96, namely 3.963. This indicates that Intelligent-TCK directly has a significant effect on ethics. A positive relationship was also found between ethics and Intelligent-TCK, with an original sample value of positive 0.289. This makes it clear that ethics positively and significantly influence Intelligent-TCK among FEB lecturers at the State University of Surabaya, so h4b is accepted.

Table 3 also shows that ethics positively and significantly influenced Intelligent-TPACK in this study. This can be seen from the t-value produced in this relationship of 2.986, which means > 1.96 . Meanwhile, the positive influence of ethics on Intelligent-TPACK can be seen from the resulting original sample value of positive 0.235. Therefore, it can be concluded that h4c in this study is accepted.

Table 3. T-Value Analysis Summary

Path Coefficients	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
Intelligent-TK -> Intelligent-TPK	0.542	0.534	0.081	6.685	0.000
Intelligent-TK -> Intelligent-TCK	0.595	0.597	0.091	6.514	0.000
Intelligent-TK -> Ethic	0.471	0.484	0.081	5.831	0.000

Intelligent-TPK -> Intelligent-TPACK	0.549	0.537	0.085	6.487	0.000
Intelligent-TCK -> Intelligent-TPACK	0.261	0.263	0.071	3.693	0.000
Ethic -> Intelligent-TPK	0.376	0.386	0.079	4.776	0.000
Ethic -> Intelligent-TCK	0.289	0.286	0.118	2.455	0.014
Ethic -> Intelligent-TPACK	0.235	0.256	0.079	2.986	0.003

Source: data processed by researchers

Discussion

H1a: Smart-TK has a positive and significant influence on Smart-TPK among FEB lecturers at the State University of Surabaya

Research findings show a positive and significant influence between Intelligent-TK and Intelligent-TPK on FEB lecturers of the State University of Surabaya 0.542. The higher the lecturers' technological knowledge, the higher their knowledge of how to use AI technology to teach. An increase in Intelligent-TK will increase Intelligent-TPK by 54.2%. This makes it clear that as long as lecturers understand the pedagogical benefits of AI-based tools, they will easily interact with them and use them to support the learning process. Lecturers who are more familiar with AI-based technology can better evaluate the usefulness of AI-based educational tools. Supporting this, previous research explains that educators who better understand AI-based educational tools can conduct automated assessments and discover the pedagogical potential in the teaching process (Chaudhry & Kazim, 2022). In addition, past research has also suggested that educators' technical capabilities around AI-based educational tools allow them to be used for personalized learning and timely feedback (Zawacki-Richter et al., 2019). It is reported that personalized learning allows educators to use technology to develop their pedagogical knowledge in teaching specific content (Kajonmanee et al., 2020).

H1b: Intelligent-TK has a positive and significant influence on Intelligent-TCK in FEB lecturers at the State University of Surabaya

The data analysis showed a positive and significant relationship between Intelligent-TK and Intelligent-TCK in FEB lecturers of the State University of Surabaya 0.595. In other words, the increase in Intelligent-TK will increase the Intelligent-TCK of lecturers by 59.5%. This explains that lecturers with good technological knowledge of AI-based tools also know how to use AI-based tools to create effective teaching content that fits the teaching objectives. The technological knowledge lecturers possess is the basis for integrating AI technology to teach certain content effectively.

Lecturers' technological knowledge about AI helps them understand the features and functions of AI-based tools that can be used to teach specific content according to their field. With this knowledge, lecturers can choose the right technology and use it effectively to achieve learning objectives. For example, ChatGPT and Chatbots act as online educators who answer questions and provide feedback promptly (Gill et al., 2024). Supporting this, previous research states that educators who know more about how to use technology in teaching various subjects directly increase pedagogical knowledge in certain subjects, such as technology-related content (Guggemos & Seufert, 2021).

H1c: Intelligent-TK has a positive and significant influence on Ethics in FEB lecturers at the State University of Surabaya

Intelligent-TK was found to positively and significantly contribute to ethics in FEB lecturers of the State University of Surabaya 0.471. Increasing Intelligent-Kindergarten will increase lecturer ethics by 47.1%. This indicates that lecturers who have good technological knowledge are able to assess the impact of every decision produced by AI-based tools. This is due to concerns that the results of decisions made by AI technology could cause bias (Wang & Wang, 2022). Therefore, lecturers who frequently interact with AI-based tools will have a good understanding of the basic functions and technical capacity of AI-based tools. Lecturers' understanding of the technical capacity of good AI-based tools can increase lecturers' ethical awareness in integrating AI-based tools. Therefore, ethics is the basis for lecturers who use AI-based tools professionally. This is supported by previous research, which states that educators who have a deep understanding of ethical judgment can assess decisions made by AI-based tools (Selin Akgun & Christine Greenhow, 2021).

H2: Intelligent-TPK has a positive and significant influence on Intelligent-TPACK in FEB lecturers at the State University of Surabaya

This research also found a positive and significant influence between Intelligent-TPK and Intelligent-TPACK on lecturers of 0.549. Increasing Intelligent-TPK units will increase Intelligent-TPACK for lecturers by 54.9%. This means that lecturers who are tech-savvy will know how to use AI-based tools effectively to teach specific material. Lecturers who have a good understanding of AI-based tools can understand the pedagogical role of AI-based tools. Thus, they can teach effectively by utilizing AI-based tools in line with previous research, which suggests that educators who understand AI-based tools well will know how AI changes the role of pedagogy, and they will most likely use AI systems more in their teaching (Celik, 2023). For example, lecturers who have

good TPACK competencies will easily provide direct feedback using AI-based tools in their teaching. Supporting this, previous research explains that educators who have good TPACK knowledge are able to provide direct feedback to students (Seo et al., 2021). However, it can be difficult for educators to provide immediate feedback to all learners simultaneously due to time constraints (Beardsley et al., 2021).

H3: Intelligent-TCK has a positive and significant influence on Intelligent-TPACK in FEB lecturers at the State University of Surabaya

Subsequent research findings found that Intelligent-TCK had a positive and significant effect on Intelligent-TPACK in lecturers by 0.261. This explains that every increase in Intelligence-TCK units will increase Intelligent-TPACK for lecturers by 26.1%. As lecturers become more knowledgeable about AI-based tools in a particular field, their knowledge of leveraging AI to update their content knowledge will likely increase. For example, in professional development programs, lecturers have the opportunity to interact with new technologies to enhance teaching content. Thus, their content choices will suit the needs and interests of students (Chiu & Chai, 2020). It is reported that when educators understand new technologies in professional development programs, they will be better able to integrate them into the teaching (Falloon, 2020). Professional educators are those who have a good Technological, Pedagogical, and Content Knowledge (TPACK) framework Field (Mishra & Koehler, 2006) that supports their work in the use of pedagogical technology and content in the teaching (McKenney & Visscher, 2019).

H4a: Ethics has a positive and significant influence on Intelligent-TPK in FEB lecturers at the State University of Surabaya

This research also found that ethics has a positive and significant influence on Intelligent-TPK in lecturers of 0.376. Improving ethics can increase Intelligent-TPK in lecturers by 37.6%. In other words, the lecturer's ethical judgment ability to assess AI-based tool decisions requires the lecturer's pedagogical and technical knowledge about the integration of AI into education (Adams et al., 2023). Lecturers with good knowledge of technology and pedagogy can determine whether AI decisions are reasonable and accountable (Jobin et al., 2019). Thus, ethical AI assessment directly increases lecturers' pedagogical understanding of implementing teaching strategies that are tailored to their needs and without harming students.

H4b: Ethics has a positive and significant influence on Intelligent-TCK in FEB lecturers at the State University of Surabaya

The results of data analysis found that there was a positive and significant relationship between ethics and Intelligent-TCK in lecturers at 0.289. These results can be interpreted as a result of improving ethics, which can increase Intelligent-TCK in lecturers by 28.9%. The higher the lecturer's ethical knowledge, the higher the lecturer's knowledge in choosing appropriate teaching content that is tailored to student characteristics, lecture material, and teaching objectives. This will certainly encourage lecturers to critically reflect on potential decision biases and shortcomings of AI-based tools, thus encouraging them to consider the ethical implications of using AI tools in the classroom. Supporting this, previous research explains that educators who understand the ethics of using AI technology can be responsible for the use of content and the appropriate application of content in learning (Gómez-Trigueros, 2023).

H4c: Ethics has a positive and significant influence on Intelligent-TPACK in FEB lecturers at the State University of Surabaya

The research findings found that ethics has a positive and significant influence on Intelligent-TPACK in lecturers by 0.235, and it can be concluded that every increase in ethical variables can also increase Intelligent-TPACK in lecturers by 23.5%. These results can explain that the decision-assessment ability of lecturers using AI-based tools indirectly increases lecturers' knowledge and skills in integrating AI-based tool technology effectively. In other words, ethics encourages lecturers to use technology responsibly and not harm students. The results show that the more lecturers are aware of the ethical issues associated with implementing AI in education, the more they understand how to incorporate AI-based tools into education. Therefore, the evaluation of AI can improve their TPACK (Celik, 2023).

Limitations and Future Directions

The research questionnaires were distributed to 112 lecturers at the Faculty of Economics and Business, Surabaya State University, as the sample was not large. Therefore, future research should use a larger sample size so that we can see a broader perspective on how factors influence Intelligent-TPACK in lecturers in higher education and how the Intelligent-TPACK scale can be applied in other higher education. Nevertheless, this research is in-depth and represents something new in the exploration of lecturers' knowledge and skills in integrating AI-based tools in teaching pedagogically and ethically.

CONCLUSION

This research shows five factors that influence Intelligent-TPACK in FEB lecturers at Surabaya State University. These factors have a positive and significant relationship. Research findings show that Smart-TK has a positive and significant effect on Smart-TPK, Smart-TCK, and ethics. Intelligent-TPK and Intelligent-TCK have a positive and significant effect on Intelligent-TPACK. Ethical assessment contributes positively and significantly to Intelligent-TPK, Intelligent-TCK, and Intelligent-TPACK. This research is limited to exploring the factors that influence Intelligent-TPACK in FEB lecturers at the State State University of Surabaya. Future research is expected to expand the sample to be able to see a broader perspective on how factors influence Intelligent-TPACK in lecturers in higher education and how the Intelligent-TPACK scale can be applied in other higher education.

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