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Investigating the Role of Teacher's Transformative Leadership in Fostering Technology Acceptance among Vocational High School Students

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ABSTRACT: As education evolves, technology integration has become a key factor in enhancing learning quality. However, its effectiveness largely depends on teachers as the primary agents of implementation. This study examines the role of transformational leadership in influencing students' acceptance of technology in Vocational High Schools. The Technology Acceptance Model (TAM**)** is extended by incorporating Motivation for Use and Transformational Leadership as additional variables. Data were collected from 365 Vocational High School students in Surakarta and Karanganyar using a structured questionnaire. The analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) to explore complex relationships. The results highlight the significant influence of teacher transformational leadership on students' perception of technology's ease of use and usefulness. These findings emphasize the need for teacher training, technology integration in the curriculum, infrastructure support, and continuous evaluation to foster effective technology adoption in vocational education. Strengthening teachers' transformational leadership can enhance students' motivation and willingness to embrace technology, ultimately improving learning outcomes in vocational schools.

Keywords: Education, Transformational leadership, Technology Acceptance Model (TAM), Vocational High School (SMK)

ABSTRAK: *Seiring dengan perkembangan pendidikan, integrasi teknologi telah menjadi faktor kunci dalam meningkatkan kualitas pembelajaran. Namun, efektivitas adopsi teknologi sangat bergantung pada peran guru sebagai agen utama dalam implementasinya. Penelitian ini mengkaji peran kepemimpinan transformasional guru dalam mempengaruhi penerimaan teknologi oleh siswa di Sekolah Menengah Kejuruan (SMK). Model Technology Acceptance Model (TAM) diperluas dengan menambahkan variabel motivasi Penggunaan dan Kepemimpinan Transformasional. Data dikumpulkan dari 365 siswa SMK di Surakarta dan Karanganyar melalui kuesioner tertutup. Analisis dilakukan menggunakan Partial Least Squares Structural Equation Modeling (PLS-SEM) untuk mengeksplorasi hubungan yang kompleks. Hasil penelitian menunjukkan bahwa kepemimpinan transformasional guru berpengaruh signifikan terhadap persepsi siswa mengenai kemudahan penggunaan dan manfaat teknologi. Temuan ini menekankan pentingnya pelatihan guru, integrasi teknologi dalam kurikulum, dukungan infrastruktur, serta evaluasi berkelanjutan untuk mendorong adopsi teknologi yang efektif dalam pendidikan kejuruan. Penguatan kepemimpinan transformasional guru dapat meningkatkan motivasi dan kesiapan siswa dalam menerima teknologi, sehingga meningkatkan hasil pembelajaran di SMK.*

***Kata Kunci**: Kepemimpinan Transformasional, Sekolah Menengah Kejuruan, Technology Acceptance Model, PLS-SEM, Teknologi Pendidikan*

INTRODUCTION

In an era where information and Communication Technology (ICT) dominates, the integration of technology has brought a huge impact on various aspects of life, particularly in the field of education such as the improvement of learning to be Interactive, the development of critical skills, and administrative efficiency (Cao et al., 2022; Shetelia et al., 2024; Oliviera et al., 2020; Chen et al., 2020; Lai & Pratt, 2007). Vocational schools, which aim to develop practical skills and competencies to prepare students for the world of work, are also affected by this change (Ramadan et al., 2018). The application of ICT in vocational schools opens up new opportunities to enrich the learning experience of students. This technology not only enables more personalized learning, but also accelerates skill development, increases student motivation, and bridges the needs of the industrial world (Banagiri et al., 2021). In addition, ICT encourages collaboration between students and adds a creative dimension to the learning process (Valentine et al., 2005). However, behind the positive potential, there are challenges that must be overcome. Vocational High School (SMK) students often face obstacles such as limited access to ICT resources, low digital literacy, and lack of support from teachers (Habibi et al., 2023; Joseph et al., 2021). Overcoming these barriers is the key to ensuring that the benefits of ICT can be optimally felt in the vocational education environment.

The role of the teacher becomes a central element in overcoming these challenges. Educators are not only tasked with integrating ICT into the learning process, but also guiding students to master digital literacy and positively accept technology (Backfisch et al., 2021). Teachers who are able to effectively utilize ICT act as catalysts for the transformation of learning in vocational schools. In this context, teacher transformational leadership-defined as a leadership style that inspires students to transcend personal boundaries and motivates shared progress (Bass, 1985)—has had a major influence in driving ICT adoption (Peeraer & Van Petegem, 2011). This approach has proven effective in forming a positive attitude towards technology and supporting ICT integration in education (Afshari et al., 2012; King et al., 2018; Schepers et al., 2005; Yee, 2000).

Although transformational leadership is recognized as important in ICT acceptance, research specifically exploring the role of teachers in this regard is limited. Previous studies have focused more on the role of principals or technical aspects of ICT implementation in learning (Afshari et al., 2012; King et al., 2018; Schepers et al., 2005; Yee, 2000). In fact, teachers' transformational leadership has strategic value for shaping students' attitudes towards technology, which can ultimately improve the effectiveness of vocational education. It is undeniable that teachers have great potential as agents of change at the classroom level, where mastery of technological skills is an important foundation for future job readiness. Therefore, this study aims to fill this gap by examining the relationship between teacher transformational leadership and ICT acceptance among vocational students. The study seeks to reveal the extent to which the role of

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teachers influences the adoption of technology by students, while providing practical insights to develop educational strategies for the application of more effective learning models or methods in this digital age.

Technology Acceptance Model (TAM)

The technology acceptance Model (TAM) was originally developed by Davis (1985) to analyze the factors that influence the adoption and acceptance of technology by individuals. The Model involves variables such as perceived usefulness (PU) and perceived ease of use (PEU). In a further development by Davis and Venkatesh (1996), they included the perceptual factor behavioral intention (BI) as part of the expansion of Tam science. A meta-analysis conducted by marangunić & granić (2015) found that all three had both direct and indirect influences.

The world of education must constantly move in response to technological advances, which bring various challenges and changes to educational institutions (Scherer et al., 2019). Technology facilitates the way teachers and students search for answers, while increasing the role of teachers as educators, trainers, and assessors (Akmaliyah et al., 2023). The technology acceptance Model (TAM), used in several studies to assess the perception of technology use, has a significant effect on the implementation of e-learning (Abbad, 2011; Alharbi, 2021; Castiblanco Jimenez et al., 2021). This suggests that a positive perception of technology encourages its more effective use.

In the context of learning methods, the flipped classroom model plays an important role in increasing student engagement. Alyoussef (2022) found a positive correlation between the perceived of usefulness (PU), perceived ease of use (PEU), and behavioral intention (BI) of students in the use of the flipped model. In addition, TAM is also relevant for teachers in conducting teaching and training. Scherer et al. (2019) argue that TAM plays an important role in education, especially in supporting the integration of technology at various levels.

The application of TAM is not only limited to general education, but has also been shown to be effective in vocational education. Vocational teachers have successfully applied TAM in the learning process to enhance student training and practice (Zarafshani et al., 2020). Various studies also confirm the success of TAM in vocational education, particularly in examining how vocational teachers adopt digital tools in teaching practice (Antonietti et al., 2022). Another study in Saudi Arabia used TAM to predict e-learning acceptance among college students (Alammary et al., 2022; Alassafi, 2022), affirms the flexibility of this model in various educational contexts, including vocational.

TAM (Venkatesh & Davis, 1996) offered a framework for assessing how individuals adopt and utilize technology. Portz et al (2019) highlighted that TAM serves as a conceptual framework within the field of information technology, designed to explore how individuals accept and develop the intention to use technology. Furthermore, TAM is recognized as a well-established theoretical model that is frequently utilized in information systems research (Sternad

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Zabukovšek et al., 2019; Venkatesh et al., 2003). The TAM theoretical framework consists of three key variables that impact an individual's technology adoption: perceived ease of use (PEU), perceived usefulness (PU), and behavioral intention (BI) (Venkatesh & Davis, 1996).

Transformational Leadership

Transformational leadership has a strong focus on initiating organizational change and inspiring followers to commit to the collective vision and goals of the organization or unit (Bass & Riggio, 2006). In their book, Bass and Riggio (2006) state that transformational leadership has become a major paradigm in 20th Century Leadership Theory, prompting much research to explore this leadership style. For example, the study of Schepers et al. (2005) found that the application of transformational leadership in various companies contributes positively to the perception of employees regarding the benefits of technology. This is in line with Nguyen's (2023) study, which used the Technology Acceptance Model (TAM) as a mediating variable between knowledge sharing moderated by transformational leadership and technology adoption, showing a positive correlation influenced by perceptions of benefits as well as gender factors.

Furthermore, Dun and Kumar's (2023) research found that transformational leadership significantly influences technology acceptance among company employees. This leadership style is also a major factor driving adoption of technology 4.0, as found in the study of Bednall et al. (2018) and Peng et al. (2021). In addition, Khasawneh (2020) affirms that transformational leadership, through a psychological approach to employees and the creation of a safe and comfortable work environment, can increase the acceptance of new technologies and favor change in the company. Leaders who encourage employees to share knowledge in utilizing technology, while facilitating interindividual cooperation and learning, also motivate subordinates to adopt new technologies, as revealed in the research of Moon & Jung (2018), and Moon & Park (2019).

Motivation to Use

In the context of information technology usage, motivation refers to the psychological and behavioral factors that encourage individuals to adopt, utilize, and engage with information technology (Venkatesh et al., 2003). This concept explains the reasons behind an individual's decision to adopt and engage with a specific technology. Rodriguez et al (2018) identified that an individual has the motivation to use information technology such as entertainment, social interaction, self-branding and seeking information. Information technology is used to meet various needs of each user (Alhabash et al., 2024; Alhabash & Ma, 2017; Phua et al., 2017). A Dutch study reporting on the motivation to use virtual assistants by several families, found that each family has a different motivation in using virtual assistants (Wald et al., 2023). The continuous use of technology by individuals are the results of getting the comfort in using it (Wald et al., 2023).

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Meanwhile in China, it was found that the motivation to use travel applications received a positive correlation. Other reports also stated that young Chinese showed interest in continuing to use travel applications (Zhou et al., 2021). The COVID-19 pandemic has driven significant shifts toward digital transformation across various sectors, including education (Gewerc et al., 2020). Thus, motivation plays a crucial role in developing digital competencies, skills, and technology adoption (Nalipay et al., 2023; Vermote et al., 2020). The findings of Beardsley et al (2012) successfully identified teachers' abilities and motivation in utilizing information technology for distance teaching.

Scherer et al (2019) found that individual motivation influences technology use. Exploration of individual motivations for using information technology is carried out in technology acceptance (Camilleri & Falzon, 2020; Muñoz-Leiva et al., 2017; Nagy, 2018; Tefertiller, 2020). Cammileri & Falzon's (2021) research reported that motivation to use streaming technology has a positive correlation with individual intentions to use it. Another study supported the previous statement, it mentioned the motivation for using information technology influenced by TAM (Salimon et al., 2021; Teo et al., 2019). Moreover, studies on English language learning integrated with information technology have reported a positive correlation with student learning motivation (An et al., 2023; Gan et al., 2020; Panagiotidis et al., 2023).

Hypotheses Development

Based on the literature review described above, this study proposes a hypothesis that is going to be tested empirically. The hypotheses that have been developed in this study are as follows:

H1: Perceived Ease of Use (PEU) by students in using information technology has a positive effect on the Perceived Usefulness (PU) of Information Technology.

H2: Perceived Ease of Use (PEU) by students in using information technology has a positive effect on Behavioral Intention (BI) towards the use of Information Technology.

H3: Perceived Usefulness (PU) of the benefits of Information Technology has a positive effect on Behavioral Intention (BI) to the use of Information Technology.

H4: Transformational leadership (LS) applied by teachers has a positive effect on the Perceived Ease of Use (PEU) of students in using information technology.

H5: Transformational leadership (LS) applied by teachers has a positive effect on Perceived Usefulness (PU) of the benefits of Information Technology.

H6: Transformational leadership (LS) applied by teachers has a positive effect on Behavioral Intention (BI) related to the use of Information Technology.

H7: Transformational leadership (LS) applied by teachers has a positive effect on the motivation to use information technology (MU).

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H8: Motivation to use (MU) information technology has a positive effect on Behavioral Intention (BI) to use information technology.

In more detail, the research model and hypothesis developed in this study are depicted in Figure 1.

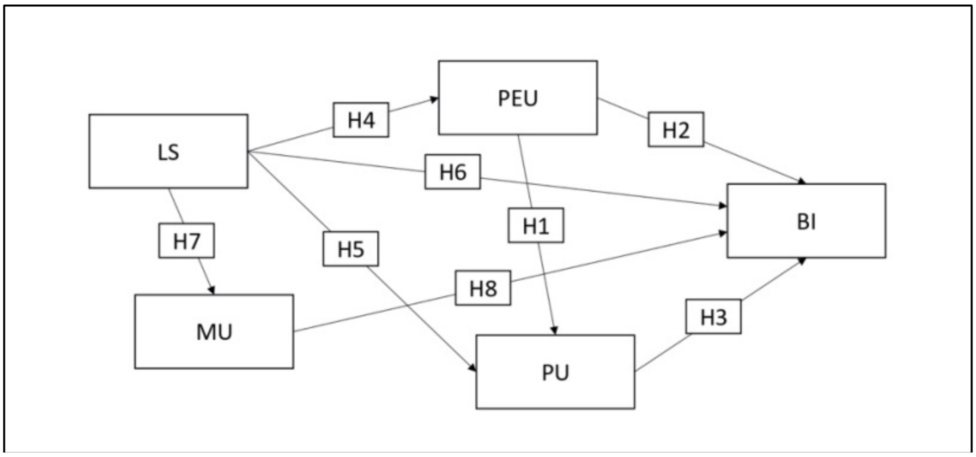

Figure 1. Research Models and Hypotheses

RESEARCH METHOD

Research Instruments

To assess the variables in this research model, a survey instrument consisting of 23 statement items was designed by adapting a previously validated instrument from a previous study. Specifically, the instrument incorporates: (1) items developed by Venkatesh and Davis (1996) to measure three constructs of the Technology Acceptance Model (TAM), namely Perceived Usefulness (PU) with five items, Perceived Ease of Use (PEU) with five items, and Behavioral Intention (BI) with four items; (2) an instrument from Aldholay et al. (2018) consists of 5 items to measure Transformational Leadership (LS) (Loading factor 0.811-0.879; CR 0.908; AVE 0.713) the results obtained have exceeded the instrument testing threshold; and (3) instruments from Zhou et al. (2022) with four items to assess Motivation to Use (MU) (Loading factor 0.71-0.8; CR 0.848; AVE 0.584) the results obtained have exceeded the instrument testing threshold. The process of adapting the instruments was done carefully to ensure language appropriateness and relevance to the vocational education context. This adaptation involved adjusting each statement item to fit the characteristics of the respondents, namely students at Vocational High Schools (SMK), as well as the research focus on the use of technology in learning. Afterwards, the instrument was submitted to experts for further input and validation. Each statement in the questionnaire was made using a five-point Likert scale, to assess each search variable.

Respondents, and Data Collection

The study population consisted of all vocational school students in Surakarta City and Karanganyar Regency, Central Java Province. The sample size

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was calculated using G*Power 3.1.9.4 software to ensure the optimal number of participants, taking into account the complexity of the structural model being developed. This calculation uses a power level of 0.88, effect size 0.051, probability 0.5, predictor 4 variables. Based on this calculation, the minimum sample size required is 289 respondents. To increase the reliability of hypothesis testing, this study selected more than 300 respondents as samples. After determining the sample size, a simple random sampling technique was used to select respondents from the research population (Setia, 2016). This method was chosen because every student in the population has the same opportunity to be selected, thus reducing selection bias and ensuring a representative sample (Beck, 2024; Sirait, 2020). Simple random sampling is more efficient and practical to apply to the population of vocational students who are spread across various schools with relatively homogeneous characteristics.

The data collection process is carried out systematically through several stages, namely coordination with schools, distribution of survey instruments, data collection within a certain period of time, and preparation of data into a table format. The distribution of instruments has been approved by classroom teachers, principals of vocational schools in the cities of Surakarta and Karanganyar, PAP FKIP UNS Study Program. After getting approval, teachers in each school distribute questionnaires to students. This method was chosen to ensure the reliability of student responses, as teachers can provide direct explanations related to the survey instrument if needed.

Participants of the Study

Data collection was conducted from May 2023 to June 2023, with a carefully selected time frame to adjust each school's academic schedule. This study has obtained permission from schools and universities, and informed consent is obtained from each respondent before they fill out the questionnaire. Respondents were given written and oral explanations regarding the purpose of the research, data collection procedures, and their right to withdraw at any time without consequences. Participation in the study was voluntary, and no incentives were given to respondents to ensure that participation was based on personal will, thereby reducing the potential for response bias that may arise as a result of certain pressures or expectations.

All data was collected anonymously, so the identity of the respondents was not recorded or revealed in the research report. This step is taken to protect the privacy and confidentiality of respondents in accordance with research ethical standards, while preventing response bias that may arise from concerns about privacy or social pressure. In total, this study succeeded in collecting data from 370 vocational school students in Surakarta City and Karanganyar Regency, Central Java Province. After the data curation process, 365 respondents were considered eligible for further analysis. A detailed overview of the respondent demographics is presented in Table 1.

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Table 1. Demographic Data of Respondents

No.	Demographic Characteristics	Total	%
1	Gender		
	Male	15	4
	Female	350	96
2	Home environment		
	Urban	135	37
	Countryside	230	63
3	Have a laptop		
	Yes	154	42
	No	211	58
4	The use of Android phones / laptops is the most.		
	Social Media	302	83
	Learning	44	12
	Play Games	17	4
	Read the news	2	1
5	The lowest use of Android phones.		
	Social Media	11	3
	Learning	19	5
	Play Games	220	60
	Read the news	115	32

The demographic characteristics in Table 1, which include gender, living environment, laptop ownership, as well as Android/laptop phone use, were selected for their relevance to the research objectives focused on technology adoption and perception among vocational students.

Research Model and Data Analysis

As shown in Figure 1, this study uses the extended Technology Acceptance Model (TAM) approach by adding Transformative Leadership (LS) and Motivation to Use (MU) variables as antecedents that affect Perceived Ease of Use (PEU), Perceived Usefulness (PU), and Behavioral Intention (BI). The Partial Least Squares Structural Equation Modeling (PLS-SEM) method was chosen to test the hypothesis because it is able to analyze complex relationships between variables simultaneously without assuming a normal distribution (Hair & Alamer, 2022) and is flexible for small sample sizes (Lin et al., 2020). The analysis was performed with Smart PLS 4.0 which provides a comprehensive tool for hypothesis testing and model evaluation. The evaluation of the PLS-SEM model includes three main stages based on Hair et al. (2019), namely outer model testing, inner model testing, and hypothesis testing through bootstrapping with p-value < 0.05. This evaluation ensures the model is reliable, valid, and appropriate to explain the adoption of Information Technology. Below is a table summarizing the conformity assessment criteria of the PLS-SEM model.

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Table 2. Criteria for measuring the PLS-SEM model

Criteria	Threshold	Description
Reliability (Outer Model)	CR > 0,7; loading factor > 0,7	Shows the internal consistency of indicators in measuring constructs.
Convergent Validity (Outer Model)	AVE > 0,5	Indicating constructs account for more than half the variance of their indicators.
Coefficient Of Determination (Inner Model)	R^2 > 0,25	Indicates the proportion of variance described by the model.
Predictive Relevance (Inner Model)	Q^2 > 0	Demonstrate the predictive capabilities of the model.
SRMR (Inner Model)	SRMR < 0,1	Indicates the compatibility of the entire model with the data.
Collinearity test (Inner Model)	VIF< 3	Whether or not there is multicollinearity
Hypothesis testing	p-value < 0,05	Determine the significance of the path between variables in the model.

RESULT AND DISCUSSION

Measurement Model

At this stage, model measurement tests were conducted, including reliability and validity assessments of the developed instruments and a model fit test. Following Hair et al. (2019The reliability of the research instrument was tested by three methods, namely (1) convergent validity, (2) indicator loading and internal consistency reliability, and (3) discriminant validity. In addition, the suitability of the model was analyzed using the residual value of the mean square of the standard Root (SRMR) to assess the suitability of the structural equation model, following the guidelines of Hu and Bentler (1999) and Schermelleh-Engel and Moosbrugger (2003).

In testing instrument reliability, firstly we tested the value of indicator loadings on each indicator that makes up the research variable. The test results showed that the load indicator values for all variables in the study were greater than 0.708 (Table 3, Column II) and has met the minimum threshold of the recommended loadings indicator value (Hair et al., 2019; Mukminin et al., 2020). The internal consistency reliability was then evaluated, using Cronbach's alpha and composite reliability. The results of the analysis showed that the two measures have a reliability value ranging from 0.730 to 0.923 for each variable in the study. (Table 3, Columns III and IV). These results suggest that the Cronbach's Alpha (α) and Composite Reliability (CR) values for all research variables meet the recommended standards (Hair et al., 2019).

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In the validity test, the first step is to test the validity of the convergent value through the calculation of the average variance extracted (AVE). The results of the analysis show that all the observed variables are convergent and have an AVE value greater than 0.500 (Table 3, Column V) and indicated that the measured constructs as a whole had adequate convergence. Next, we tested discriminant validity to test whether each research variable measured was able to describe its construct well. In testing discriminant validity, we applied the Fornell and Larcker test (1981) and heterotrait-monotrait ratio (HTMT).

Table 3. Construct reliability and convergent validity

Item	Item loadings	Cronbach's Alpha (α)	Composite Reliability (CR)	Average Variance Extracted (AVE)
I	II	III	IV	V
BI1	0.721	0.64	0.788	0.586
BI2	0.765			
BI3	0.727			
BI4	0.75			
LS1	0.72	0.793	0.859	0.551
LS2	0.795			
LS3	0.769			
LS4	0.761			
LS5	0.777			
MU1	0.797	0.761	0.848	0.584
MU2	0.8			
MU3	0.71			
MU4	0.759			
PEU1	0.861	0.891	0.92	0.697
PEU2	0.864			
PEU3	0.839			
PEU4	0.769			
PEU5	0.838			
PU1	0.825	0.896	0.923	0.707
PU2	0.824			
PU3	0.847			
PU4	0.856			
PU5	0.851			

Finally, a model fit test was performed by calculating the SRMR value. The test results showed an SRMR value of 0.09 (Table 4). Although the SRMR value slightly exceeded the lower bound of the recommended range, but it was still within the acceptable range. Referring to the guidelines proposed by Schermelleh-Engel and Moosbrugger (2003), it was stated that SRMR values are acceptable if they are in the range of $0.05 < SRMR \leq 0.10$. Thus, the SRMR value

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indicates that the developed structural model has a good fit to the observed data.

Table 4. Model Fit

	Saturated Model	Estimated Model
SRMR	0.09	0.099
d_ULS	2.694	7.471
d_G	2.728	2.859
Chi-Square	2677.005	2836.171
NFI	0.576	0.55

Hypothesis Testing

The first step in the evaluation of the model developed is to assess its strength and predictive ability through R-square and Q-square analysis. R-square analysis is used to measure the extent to which endogenous variables can be described by independent variables in the model. The R-square test results are presented in Table 5, columns I and II. The results of the R-square analysis show that the BI variable has an R-square value of 0.626, indicating a significant contribution from the independent variable in explaining its variation. In addition, the PU variable also obtained a fairly high R-square value of 0.521, which confirmed the significant role of the independent variable in explaining variations in the PU variable. However, the variables MU and PEU shows relatively low R-square values, namely 0.124 and 0.123. The results indicated that the independent variables made a more significant contribution to the variation of BI and PU compared to MU and PEU. Furthermore, Q-square analysis was conducted using the blindfold procedure on SmartPLS software. The test results showed that the Q-square value obtained was greater than 0 (Table 5, column III). According to the criteria established by Henseler et al. (2015), a model is considered to have good predictive relevance if its Q-square value is greater than 0. These results confirm that the model used in this study has strong predictive capabilities, making it sufficiently relevant to generate predictions.

Table 5. R-square and Q-square

	R Square	R Square Adjusted	Q square
	I	II	III
BI	0.626	0.622	0.284
MU	0.124	0.121	0.069
PEU	0.123	0.12	0.083
PU	0.521	0.518	0.363

To evaluate the level of multicollinearity among the predictor variables, the Variance Inflation Factor (VIF) test was conducted. The test results showed that all VIF values were below 3.00 (Table 6, column III). According to Hair et al. (2019), a VIF value exceeding 3.00 may indicate multicollinearity among the predictor variables. Therefore, it can be concluded that there is no significant evidence of multicollinearity that could affect the validity or interpretation of the results of the research model analysis.

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Table 6. Results of Hypothesis Testing

Hypothesis		VIF	Std. Dev	P value	Results
I	II	III	IV	V	VI
H1	PEU ->PU	1.14	0.043	0	*Confirmed*
H2	PEU ->BI	2.414	0.062	0	*Confirmed*
H3	PU ->BI	2.269	0.063	0	*Confirmed*
H4	LS ->PEU	1	0.061	0	*Confirmed*
H5	LS ->PU	1.14	0.05	0.019	*Confirmed*
H6	LS ->BI	1.19	0.063	0	*Confirmed*
H7	LS ->MU	1	0.054	0	*Confirmed*
H8	MU ->BI	1.985	0.058	0.025	*Confirmed*

The results of testing the main hypotheses in this study can be seen in Table 6, columns IV-VI, while the path coefficients between variables are presented in Figure 2. Hypothesis testing was conducted using the bootstrap method with 5,000 subsamples. The analysis results show that all research hypotheses are supported, with the relationships between variables proving statistically significant. Based on the test results, the Transformative Teacher Leadership (LS) variable has an effect on all components of the TAM model (PEU, PU, and BI). In addition, LS variable has a significant positive impact on Motivation to Use (MU) variable. A more detailed explanation of the hypothesis test results is presented in the following section.

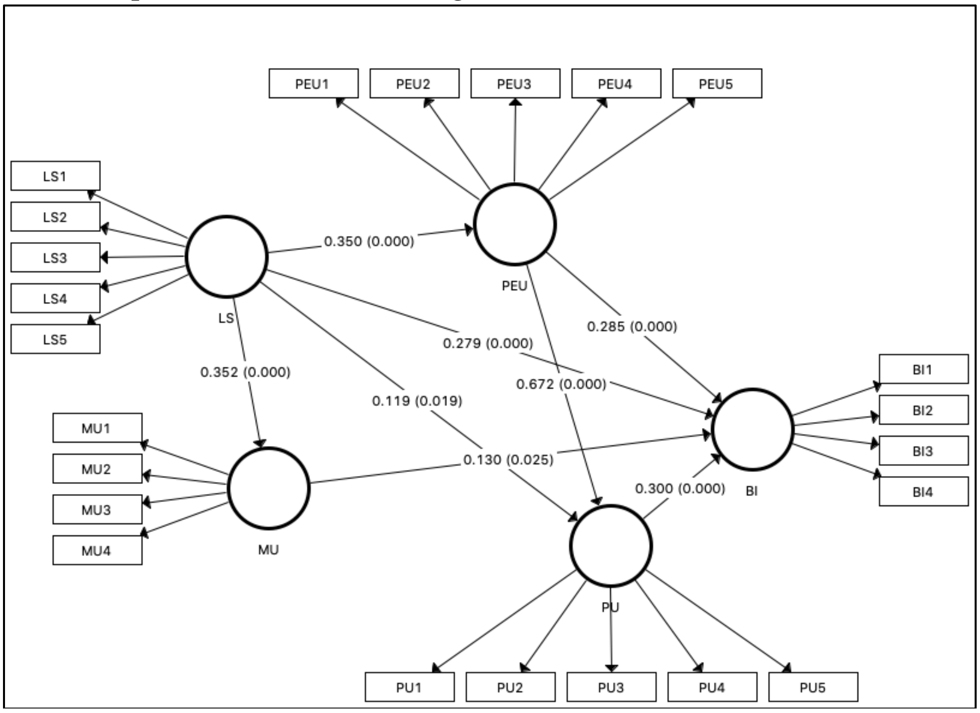

Figure 2. Path coefficients between variables in structural models

Discussion

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The results of this study reinforce previous findings while providing a new perspective in the context of vocational education. The study is aligned with Cho et al. (2011) who found that transformational leadership in higher education increases acceptance of technology through staff empowerment, but this study extends those findings by emphasizing teacher agency as a technology role model in the vocational context. In a practical skills-oriented vocational environment, teachers not only act as tutors but also as practitioners who model the use of technology in real work simulations (for example, the use of CAD in engineering or digital accounting applications). This reinforces the model of Ghazali et al. (2015) on technology leadership in secondary schools, but with a unique emphasis on the contextual leadership dimension where vocational teachers double as instructors and industry partners. This finding is also in line with the research of Bunjak et al. (2022) on transformational leadership in manufacturing sector 4.0, but with an important correction: in the vocational environment, the effectiveness of teacher leadership largely depends on the ability to align students ' intrinsic motivation (interest in technology) with extrinsic motivation (job market needs).

From the perspective of cognitive psychology, the effect of LS on PU (β=0.119) can be explained through Cognitive Apprenticeship theory (Collins et al., 1987). Transformative teachers in the vocational context apply modeling strategies (demonstrating the use of technology), coaching (structured guidance), and scaffolding (gradual support) that transform the perception of technological complexity into competencies that can be mastered. This mechanism is reinforced by the findings of Backfisch et al. (2021) on utility-value intervention, in which teachers who are able to relate technology to practical applications in the world of work (for example, showing how digital data analysis improves the efficiency of automotive workshops) significantly improve the perception of the usefulness of technology.

With regard to the implementation of transformational leadership by teachers, previous research has explained that the integration of this approach in the learning process can create a dynamic classroom environment, improve students ' critical thinking skills, and strengthen holistic academic engagement (Small, 2023). This condition indicates that students tend to show more active participation in the use of technology for learning and practical purposes in vocational education. Recent research by Schmitsz et al. (2023) reinforce these findings by showing that the application of transformational leadership by teachers, particularly through the integration of digital technology in the classroom, significantly increases student engagement and optimizes the learning experience. The findings reinforce the argument that transformational leadership styles in vocational teachers act as a catalytic stimulus in encouraging student adoption of technology. Through practices such as providing technology-based inspiration, collaborative mentoring, and providing applicative context, transformational teachers are able to transform students ' perceptions from mere passive users to active participants in the technology-based learning ecosystem (De Angelis, 2018; Yacek, 2021; Matikainen, 2024).

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Vocational education and technology will always coexist (and Wiliam, 2015), so it is important for vocational educators to be aware of the need to design learning, both in the classroom and in practice, that is technology-based and interactive (Reich et al., 2021). This approach will improve the competence of vocational students to be able to compete and meet the qualifications needed in the industrial world.

The implication of this research for vocational education is to encourage schools to be more aware of technological developments. In particular, principals are expected to conduct training for teachers on transformational leadership, which has a positive impact on the learning process through the integration of technology. In addition, it is necessary to create a vocational technology framework standard that connects technology-based curricula with industry needs. The Department of education and schools are also expected to collaborate in building technology laboratories that support students to experiment independently with teacher assistance.

CONCLUSION

This study highlights the crucial role of teacher transformational leadership in shaping students ' perceptions, motivations, and intentions to adopt technology in vocational education. This study extends the technology acceptance Model (TAM) by integrating transformational leadership theory as a significant external factor in the context of vocational education. Different from the original TAM assumptions that focused on technology and individual factors such as perceived ease of use and perceived usefulness, this study shows that transformational leadership not only influences students ' perceptions of technology, but also increases their motivation to use it. Student motivation proved to be a key mediator linking transformational leadership with students ' intention to adopt technology, thus refining TAM by adding motivational and leadership dimensions.

A new insight from the study is the mediating role of motivation in the relationship between transformational leadership and technology adoption. These findings reveal that student motivation is not only a contributing factor, but a key pathway that reinforces the influence of teacher leadership on student engagement with technology. Teachers who are active, encourage experimentation, and create a conducive learning environment can improve students ' perceptions of the ease of Use and benefits of technology, while motivating them to actively integrate technology into the learning process.

This research seeks to provide recommendations to teachers to encourage students to experiment with new technologies, such as Artificial Intelligence (AI), to build skills and creativity. For school administrators, this study suggests providing training for teachers in the application of transformational leadership as well as the use of technology, so as to create a school climate that supports technological innovation and experimentation This research seeks to provide recommendations to teachers to encourage students to experiment with new technologies, such as Artificial Intelligence (AI), to build

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skills and creativity. For school administrators, this study suggests providing training for teachers in the applies.

Limitations for Future Research

While this research provides new insights into TAM, the motivations for using technology, and transformational leadership, there are some limitations. The study focused on vocational education with a relatively small sample size, making it susceptible to generalization of findings. In addition, the selection of research sites that are limited to one province has its own limitations. Therefore, further studies are needed to fill the existing gaps, such as longitudinal research to examine the long-term impact of transformational leadership on the use of technology in vocational schools, comparison of findings between public and vocational schools, and the addition of new variables, such as modern leadership that is more relevant to the current era.

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