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The mediating role of meaning in work in promoting teachers' technology integration

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Teachers' integration of technology has been a critical focus for both teachers and researchers over the past three decades. This emphasis has intensified due to the COVID-19 pandemic, where technology integration has become a key factor in the success of classroom teaching and learning processes. Despite this attention, previous studies have shown limited exploration of the relationship between teachers' technology integration and meaning in work as an internal variable. Therefore, using AMOS-structural equation modeling (SEM) analysis, this study aimed to develop a conceptual model examining the mediating role of meaning in work in the relationship between digital leadership, self-efficacy, and teachers' technology integration. The study involved 200 junior high school teachers from Balikpapan City, East Kalimantan Province, a region in eastern Indonesia projected to become the new capital. A total of four variables were analyzed in this study: meaning in work, digital leadership, self-efficacy, and teachers' technology integration (Z, X, and Y, respectively). The results showed that (1) digital leadership affected meaning in work and teachers' technology integration, (2) self-efficacy affected meaning in work and teachers' technology integration, (3) meaning in work affected teachers' technology integration, and (4) meaning in work could mediate the relationship between digital leadership and self-efficacy in teachers' technology integration. These findings contribute to a deeper understanding of the relationships among digital leadership, self-efficacy, and meaning in work, and their collective impact on teachers' technology integration. Furthermore, the study highlights the significant role of meaning in work as a mediator in these relationships, providing a foundation for the development of digital leadership strategies and training programs aimed at improving technology integration in education.

KEYWORDS

digital leadership, meaning in work, self-efficacy, structural equation model, teachers' technology integration

1 Introduction

Teachers' integration of technology has been a critical focus for educators and researchers over the past three decades (Nelson et al., 2019). This focus has intensified in the past three years due to the widespread adoption of online learning in response to the COVID-19 pandemic (Chiu, 2022; Gomez et al., 2022).

Furthermore, the transition from traditional in-person to online platforms requires teachers to employ a wide range of digital tools and resources to enhance the effectiveness of the instructional method (Eickelmann and Drossel, 2020).

A previous study highlighted the need for teachers to develop digital teaching skills and become proficient technology users (Botham, 2018).

Technology is considered a critical tool for ensuring the continuity of education (AlAjmi, 2022), playing a crucial role in bridging the gap between teachers and students (Khatoony and Nezhadmehr, 2020).

The integration of technology has been proven to enhance the quality of the educational process, particularly during the pandemic (Alqahtani and Rajkhan, 2020; König et al., 2020a). This improvement is especially evident in enhancing competency (Ahmed and Opoku, 2022; Hasin and Nasir, 2021) and increasing student satisfaction with the learning experience (Nasir, 2020).

A previous report (Chiu, 2022) suggested that educational technology could support the learning process by engaging students in interactive activities. In line with these results, school curricula integrate ICT more thoroughly, allowing students to use digital resources for creative and innovative problem-solving.

Furthermore, the development of artificial intelligence (AI) strengthens the importance of technology integration in learning (Akgun and Greenhow, 2022; Al-Sharafi et al., 2023; Chen et al., 2020; Narvaez Rojas et al., 2021). AI facilitates personalized learning by analyzing student data and adjusting materials and teaching methods according to individual needs (Ouyang and Jiao, 2021). This reduces teachers' administrative burden, such as grading and lesson planning, leading to increased focus on direct student interactions. With the increasing application of AI technology, teachers can eliminate repetitive and tedious tasks and respond to students promptly, thereby advancing adaptive and personalized teaching processes (Chan and Zary, 2019). Several studies have shown that it can also provide innovative teaching aids, such as virtual assistants and adaptive platforms, which enrich the learning experience and improve teaching effectiveness. However, challenges, such as the need for teachers training in using new technology and ensuring equitable access for all students, must be addressed to maximize the potential benefits. AI overuse can also reduce essential human interaction, such as emotional guidance and teachers' motivation.

Additionally, there is a risk of a digital divide where students from economically disadvantaged backgrounds may not have adequate access to advanced technology, widening the educational gap. Data privacy is a major issue as AI is associated with collecting and analyzing students' sensitive personal data (Chen et al., 2020; Nguyen et al., 2023), which can pose a risk of security breaches if not managed carefully. Due to the role of integrating ICT in affecting the success of modern teaching processes and providing meaningful learner experiences, it is important to conduct studies on the antecedents and consequences of this variable.

Several studies showed that teachers' technology integration is affected by and requires support from various components. Adarkwah (2021) underscored the essential role of curriculum, training and development, organizational aspects, leadership, and school culture in achieving effective technology integration. Meanwhile, other studies categorized factors affecting this variable into two categories, such as internal and external (Cheng et al., 2020). The external factors include school principals, pedagogical, technical, and administrative support, and the availability of digital learning resources (Cheng et al., 2020; Chiu, 2017). The internal factors focus more on psychological aspects related to technology, such as teachers' attitudes and beliefs (Farjon et al., 2019), interests, and concerns about using innovations (Chiu and Churchill, 2016; Hsu, 2016). Previous reports also examined the factors affecting teachers' intentions to adopt technology in the classroom. The results showed that self-efficacy, attitudes, and perceived ease of use significantly predicted intention (Li et al., 2016).

Due to the wide variety of results related to integrating educational technology in schools, several variables affect the development of studies on this phenomenon. This study explored the variables affecting teachers' technology integration by sampling teachers in junior high schools in Balikpapan City, East Kalimantan Province, Indonesia. Furthermore, as a developing country, Indonesia has its own unique complexity and challenges. Aksal and Gazi (2015) stated that technology integration in developing countries still faces significant challenges. Technology adoption differed between developed and developing countries, with developed countries being more advanced in infrastructure.

The environmental and contextual differences and strategies used in developed countries cannot be directly applied in developing areas. Rural areas or the size of the community or district where the schools were located could also affect integration.

This study considered the digital leadership of school principals and self-efficacy as independent variables that affect technology integration in education. In addition, effective digital leadership by school principals was posited to positively impact teachers' technology integration during teaching and learning. Principals who possess skills and knowledge in technology usage and can facilitate its use by teachers are expected to create an environment in schools that encourages adoption (AlAjmi, 2022). Appropriate support and guidance can increase the motivation and confidence among educators in using technology, thereby enhancing the effectiveness of learning and the overall learning experience of students (AlAjmi, 2022). Previous studies found that the digital leadership of school principals was grouped into three categories: technology use, managerial skills, and individual skills. To realize digital transformation in K-12 education, principals must first demonstrate their digital leadership and actively support the development of a digital learning culture in schools (Karakose et al., 2021).

In addition, a period-based analysis revealed that technology management, with a focus on virtual teams, was the dominant theme during the first period. The emphasis shifted to technology in the second period, while the third period focused on COVID-19, virtual reality, and digital technology as the central themes. The thematic evolution analysis indicated that virtual leadership was a significant study theme in the first and second periods, while virtual teams became prominent in the second. Electronic and technology leadership were key themes in the second and third periods. Digital leadership, COVID-19, and virtual reality emerged as important focus areas during the third period. Technology leadership, consistently present across all three periods, was well-developed (Karakose et al., 2022).

Additionally, meaning in work was used as a mediating variable in this relationship. Based on observation, there are no studies on the mediating role of the variable.

According to Lee (2015) and Suyatno et al. (2021), meaning in work comprises four important attributes: the meaning of work, experiencing positive emotions at the workplace, meaningful purposes and goals of work, and work as a part of life toward meaningful

existence. Meaning in work was predicted to mediate the relationship between the independent and dependent variables based on the aforementioned attributes. This study was conducted because Indonesia was a developing country with a different technological development context than Western countries. Access to technology, teachers' readiness, and institutional support greatly determined the integration of teachers' technology in learning. Therefore, this study aims to test the conceptual model of the meaning of the work variable in mediating the relationship between digital leadership and self-efficacy variables with teachers' technology integration. First, this study discussed the problems and then described the method used: selecting the appropriate approaches, data collection, and data analysis techniques. The following section presents the data analysis results using a structural equation model. The last section describes the discussion, conclusions, and several recommendations for further studies. The results of this study were expected to offer a framework for management at the macro (government through the Ministry of Education and Culture), meso (educational agencies), and micro levels (school principals) in preparing for teachers' technology integration in education, leading to the successful implementation of innovations.

2 Methods

2.1 Study design

Using PLS-structural equation modeling (SEM) model analysis, we used a cross-sectional study design to develop a conceptual model by identifying antecedent and consequent variables related to meaning in work for teachers (Collier, 2020). Furthermore, the study procedures comprised four key variables: meaning in work, digital leadership and self-efficacy, and teachers' technology integration, represented as variables Z, X, and Y, respectively.

2.1.1 Population and respondents

The study population included all junior high school teachers, both public and private, in Balikpapan City, East Kalimantan Province, both public and private. The participants included 1,449 teachers—1,053 women and 396 men—distributed across nine subdistricts.

A convenience sampling technique (Emerson, 2021) was used to select a total of 200 teachers for the study, as shown in Table 1.

Table 1 shows that there were more female participants than males. The majority of the participants held a bachelor's degree, making up 80% of the group. In terms of teaching experience, the majority had been teaching for 1–5 years. Additionally, the largest age group was young teachers between 21 and 30 years old, accounting for 41% of the population. Regarding the subjects taught, religious studies were the most common at 21%, followed by natural sciences at 14%, and English at 11.5%. Overall, the demographics reflected a range of differences in gender, education level, teaching experience, and subject areas.

TABLE 1 Demographics of respondents.

Profile	Description	Number of respondents	Percentage
Gender	Men	65	42%
	Women	135	58%
Educational level	Bachelor's degree	161	80%
	Master's degree	18	9%
	Doctoral Degree	0	0%
	Others	21	11%
Teaching experience	1–5 years	81	40%
	6–10 years	42	21%
	11–15 years	31	16%
	16–20 years	28	14%
	21–25 years	6	3%
	26–30 years	12	6%
Age	21–30 years	82	41%
	31–40 years	60	30%
	41–50 years	42	21%
	51–60 years	16	8%
Field of study	Religious education	46	23%
	Natural sciences	28	14%
	Social sciences	8	4%
	Indonesian language	21	10.5%
	English language	23	11.5%
	Arabic language	10	5%
	Civic education	7	3.5%
	Art and culture	6	3%
	Physical education	3	1.5%
	Guidance and counseling	7	3.5%
	Mathematics	12	6%
	Thematic/class Teacher	10	5%
	Others	19	10%

2.2 Data collection instruments

The data collection process was conducted using four questionnaires: (a) a digital leadership questionnaire adopted from Bass and Riggio (2018), (b) a self-efficacy questionnaire adopted from Lam et al. (2010), (c) a meaning-in-work questionnaire adapted from Steger et al. (2012), and (d) a teachers' technology integration questionnaire adopted from Allen and Meyer (1990). Furthermore, each variable was developed into several indicators, as shown in Table 2.

The questionnaires were created using a Likert scale with scores ranging from 1 to 5, and the data collected were in the form of intervals. Scores 1, 2, 3, 4, and 5 represented "strongly disagree," "disagree," "neutral," "agree," and "strongly agree," respectively. For negative statements, the scores were reversed, with 5, 4, 3, 2, and 1 representing "strongly disagree," "disagree," "neutral," "agree," and "strongly agree," respectively.

This study instrument was adapted from the theory developed by previous studies. Based on this theory, the indicators of each variable were adapted, as shown in Table 2. Each indicator was developed into questionnaire statement items with a proportional number of items from each indicator. Furthermore, the study used the expert judgment validity test using the services of 2 people with expertise in the field being studied. After being approved and declared suitable for use, the instrument was developed into a finished instrument. This study

conducted an outer model evaluation to test the validity and reliability of indicators from each latent variable. In smartPLS, there were two types of validity and reliability tests: construct reliability and validity and discriminant validity.

2.2.1 Construct reliability and validity

Validity and reliability testing using SmartPLS followed certain criteria: An indicator was considered valid when the Average Variance Extracted (AVE) value was ≥0.50, and both the loading factor and rho-A values were ≥ 0.70 (Hair and Alamer, 2022). Additionally, an indicator was considered reliable when the composite reliability and Cronbach's alpha reliability values were ≥ 0.70. Based on the analysis results, this study obtained the validity and reliability results of indicators for latent variables, as shown in Tables 3, 4.

2.3 Discriminant validity

In SMART-PLS, discriminant validity could be assessed using the Fornell-Larcker criterion and the heterotrait-monotrait ratio (HTMT). Discriminant validity ensures that the measurement tool accurately measures the intended construct rather than overlapping with others. According to the Fornell-Larcker criterion, discriminant validity is considered good when the square root of the AVE for each construct is greater than the correlation between that construct and others. In this study, the Fornell-Larcker criterion values met the required criteria, as shown in Table 5.

Discriminant validity in this study was also reinforced by HTMT values, which had fulfilled the criteria, HTMT ≤0.90, as shown in Table 6.

Table 6 shows that all indicators of each latent variable met the criteria for validity and reliability in the measurement model, both in terms of construct reliability and validity, as well as discriminant validity. Therefore, this ensured that each indicator was accurate, consistent, and capable of precisely representing the results.

TABLE 2 Variable indicators.

Variable	Indicators	Code
Digital leadership	1. Visionary leadership	XD1
	2. Digital age learning culture	XD2
	3. Excellence in professional practice	XD3
	4. Systemic improvement	XD4
	5. Digital citizenship	XD5
Self-efficacy	1. Level dimension	XE1
	2. Strength dimension	XE2
	3. Generality dimension	XE3
Meaning in work	1. Positive meaning	Z1
	2. Meaning making through work	Z2
	3. Greater good motivations	Z3
Teachers' technology integration	1. TPACK	Y1
	2. TI-ICT tools	Y2
	3. TI-social media	Y3
	4. TI-graphic and dynamic visualizations	Y4

2.4 Data analysis

This study used SEM for data analysis using AMOS software (Collier, 2020). Furthermore, SEM analysis was used to examine the relationship between digital leadership and self-efficacy as exogenous variables, and meaning in work and teacher's technology integration as mediating and endogenous variables. AMOS was selected for SEM analysis because it allowed for the analysis of multi-group data and the availability of SEM diagram tools to evaluate the outer model, inner moderation, and first-order and second-order models. The initial AMOS-SEM model tested in this study is presented in Figure 1.

The hypotheses tested in this study are presented below:

H1: Digital leadership affects the meaning in work for teachers.

H2: Digital leadership affects teachers' technology integration.

H3: Self-efficacy affects meaning in work.

H4: Self-efficacy affects teachers' technology integration.

H5: Meaning in work affects teachers' technology integration.

H6: Digital leadership affects teachers' technology integration through meaning in work.

H7: Self-efficacy affects teachers' technology integration through meaning in work.

3 Findings

The study results showed the outcome of several data analyses, which consisted of normality tests, Cronbach alpha values, measurement model analysis, structural models, and correlation tests.

TABLE 3 Construct reliability and validity results.

Variable	Cronbach's alpha	Composite reliability (rho-A)	AVE	Predicate
Digital leadership (DL)	0.930	0.936	0.780	Valid and reliable
Self-efficacy (SE)	0.701	0.700	0.593	Valid and reliable
Meaning in work (MIW)	0.802	0.881	0.711	Valid and reliable
Teachers' technology Integration (TTI)	0.767	0.765	0.588	Valid and reliable

TABLE 4 Loading factor results.

	Outer loadings
XD1 < - DL	0.874
XD2 < - DL	0.896
XD3 < - DL	0.892
XD4 < - DL	0.892
XD5 < - DL	0.861
XE1 < - SE	0.821
XE2 < - SE	0.728
XE3 < - SE	0.760
Y1 < - TTI	0.749
Y2 < - TTI	0.813
Y3 < - TTI	0.780
Y4 < - TTI	0.721
Z1 < - MIW	0.996
Z2 < - MIW	0.901
Z3 < - MIW	0.916

TABLE 5 Fornell-Larcker criterion.

	DL	MIW	SE	TTI
DL	0.883			
MIW	0.371	0.843		
SE	0.370	0.438	0.770	
TTI	0.451	0.152	0.388	0.767

TABLE 6 Heterotrait-monotrait ratio (HTMT).

	Heterotrait-monotrait ratio (HTMT)
MIW < -> DL	0.403
SE < -> DL	0.465
SE < -> MIW	0.565
TTI < -> DL	0.513
TTI < -> MIW	0.189
TTI < -> SE	0.532

3.1 Normality test

This study conducted a data normality test by examining the univariate and multivariate normality indices. Univariate distribution was evaluated based on outliers, skewness, and kurtosis values, while multivariate distribution was assessed through multivariate normality and the presence of outliers. In addition, data normality was determined by the critical ratio (CR) values for skewness and kurtosis. Data were considered normal, both univariately and multivariately, if the c.r. kurtosis value was <3 at a 5% significance level (Ulmann, 2021). As shown in Table 7, the CR values for skewness and kurtosis were < 3, indicating that the data met the criteria for univariate normality.

3.2 Cronbach alpha

Cronbach's alpha, α, indicated the questionnaire's reliability. The α value must be at least 0.7 or more to be accepted (Hair et al., 2012), as shown in Table 8.

In this study, all questionnaire items from each variable met Cronbach's alpha reliability criteria because the α value was more than 0.6, as shown in Table 9.

3.3 Measurement model

The measurement model represented the relationship between the values of observed indicator variables and unobserved latent variables through confirmatory factor analysis (CFA), which assesses the indicator variable's validity. The indicator variables presented in Table 2 passed the validity test with CFA analysis in AMOS. In addition, the validity of the indicators was determined using the CFA test, with a criterion of CR value >1.96 and a probability (*p*-value) of <0.05. The validity results for each indicator in this study are presented in Table 10.

A CR value greater than 1.96 and a probability less than 0.05, as shown in Table 10, indicated that each indicator variable met the validity requirements and adequately reflected the study variables. Additionally, validity was assessed by examining the standardized loading estimate values (loading factors), with values greater than 0.5 considered acceptable, as presented in Table 11. The results demonstrated that the indicators for each research variable exceeded the required loading factor threshold, confirming the validity of each indicator.

Apart from validity testing, instrument reliability testing was also conducted using construct reliability and variance-extracted tests for each latent variable. The accepted threshold value (cut-off) for construct reliability testing was >0.70, while the recommended threshold value (cut-off) for variance extracted testing was >0.50. Based on Table 12, all instruments in this study met the reliability requirements from both construct reliability and variance extracted tests.

3.4 Structural model

The structural model illustrated the relationships between latent variables, showing their position as either exogenous, intervening, or endogenous. The validity of the structural model was measured by the value of the GOF (goodness of fit) or model fit test by observing the achievement of conformity criteria indices and their cut-off values. These indices included GFI, AGFI, CMIN/DF, TLI, CFI, and RMSEA. GFI and AGFI served as references to depict the level of model fit within a range of values from 0 (poor fit) to 1.0 (perfect fit). In addition, GFI and AGFI values approaching 1.0 showed that the tested model had a good fit (Arbuckle, 2014). The results obtained in this study, with a GFI value of 0.888 and AGFI of 0.840, showed that the model could be considered a good fit. CMIN/DF and TLI served as indicators to measure the level of model fit in the study, with criteria of CMIN/DF ≤ 2.0 and TLI ≥ 0.95 (Fogarty et al., 2020). The analysis results of this study indicated a CMIN/DF value of 2.248 and a TLI

value of 0.917, thereby meeting the acceptance criteria for the model. The next two criteria determining the level of model acceptance were (a) CFI with a criterion value ranging from 0 to 1, where the closer the value was to 1, the higher the level of model acceptance, and (b) RMSEA with a criterion of ≤0.08. In this study, CFI was obtained as 0.933 and RMSEA as 0.081, both of which showed a high level of model acceptance, as presented in Table 13.

3.5 Correlation/hypothesis test

Hypothesis testing in SEM using AMOS was conducted by examining the CR and *p*-values in the output regression weights table. A hypothesis was considered accepted if the CR value exceeded 1.96 and the p-value was less than 0.05. The strength of the relationships between variables was determined by the estimated values. The results of the hypothesis testing are presented in Table 14.

Based on Table 14, all proposed hypotheses were accepted because the CR value was >1.96 and $p < 0.05$, with the following description:

a. Hypothesis 1, which posited that digital leadership affected teachers' sense of meaning in work, was accepted and had a significant correlation because the CR value was 2.078 and $p < 0.005$.
b. Hypothesis 2, which posited that digital leadership affected teachers' technology integration, was accepted and had a significant correlation because the CR value was 3.316 and $p < 0.005$.
c. Hypothesis 3, which posited that self-efficacy affected meaning in work, was accepted and had a significant correlation because the CR value obtained was 4.147 and $p < 0.005$.
d. Hypothesis 4, which posited that self-efficacy affected teachers' technology integration, was accepted and had a significant correlation because the CR value obtained was 3.487 and $p < 0.005$.
e. Hypothesis 5, which posited that meaning in work affected teachers' technology integration, was accepted and had a significant correlation because the CR value obtained was 3.081 and $p < 0.005$.
f. Hypothesis 6, which posited that digital leadership affected teachers' technology integration through meaning in work, was declared acceptable and correlated significantly because the CR value >1.96 and $p < 0.005$.
g. Hypothesis 7, which posited that self-efficacy affected teachers' technology integration through meaning in work, was declared accepted and had a significant correlation because the values obtained were CR > 1.96 and $p < 0.005$.

4 Discussion

The results obtained provided answers to the seven developed hypotheses and were summarized below:

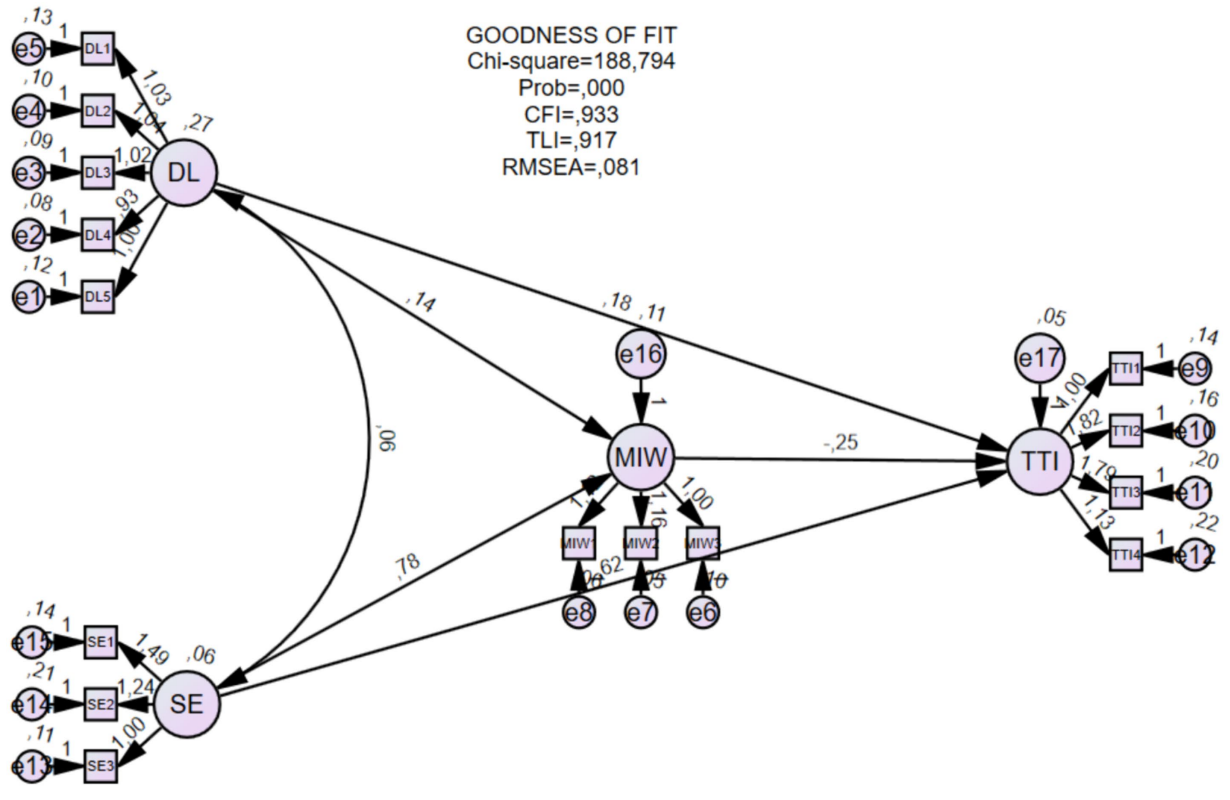

FIGURE 1
The results of the AMOS-SEM model tested.

TABLE 7 Results of the data normality test.

Variable	Min	Max	Skew	C.R	Kurtosis	C.R
SE1	2.000	4.000	0.201	1.136	−0.095	−0.268
SE2	2.000	4.000	−0.380	−2.147	−0.953	−2.689
SE3	2.000	4.000	0.916	5.170	1.649	4.653
TTI4	1.000	4.000	−0.332	−1.872	1.494	4.215
TTI3	1.000	4.000	−0.428	−2.414	0.408	1.151
TTI2	1.000	4.000	−0.592	−3.342	1.152	3.250
TTI1	1.000	4.000	0.071	0.401	2.634	7.431
MIW1	2.000	4.000	0.203	1.145	−1.169	−3.299
MIW2	2.000	4.000	0.230	1.300	−0.945	−2.665
MIW3	2.000	4.000	0.223	1.260	−1.152	−3.249
DL1	1.000	4.000	−0.673	−3.796	1.058	2.985
DL2	1.000	4.000	−0.636	−3.588	1.619	4.569
DL3	1.000	4.000	−0.369	−2.080	0.784	2.212
DL4	1.000	4.000	−0.144	−0.815	0.744	2.098
DL5	1.000	4.000	−0.513	−2.896	1.184	3.340
Multivariate					82.785	25.331

4.1 Digital leadership affects meaning in work and teachers' technology integration

The results showed that school principals' digital leadership significantly affected teachers' sense of meaning in work and technology integration. Furthermore, school principals who could affect, guide, and motivate teachers to develop and implement education and teaching in the digital era had an impact on improving teachers' performance in fulfilling the learning needs of Generation Z. The characteristics of Generation Z, who were closely connected to technology, required a more modern approach to the learning process. Therefore, teachers must become more tech-savvy and accustomed to integrating technology into teaching. This demand was easier to fulfill with support from the school, primarily through the digital leadership of the school principal. Several studies showed that organizational support, including support from the school principal, positively impacted the meaning of work (Akgunduz et al., 2018). Digital leadership also provided teachers with a real experience in using technology during teaching. This experience ultimately led to the emergence of meaning in work for teachers. Meaning in work was affected by experiences and the happiness experienced. Other studies also showed that digital leadership was correlated with improved work performance and employee well-being because employees performed tasks more easily with technology (Artuz and Bayraktar, 2021; Zeike et al., 2019).

This was also applicable to the field of education, where digital leadership significantly affected teachers' happiness and work motivation due to the feeling of being assisted by technology facilities, openness, and flexibility in the teaching process supported by school principals. The results reinforced the idea that school principals' digital leadership significantly impacted teachers' technology integration. Encouragement from principals who understood the need for technology in the learning process affected the use of technology. This was supported by previous studies that identified various components, such as the curriculum, teachers' training and competence development, organization, leadership, and school culture, as important factors for the success of technology integration (Adarkwah, 2021). According to previous studies, support from school principals, the availability of digital learning resources, and pedagogical, technical, and administrative support had significant influence (Cheng et al., 2020). School principals with digital leadership could build a digital culture in schools (Karakose et al., 2021). Therefore, digital leadership was an external factor and a focus on innovation in teaching by teachers, which ultimately impacted improving student achievement. Several studies showed that during the pandemic, the use of digital learning technology enhanced the quality of education (König et al., 2020b), specifically in improving competence and students' satisfaction with the learning experience (Hasin and Nasir, 2021).

4.2 Self-efficacy affects meaning in work and teachers' technology integration

The results showed that self-efficacy significantly affected the sense of meaning in work and teachers' technology integration. Furthermore, self-efficacy, showing that teachers had belief and confidence in carrying out tasks, achieving goals, and solving problems, impacted the sense of meaning in work. This variable was closely related to respondents' engagement in improving students' achievement and school development. Higher levels of self-efficacy were associated with greater engagement and an increased likelihood of finding meaning in work (Van Wingerden and Van Der Stoep, 2018). Based on the results, engagement, as a consequence of self-efficacy, was an indicator to determine whether teachers found meaning in their work. Teachers' self-efficacy could be used to determine the level of belief that the work was the center of their lives and provide a measure of the psychological identification with the profession. The stronger one's belief in the value of their work, the more difficult it became for them to disengage from it, thereby imbuing the profession with greater significance.

In this study, self-efficacy also served as a driver to enhance teachers' competence in the 21st century by integrating technology into the learning process. Furthermore, it was a crucial construct of incompetence due to the role in predicting the ability to adapt to technology-based teaching methods (König et al., 2020b). Teachers with high self-efficacy were more likely to adapt to technological advancements and master teaching technology as professionals during challenges. The level of pedagogical confidence and belief in the value of technology use could be a barrier to using technological tools in the classroom. This showed that self-efficacy significantly and positively affected technology integration, as reported in previous studies (Farjon et al., 2019). Similar results were also obtained by Clipa et al. (2023), which correlated with teachers' behavior, self-efficacy, and IT skills.

4.3 Meaning in work affects teachers' technology integration

Hypothesis 5, meaning in work affected teachers' technology integration, was accepted and had a significant correlation as the CR

TABLE 8 Cronbach's alpha level of reliability.

Cronbach's alpha score	Level of reliability
0.0–0.20	Less reliable
>0.20–0.40	Rather reliable
>0.40–0.60	Quite reliable
>0.60–0.80	Reliable
>0.80–1.00	Very reliable

TABLE 9 Cronbach's alpha results in the study.

Variable	Score of Cronbach's Alpha (α)	Description
Teacher technology integration (TTI)	0.777	Reliable
Digital leadership (DL)	0.929	Very reliable
Self-efficacy (SE)	0.651	Reliable
Meaning of work (MIW)	0.893	Very reliable
Total	0.878	Very reliable

TABLE 10 CR value and probability in the CFA test.

			Estimate	S.E.	C.R.	P	Label
MIW	<---	DL	0.142	0.069	2.078	0.038	
MIW	<---	SE	0.785	0.189	4.147	***	
TTI	<---	MIW	−0.252	0.082	−3.081	0.002	
TTI	<---	SE	0.623	0.179	3.487	***	
TTI	<---	DL	0.184	0.055	3.316	***	
DL5	<---	DL	1.000				
DL4	<---	DL	0.935	0.063	14.863	***	
DL3	<---	DL	1.023	0.069	14.919	***	
DL2	<---	DL	1.045	0.071	14.758	***	
DL1	<---	DL	1.026	0.074	13.863	***	
MIW3	<---	MIW	1.000				
MIW2	<---	MIW	1.156	0.085	13.678	***	
MIW1	<---	MIW	1.117	0.084	13.362	***	
TTI1	<---	TTI	1.000				
TTI2	<---	TTI	1.824	0.239	7.619	***	
TTI3	<---	TTI	1.788	0.240	7.458	***	
TTI4	<---	TTI	1.134	0.182	6.225	***	
SE3	<---	SE	1.000				
SE2	<---	SE	1.239	0.218	5.679	***	
SE1	<---	SE	1.486	0.232	6.399	***	

Description: *** = p value < 0.001.

value was 3.081 and $p < 0.005$. Meaning in work refers to individuals' beliefs, motivation, and sense of purpose regarding their role in a job. In addition, it significantly impacted teachers' technology integration in the educational context.

TABLE 11 Standardized loading estimate value.

			Estimate
DL5	<---	DL	0.833
DL4	<---	DL	0.867
DL3	<---	DL	0.869
DL2	<---	DL	0.863
DL1	<---	DL	0.829
MIW3	<---	MIW	0.790
MIW2	<---	MIW	0.909
MIW1	<---	MIW	0.880
TTI1	<---	TTI	0.606
TTI2	<---	TTI	0.794
TTI3	<---	TTI	0.751
TTI4	<---	TTI	0.571
SE3	<---	SE	0.606
SE2	<---	SE	0.563
SE1	<---	SE	0.710

Teachers who perceived technology as having clear and relevant meaning in their work were more likely to be motivated to adopt and integrate it into their teaching practices. Meaning in work could reinforce perceptions of the value and relevance of technology in achieving learning goals, thereby enhancing the desire and engagement for its use as an effective learning tool.

The presence of meaning in work also helped overcome barriers that occurred in teachers' technology adoption. When teachers felt that using technology contributed positively to achieving learning goals or enhancing students' learning experiences, it alleviated their uncertainties or concerns (Fishman et al., 2016). Therefore, meaning in work could help create a supportive environment and motivate teachers to integrate technology into teaching.

4.4 Digital leadership affects teachers' technology integration through meaningful in-work

Hypothesis 6, which posited that digital leadership affected teachers' technology integration through meaning in work, was accepted and had a significant correlation as the CR value >1.96 and $p < 0.005$. In the context of technology integration by teachers, effective digital leadership had a positive impact through the moderating variable of meaning in work. When school principals created a work environment that provided clear meaning and purpose regarding using technology in learning, it strengthened the relationship between digital leadership and teachers' technology integration (Sunu, 2022). Meaning in work can also drive teachers' motivation and engagement in adopting and integrating innovations into their teaching practices (Schmitz et al., 2023). When educators felt that using technology could help achieve larger learning goals or add value to students'

TABLE 12 Construct reliability and variance extracted values.

No	Variable	Indicator	Standard loading	Kuadrat standard loading	Measurement error	Construct reliability	Variance extracted
		DL 1	0.829	0.687	0.313		
		DL 2	0.863	0.745	0.255		
		DL 3	0.869	0.755	0.245	0.930	0.727
		DL 4	0.867	0.752	0.248		
		DL 5	0.833	0.694	0.306		
		∑	4.261	3.633	1.367		
1	DL	∑2	18.15612	5.000			
		SE 1	0.71	0.504	0.496		
		SE 2	0.563	0.317	0.683	0.661	0.396
		SE 3	0.606	0.367	0.633		
		∑	1.879	1.188	1.812		
2	SE	∑2	3.530641	3.000			
		MIW 1	0.88	0.774	0.226		
		MIW 2	0.909	0.826	0.174	0.896	0.742
		MIW 3	0.79	0.624	0.376		
		∑	2.579	2.225	0.775		
3	MIW	∑2	6.651241	3.000			
		TTI 1	0.606	0.367	0.633		
		TTI 2	0.794	0.630	0.370	0.778	0.472
		TTI 3	0.751	0.564	0.436		
		TTI 4	0.571	0.326	0.674		
		∑	2.722	1.888	2.112		
4	TTI	∑2	7.409284	4.000			

learning experiences, it provided motivation (Suyatno et al., 2020).

The moderating variable of meaning in work could further strengthen the positive effect of digital leadership on teachers' technology integration by reducing barriers to adoption. School principals who help teachers recognize the value and relevance of technology in their roles can help alleviate uncertainty or concerns (Richardson et al., 2021). Consequently, educators became more receptive to adopting and integrating technology into their teaching practices.

4.5 Self-efficacy affects teachers' technology integration through meaning in work

Hypothesis 7, which posited that self-efficacy affected teachers' technology integration through meaning in work, was accepted and had a significant correlation as the CR value >1.96 and $p < 0.005$. In the context of technology integration by teachers, teachers' self-efficacy in their ability to use technology had a significant effect. The moderating variable "meaning in work" strengthened the relationship between self-efficacy and technology integration. When educators had high self-confidence in their ability to use technology, the presence of meaning in work reinforced their motivation to integrate technology into teaching practices (winter et al., 2021). When teachers felt that technology could help achieve larger learning goals or provide added value to students' learning experiences, self-confidence for adoption was often further strengthened.

The moderating variable of meaning in work also helped reduce barriers to technology integration among teachers. When teachers perceived that technology had clear relevance to their work, it helped them overcome uncertainty or concerns (Kimmons et al., 2020). With strong support from the work environment, which provided a clear sense of meaning and purpose related to using technology in learning, educators were more confident and motivated to face challenges and overcome barriers during the adoption process.

5 Conclusion

This study aimed to test a conceptual model examining the mediating role of the meaning of the work variable in the relationship between digital leadership and self-efficacy with teachers' technology integration. The results indicated that digital leadership, self-efficacy, and the meaning in work significantly influenced teachers' technology integration. The results also showed that digital leadership not only

TABLE 13 Goodness of fit indices.

Goodness of fit indices	Cut–off value	Analyses results	Model evaluation
CMIN/DF	≤ 2.00	2.248	Fit
RMSEA	≤ 0.08	0.081	Fit
GFI	≥ 0.90	0.888	Fit
AGFI	≥ 0.90	0.840	Marginal Fit
TLI	≥ 0.95	0.917	Marginal Fit
CFI	≥ 0.95	0.933	Fit

TABLE 14 Regression weight output.

			Estimate	S.E.	C.R.	P
MIW	<---	DL	0.142	0.069	2.078	0.038
MIW	<---	SE	0.785	0.189	4.147	***
TTI	<---	MIW	−0.252	0.082	−3.081	0.002
TTI	<---	SE	0.623	0.179	3.487	***
TTI	<---	DL	0.184	0.055	3.316	***

affected the level of meaning in teachers' work but also directly influenced technology integration, while self-efficacy had a direct effect on both aspects. In addition, the meaning in work directly impacted teachers' technology integration and acted as a mediator between digital leadership and self-efficacy in shaping technology integration.

The study findings had specific benefits: First, for teachers, understanding the mediating role of meaning in work could help them recognize the importance of feeling purposeful and valued, which, in turn, enhanced their technology integration.

Training programs or activities that foster a sense of meaning in work could boost their motivation and effectiveness. Second, educational staff could design more effective training programs by considering the role of digital leadership and meaning in work. Such programs would integrate components that promote digital leadership and strengthen meaning in work, ultimately supporting technology integration. Third, policymakers could use these insights to develop policies that promote strong digital leadership, reinforce teachers' sense of meaning in their work, and enhance self-efficacy through training and resource support.

Furthermore, recognizing that meaning in work influences technology integration suggests that policies could be directed toward allocating resources to programs focusing on technology training and increasing teacher motivation and job satisfaction. Finally, the government could develop more effective national or regional strategies to improve school technology integration. This would include creating action plans that incorporate digital leadership, capacity building for teachers, and enhancing a sense of meaning in work.

This study offers two key recommendations. First, the results showed that digital leadership influences both the meaning of teachers' work and their ability to integrate technology. Therefore, principals should continuously develop and strengthen their digital leadership capacities. Consequently, the meaning of teachers' work and their ability to integrate technology into learning could improve. Second, the results showed that self-efficacy plays a role in shaping the meaning of teachers' work and technology integration. Schools should create supportive conditions and programs to increase teachers' self-efficacy.

The current study focused solely on junior high school teachers in Balikpapan City, East Kalimantan Province, Indonesia. Consequently, the results cannot be generalized to other areas. Further quantitative studies involving a larger and more diverse sample of teachers across Indonesia are recommended. Furthermore, the data were collected during the COVID-19 pandemic, when online learning was rapidly implemented due to the outbreak. Many teachers were required to integrate technology into their teaching, despite lacking adequate preparation and training. In a developing country like Indonesia, challenges to technology integration in education persist, largely due to high costs and institutional unpreparedness. Therefore, future studies should be conducted under normal circumstances, allowing teachers to integrate technology into teaching without the constraints imposed by emergency situations such as the COVID-19 pandemic.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Universitas Ahmad Dahlan Yogyakarta Indonesia. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

DP: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. SS: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. WW: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. LP: Resources, Writing – review & editing, Supervision. AM: Writing – review & editing, Visualization, Validation, Resources, Formal analysis, Data curation, Conceptualization. NN: Writing – review & editing, Resources, Data curation.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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