



Driving Digital Change: How Leadership Shapes Digital Literacy

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Abstract. This research explores the influence of digital leadership on the success of digital literacy, which consists of aspects of digital ethics, digital safety, digital skills, and digital culture. The sample data used in non-probability sampling with the purposive sampling technique in this study was 250 respondents and processed using the PLS-SEM method with SmartPLS 4. This research found that digital leadership had a significant positive effect on digital literacy. Effective digital leadership plays a vital role in fostering a digital ecosystem that is safe, inclusive, and ethically responsible. Digital leaders not only reinforce cultural values in the digital space but also promote awareness regarding cybersecurity and ethical conduct. Furthermore, they contribute to enhancing individuals' digital competencies by facilitating the acquisition of relevant skills. The outcomes of this study provide important input for the formulation of policies aimed at strengthening digital leadership development and expanding digital literacy across sectors to support a more integrated digital transformation process. In addition, this research emphasizes the need for stronger collaboration among stakeholders to ensure that digital literacy is accessible and inclusive for all segments of society. This can be realized through strategic investments in digital infrastructure, educational initiatives, and technological innovation.

Keywords: Digital Leadership; Digital Literacy; Ethics; Safety; Skills.

1. INTRODUCTION

The digital era, along with the technological revolution, has brought several challenges that need to be overcome. These challenges include information overload, reality, and virtuality bias, increased competition, ethical responsibilities, and impact on education (Ciaramello, 2023; Fischer et al., 2023; Levin & Mamlok, 2021; Solicitors, 2023; Vivian et al., 2019). This revolution has significantly transformed society by blurring the boundaries between reality and virtuality, humans, nature, and artifacts, while shifting from information scarcity to abundance and shaping a digital culture that encompasses spiritual, social, and technological dimensions (Levin & Mamlok, 2021).

Digital technology has caused a rethinking of leadership in the digital era, giving rise to digital leadership (Ahmadi et al., 2023; Bowen, 2021). Leaders are key actors in the development of digital culture, and they need to create relationships with many distributed stakeholders (Cortellazzo et al., 2019). Digital transformation involves leveraging information and communication technology to drive significant changes rather than mere automation (Kraus et al., 2021), with technology playing a critical role in future readiness, necessitating greater government attention (Sagarik, 2023), while leaders face emerging ethical challenges in the digital era, including privacy, security, and transparency (Bhatta, 2021). Williams et al. (2022) explained that the digital literacy movement, especially during the COVID-19 pandemic, the digital literacy movement helped the public access accurate information and use

time productively. Key components include cultural awareness, cognitive content evaluation, constructive communication, responsible and confident digital behavior, creativity in problem-solving, critical analysis, and social responsibility.

The relationship between digital technology and leadership is complex, and leaders are responsible for verifying the appropriateness of the technological tools adopted or applied in the organizational context (Cortellazzo et al., 2019). Digital Leadership focuses on facilitating the critical transformations necessary to successfully navigate changes in organizational structures, value chains, engagement in digital ecosystems, and rapidly evolving customer expectations (Imhof & Grivas, 2022). Digital leaders must become agents of change and create harmony between humans and technology, promote a strong teamwork orientation, and embrace the human element in technology. Leaders must balance technological advances with ethical responsibilities, as a digital leadership style enables education managers to make intelligent and ethically informed decisions (Ahmadi et al., 2023; Bowen, 2021). Digital ethics is a young phenomenon and research field, with existing literature focusing on internal processes and strategies. Very little research has addressed the digitalization of organizational management, and even less is known about the role of digital leadership in the digitalization process of enterprises (Wang et al., 2022).

Digital leadership is a relatively new and widely discussed research topic, but its definition and understanding remain vague. Digital leadership refers to the capabilities and behaviors that leaders need to ensure the competitiveness of their organizations or community in the digital realm, *state of the art* in this research. Apart from that, digital leadership also involves changing mindsets to create business value in new ways related to digital (Brunner et al., 2023). Leaders with a digital transformation mindset, also known as “digital leaders,” can build collaborative organizational networks and discover digital competencies (AlNuaimi et al., 2022). The impact of the ongoing digital revolution is enormous, and digital leadership is about blending technology and traditional communications and simply using more ICT-mediated communications (Van Wart et al., 2019). Overall, digital leadership is an important aspect of modern leadership, especially in the context of digital transformation and innovation. Leaders who have digital skills and can utilize digital technology effectively can have a positive impact on organizational performance (Eberl & Drews, 2021; Kristensen & Andersen, 2023; Pepe & Pavone, 2021). Although digital leadership in the educational environment is very interesting and important because appropriate practices have beneficial effects on all aspects of the functioning of educational organizations (Antonopoulou et al., 2020; Jameson et al., 2022), research that explores digital leadership in a broader context, particularly its relationship

with key dimensions of digital literacy such as digital ethics, digital safety, digital skills, and digital culture, remains limited. This highlights the need for further investigation to deepen our understanding of how digital leadership contributes to the development of comprehensive digital literacy in various societal and organizational settings.

2. LITERATURE REVIEW

Digital Leadership

Digital Leadership focuses on facilitating the critical transformations necessary to successfully navigate changes in organizational structures, value chains, engagement in digital ecosystems, and rapidly evolving customer expectations (Imhof & Grivas, 2022). Digital leadership emphasizes five key abilities for leaders: creativity, thinking and inquisition, curiosity, deep knowledge, and a global mindset (Wang et al., 2022). Digital leaders play an important role in the success of digital transformation because they can inspire organizational and employee confidence in disruptive and sometimes risky initiatives (Abbu et al., 2020). Effective leadership in the modern era, especially in the field of digital transformation and innovation, is very important. Leaders who are equipped with digital skills and the ability to utilize digital tools can have a good influence on organizational effectiveness and employee behavior (Eberl & Drews, 2021; Kristensen & Andersen, 2023; Pepe & Pavone, 2021).

Excellence in Professional Practice

Excellence in professional practice involves a deep understanding of the subject matter to be taught and effectively delivered to students (Christopoulos & Sprangers, 2021). Educators must possess strong pedagogical skills to ensure the successful transfer of knowledge and abilities to learners. Additionally, school leaders are responsible for fostering an environment that encourages innovation and professional growth, empowering students to engage with digital and technological tools in their education. Integrating information technology helps ensure that students remain knowledgeable and up-to-date with current advancements in technology for learning purposes (Botham, 2018).

Visionary Leadership

Visionary leadership is a key element of digital leadership, as it provides a clear direction that enhances decision-making effectiveness. Integrating visionary leadership enables school principals to identify challenges more accurately and align decisions with both short- and long-term objectives. Staying informed about technological advancements also allows educators to effectively convey leadership and development visions to stakeholders. (Botham, 2018). School leaders are responsible for securing and managing the necessary resources and

connections for digital-age learning while driving development, inspiring collaboration, and implementing a shared vision for integrating technology to foster transformation and excellence in educational settings.

Digital-age Learning Culture

In the digital age, educators are increasingly tasked with incorporating and sustaining technology as a primary learning resource (Buchholz et al., 2020). School leaders play a pivotal role in fostering and maintaining a learning culture that embraces modern digital platforms and technological advancements (Figueiredo, 2021). The success of digital leaders depends on their commitment to fostering a digital-age learning culture by effectively understanding and implementing strategies to integrate a digital learning framework within their organizations.

Digital Citizenship

Digital citizenship involves behaviors that support positive engagement in digital communities, with school principals playing a key role in fostering digital culture by promoting awareness of ethical, legal, and social responsibilities. Furthermore, they must ensure that learners have access to the necessary resources to address their technological needs (ISTE, 2024). Digital citizenship involves adopting computer science, technological platforms, and emerging trends in digital development (Mihardjo et al., 2019b). Incorporating digital citizenship into digital leadership enhances leaders' ability to address the diverse needs of stakeholders while staying informed about internal and external advancements and innovations.

Systemic Improvement

Systemic improvement involves school leaders fostering ongoing progress in digital learning while empowering students to develop their unique skills and competencies (Štrukelj et al., 2019). Systemic improvement enables meaningful changes while maintaining leadership stability, enhancing efficiency in both the short and long term, and identifying areas within digital leadership that require enhancement (Kane et al., 2019). Effective continuous improvement requires leaders to manage resources and technology efficiently, with school principals ensuring infrastructure supports seamless teaching and learning integration. (ISTE, 2024).

Digital Literacy

Osterman (2012) explains that digital literacy refers to the ability to use digital technology effectively and efficiently to find, evaluate, create, and communicate information. It involves a range of skills, including technical skills, critical thinking, and social and emotional intelligence. The modernized digital literacy framework encompasses competencies

such as visual interpretation, creative content utilization, nonlinear navigation, critical evaluation of information, understanding online social and emotional dynamics, and multitasking skills akin to video games or online teaching (Eshet-Alkalai, 2012). Key factors in fostering digital literacy include recognizing cultural diversity, promoting positive communication, enhancing cognitive and critical analysis skills, encouraging innovative problem-solving, and emphasizing social responsibility (Williams et al., 2022). Digital literacy is a concept and practice that goes beyond simply emphasizing skills to master technology and digital media but also involves engaging in digital media mediation processes productively and responsibly, including digital ethics, digital safety, digital skills, and digital culture (Kurnia et al., 2021; Kurnia & Astuti, 2017).

Digital Ethics

Digital ethics addresses the ethical principles and considerations in digital technology, focusing on issues like privacy, data protection, algorithmic bias, transparency, accountability, social and environmental impacts, and cybersecurity in a rapidly transforming society (Levitskaya & Straka, 2021; Mirghaderi et al., 2023; Santoro & Costa, 2021). Kusumastuti et al. (2021) define digital ethics as an individual's ability to realize, model, adapt, rationalize, consider, and develop digital ethical governance (netiquette) in everyday life. The use of digital media must be directed at ethical intentions, attitudes, and behavior for the common good and to improve the quality of humanity, especially in countries with multicultural contexts, making digital ethics very relevant to be understood and practiced by all citizens.

Digital Safety

Digital safety relates to the responsible and safe use of digital technologies, encompassing a wide range of practices to protect individuals and organizations in digital spaces, including cybersecurity, online privacy, media literacy, and digital well-being (Biezā, 2020; Kim & Smidts, 2015; O'Shea & Suzor, 2020; Peng & Yu, 2022). In general, digital safety can be defined as a process to ensure that the use of digital services, both online and offline, can be done safely and comfortably (Sammons & Cross, 2017). Not only to secure the data we have, but also to protect confidential personal data. Digital safety is an individual's ability to recognize, develop, implement, analyze, and increase awareness of digital safety in everyday life (Adikara et al., 2021).

Digital Skills

Digital skills refer to the abilities and knowledge required to use digital technology and tools effectively. The specific digital skills required for a particular job or industry may vary depending on the nature of the job. For example, the renewable energy industry requires skills

in smart technologies such as artificial intelligence, Big Data, and the Internet of Things (Arcelay et al., 2021). Digital skills refer to an individual's ability to understand and use ICT, encompassing knowledge of digital tools, the internet, data management, messaging, social media, digital wallets, online markets, and digital transactions (Kurnia et al., 2021; Monggilo et al., 2021).

Digital Culture

Digital culture is a complex and multifaceted concept that encompasses a wide range of phenomena related to the use of digital technologies. It can be understood as cultural practices, values, and behaviors that have emerged in response to the widespread use of digital technologies, including cultural processes, internet slang, and virtual communities (Levitskaya & Straka, 2021; Petrova & Vasichkina, 2021). Digital Culture is an individual's ability to read, interpret, develop, study, and build awareness of identity, values, and the principles of the nation in the daily lives of citizens (Astuti et al., 2021).

The Relationship between Digital Leadership and Digital Literacy

The relationship between digital technology and leadership is complex, and leaders are responsible for verifying the appropriateness of the technological tools adopted or applied in the organizational context (Cortellazzo et al., 2019). Digital Leadership drives critical transformations in organizational structures, value chains, and digital ecosystems while addressing evolving customer expectations (Imhof & Grivas, 2022), emphasizing harmony between humans and technology, teamwork, and ethical responsibility (Ahmadi et al., 2023; Bowen, 2021). Despite its growing importance, digital ethics remains an emerging research field, with limited studies on the digitalization of organizational management and the role of digital leadership in enterprise digitalization processes (Wang et al., 2022).

Leaders with a digital transformation mindset can build collaborative organizational networks and discover digital competencies (AlNuaimi et al., 2022). The impact of the ongoing digital revolution is enormous, and digital leadership is about blending technology and traditional communications and simply using more ICT-mediated communications (Van Wart et al., 2019). Overall, digital leadership is an important aspect of modern leadership, especially in the context of digital transformation and innovation. Leaders who have digital skills and can utilize digital technology effectively can have a positive impact on organizational performance and employee behavior (Eberl & Drews, 2021; Kristensen & Andersen, 2023; Pepe & Pavone, 2021).

Leaders who have expertise in digital technology and demonstrate its effective use can foster a culture of digital literacy in their organizations by offering training, resources, and

encouraging a climate of experimentation and innovation, ultimately improving their team's digital literacy skills (UÇAR & TUTGAÇ, 2022). Digitally literate leaders are more adept at making informed decisions about digital technology and conveying those decisions effectively to their teams, enabling them to utilize digital tools strategically to achieve organizational goals by understanding their potential and constraints (Peng & Yu, 2022). In the digital era, digital leadership and literacy are essential for organizational success, as they enhance innovation, collaboration, and communication, driving performance and competitive advantage while avoiding competitive disadvantages (Henny et al., 2019; Mehmood, 2023; Sugiyarti & Sudibyo, 2023).

Hypothesis: Digital Leadership has a positive impact to Digital Literacy.

3. RESEARCH METHODS

This study employed a non-probability purposive sampling technique, selecting respondents based on their relevance to the research focus. The sample included individuals who met one or more of the following criteria: (1) currently employed or previously worked in environments that actively utilize digital technology, (2) active university students involved in learning processes that incorporate digital tools, and (3) entrepreneurs who have received mentoring in the use of digital technology for business development. This sampling approach ensures that participants have direct engagement with digital environments, making their insights particularly valuable for examining how digital practices are adopted and developed across various sectors. As noted by Sekaran & Bougie (2016), purposive sampling is appropriate when the research requires information from a specific group of people who alone possess the needed facts and experiences, and whose perspectives are critical to answering the research questions.

The Digital Leadership Assessment was utilized to evaluate the digital leadership capabilities of leaders across various sectors, including education, family, private enterprises, and government. This assessment includes five categories: visionary leadership (three items), digital-age learning culture (five items), excellence in professional practice (five items), systemic improvement (five items), and digital citizenship (four items) (AlAjmi, 2022; ISTE, 2009, 2024). To measure digital literacy, this study developed the initiative of Indonesia's Ministry of Communication and Information Technology (Adikara et al., 2021; Astuti et al., 2021; Kusumastuti et al., 2021; Monggilo et al., 2021). Although this survey encompasses four constructs, digital ethics (four items), digital safety (five items), digital skill (four items), and digital culture (four items). Surveys were distributed via Google Forms, and analysis was

conducted using Smart-PLS because it is effective for analyzing complex models in exploratory research, especially with small samples and non-normal data, while also allowing simultaneous testing of construct validity and reliability (Hair et al., 2019, 2022).

4. RESULT AND DISCUSSION

Respondent Characteristic

Table 1. Respondent Characteristic.

Category	Category Description	Number of Respondents	% of respondents
		250	100%
Gender	Man	147	58,8%
	Woman	103	41,2%
Age	18 - 25 Years	89	35,6%
	26 - 30 Years	46	18,4%
	31 - 35 Years	59	23,6%
	36 - 40 Years	23	9,2%
	41 - 45 Years	11	4,4%
	46 - 50 Years	9	3,6%
	Over 50 Years	13	5,2%
	High School Degree	83	33,2%
	Diploma's Degree	9	3,6%
Last education	Bachelor's Degree	93	37,2%
	Master's/Doctoral's Degree	65	26,0%
	Civil Servant	36	14,4%
	Teacher/Lecturer	57	22,8%
Work	Private sector employee	52	20,8%
	State-owned enterprises officer	8	3,2%
	Students	73	29,2%
	Military/Police	1	0,4%
	Entrepreneur	15	6,0%
	Other	8	3,2%

Source: Primary Data (2025)

The table presents the demographic profile of 250 respondents based on four main categories: gender, age, education level, and occupation. Most respondents are male (58.8%) and fall within the 18–25 age group (35.6%). In terms of education, the majority hold a bachelor's degree (37.2%), followed by high school graduates (33.2%) and those with a master's or doctoral degree (26.0%). Regarding occupation, the largest group consists of students (29.2%), followed by teachers or lecturers (22.8%) and private sector employees (20.8%). Overall, the data reflects a diverse group of respondents, predominantly young, well-educated, and representing a variety of professional backgrounds.

Measurement Models Evaluation

This research uses multivariate analysis, specifically SEM PLS, to evaluate the influence between variables for prediction, exploration, or structural model development (Hair et al., 2019). SEM PLS is suitable for models with limited sample sizes and non-normally distributed data. The model examines Digital Leadership as the independent variable and Digital Literacy

as the dependent variable. Reflective measurement models are used, with evaluation criteria including discriminant validity (Fornell-Larcker and HTMT), a loading factor of at least 0.70, Composite Reliability of at least 0.70, and an Average Variance Extracted (AVE) of at least 0.50 (Hair et al., 2022).

Table 2. Measurement Model Evaluation, Outer Loading, Cronbach's Alpha, CR, AVE.

Variable	Measurement Items (Indicators)	Outer Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Digital Leadership	X-Visionary Leadership	0.867	0.963	0.964	0.872
	X-Digital-Age Learning Culture	0.952			
	X-Excellence in Professional Practice	0.961			
	X-Systemic Improvement	0.951			
	X-Digital Citizenship	0.936			
Digital Literacy	Y-Digital Ethics	0.855	0.909	0.913	0.786
	Y-Digital Safety	0.921			
	Y-Digital Skill	0.886			
	Y-Digital Culture	0.883			

Source: Primary Data processed using SmartPLS 4

The Digital Leadership variable, measured using five indicators, consists of Leadership Visionary, Culture of Digital Age Learning, Excellence in Professional Practice, Systemic Improvement, and Digital Citizenship (ISTE, 2009). demonstrates strong reliability and validity. Outer loadings range from 0.867 to 0.961, with a high Cronbach's Alpha (0.963) and Composite Reliability (0.964), indicating excellent internal consistency, and an AVE of 0.872 confirms good convergent validity. Similarly, the Digital Literacy variable, assessed through Digital Ethics, Digital Safety, Digital Skills, and Digital Culture (Adikara et al., 2021; Astuti et al., 2021; Kusumastuti et al., 2021; Monggilo et al., 2021), shows outer loadings between 0.855 and 0.921, a Cronbach's Alpha of 0.909, Composite Reliability of 0.913, and an AVE of 0.786, all indicating strong correlation and good convergent validity.

Table 3. Validity of Measurement Items.

Variable	Dimension	Item	Outer Loading	Validity
Digital Leadership	Visionary Leadership	Facilitate a change that maximizes learning goals using digital resources	0.923	Valid
		Engage in an ongoing process to develop, implement, and communicate technology-infused strategic plans	0.922	Valid
		Promote programs and funding to support implementation of technology-infused plans	0.901	Valid
		Continuous improvement of digital learning Model and promote the frequent and effective use of technology for learning	0.872	Valid
		Provide learning environments with technology and learning resources to meet the diverse needs of all learners	0.884	Valid
	Digital-Age Learning Culture	Ensure effective practice in the study of technology and its infusion across the curriculum	0.922	Valid
		Promote and participate in learning communities that stimulate innovation, creativity, and digital collaboration	0.900	Valid
		Allocate time, resources, and access to ensure ongoing professional growth in technology fluency and integration	0.896	Valid
	Excellence in Professional Practice	Facilitate and participate in learning	0.907	Valid

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Variable	Dimension	Item	Outer Loading	Validity
		communities that stimulate and support faculty in the study and use of technology		
		Promote and model effective communication and collaboration among stakeholders using digital-age tools	0.900	Valid
		Emerging trends of effective use of technology		
		encourage new technologies with the potential to improve student learning	0.897	Valid
		Stay up to date on educational research	0.869	Valid
		Lead purposeful change to reach learning goals using technology and media-rich resources	0.885	Valid
		Collaborate to establish metrics, collect, and analyze data, and share findings and results to improve staff performance and student learning	0.908	Valid
	Systemic Improvement	Recruit highly competent personnel who use technology to advance academic and operational goals	0.888	Valid
		Establish and leverage strategic partnerships to support systemic improvement	0.908	Valid
		Establish and maintain a robust infrastructure for technology to support management, operations, teaching, and learning	0.909	Valid
	Digital Citizenship	Ensure access to appropriate digital tools and resources to meet the needs of all learners	0.893	Valid

Variable	Dimension	Item	Outer Loading	Validity
Digital Literacy	Digital Ethic	Promote, model, and establish policies for safe, legal, and ethical use of digital information and technology	0.908	Valid
		Promote and model responsible social interactions related to the use of technology and information	0.907	Valid
		Model and facilitate the development of a shared cultural understanding and involvement in global issues through communication and collaboration tools	0.911	Valid
		The importance of internet ethics and applying it as a daily guide when doing activities in the digital space.	0.885	Valid
		Understand negative content and its impact, so I do not spread, produce, or forward hoax content, hate speech, bullying, and other negative content.	0.907	Valid
		Interact, participate, and collaborate on various digital platforms that are compliant and that are not in accordance with applicable regulations.	0.893	Valid
		The types of electronic interactions and transactions behave ethically in carrying them out.	0.899	Valid
	Digital Safety	Understand and implement security for my digital devices, both hardware (Password, Fingerprint Authentication, Face	0.785	Valid

Variable	Dimension	Item	Outer Loading	Validity
		Authentication) and software (Find My Device, Back Up Data, Antivirus, Full Disk Encryption, Shredder).		
		The importance and practice of protecting the digital identity of myself, my family, and others by using PIN/Password protection, OTP, and so on.	0.898	Valid
		The forms of digital fraud (scam, spam, phishing, hacking) and various legal provisions relating to digital fraud.	0.866	Valid
		The impact of digital track records allows able to production and management of good digital track records.	0.899	Valid
		The importance of children's safety in digital media and the need to prevent and overcome threats to children's safety in the digital space.	0.850	Valid
		Various forms of hardware and software, internet, digital security, digital security, and cyber attacks.	0.814	Valid
	Digital Skill	The characteristics of hoax information, misinformation, disinformation, malinformation, and verified information from search engine search results (Google, Bing, etc.).	0.899	Valid
		How to filter and distribute information (text and images) using chat applications and social media, and understand its impact.	0.894	Valid

Variable	Dimension	Item	Outer Loading	Validity
		Various forms of digital wallets and marketplaces and carry out non-cash financial transactions wisely.	0.851	Valid
		The values contained in Original Culture (Pancasila and Bhinneka Tunggal Ika), produce, distribute, and actively participate and collaborate in developing these values during my daily activities in the digital space.	0.905	Valid
	Digital Culture	The cultural diversity in this country, producing, watching, promoting, and doing other digital activities related to cultural content (regional languages, traditional arts, etc.).	0.932	Valid
		Buy, use, and promote domestic products during my activities in the digital space.	0.768	Valid
		Digital rights to access the internet, responsible freedom of expression, and feel safe (privacy and intellectual property rights) while doing activities in the digital space.	0.914	Valid

In this study, the Heterotrait-Monotrait Ratio (HTMT) was used to assess discriminant validity between the constructs of Digital Leadership and Digital Literacy. The HTMT value of 0.629 confirms adequate discriminant validity, as values below 0.90 indicate distinct constructs measuring different dimensions (Hair et al., 2019, 2022). This validates that the research instrument accurately measures the intended variables without significant conceptual overlap.

Table 4. Fornell-Larcker Criterion.

	Digital Leadership	Digital Literacy
Digital Leadership	0.847	
Digital Literacy	0.608	0.781

Source: Primary Data processed using SmartPLS 4

Using the Fornell-Larcker criteria, table 4 shows the discriminant validity analysis between the two constructs, *Digital Leadership* and *Digital Literacy*. This criterion ensures that both constructs have adequate discriminant validity, indicating that each represents very different phenomena and has little overlap in their measures. This increases the reliability and accuracy of the interpretation of different measurement results for each structure in the study.

Structural Model Evaluation

Evaluating a structural model involves testing hypotheses and assessing key metrics like Inner VIF values, t-statistics, p-values, and f-square. An Inner VIF below 5 indicates no multicollinearity between variables, ensuring accurate measurement of predictor impacts. Hypotheses are considered significant if the t-statistic exceeds 1.96 or the p-value is below 0.05, with results reported alongside 95% confidence intervals for Path Coefficient estimates. The f-square values indicate the variable impact at structural levels (0.02 low, 0.15 moderate, 0.35 high) (Hair et al., 2022). These evaluations confirm a robust prediction model where predictor variables are independent, ensuring reliable measurement of digital leadership's influence.

Table 5. Hypothesis Testing (Direct Influence).

Path Coefficient	Original sample (O)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values	Confidence Interval		f-square
					2.5%	97.5%	
Digital Leadership -> Digital Literacy	0.619	0.054	11.413	0.000	0.506	0.719	0.622

Source: Primary Data processed using SmartPLS 4

Based on the hypothesis measurement table, it shows that the direct influence of digital leadership on digital literacy as a whole is the *path coefficient*, which reached 0.608. With a low standard deviation (0.054) and a very high t-statistic value (11.413), this means that there is a very strong and consistent influence accompanied by a *p-value* of 0. The wide confidence interval from 0.506 to 0.719 indicates that there is variability in this effect, but it is still within the positive and significant range, underscoring the reliability of this estimate. Mark *f-square* the high level (0.622) indicates that Digital Leadership is a dominant and important factor in

the success and effectiveness of Digital Literacy, which influences it widely from strategy to implementation.

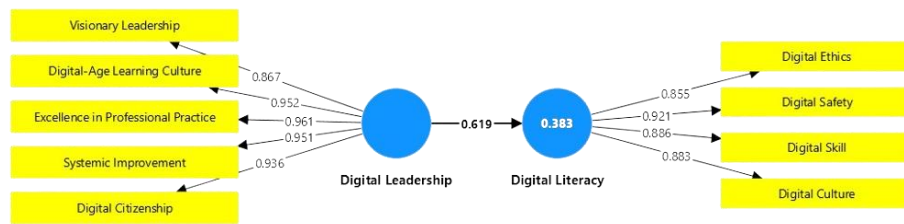


Figure 1. Diagram Path Coefficient.

Goodness-of-Fit Model Evaluation

Partial Least Squares (PLS) is an analysis *Structural Equation Model* (SEM) is a variance-based study that focuses on prediction studies. Therefore, several measures were developed to demonstrate the acceptability of the proposed model, such as *R-square*, *Q-square*, *Standardized Root Mean Square* (SRMR), dan PLS-Predict (AlAjmi, 2022; ISTE, 2009, 2024).

Table 6. R-Square and Q².

	R-square	Q ²
Digital Literacy	0.383	0.290

This table shows the values of *R-square* and *Q-square* for the analysis of the impact of Digital Leadership on Digital Literacy. As a whole, shows an R-square value of 0.383, indicating that around 38.3% of the variation in results measured by the Digital Literacy can be explained by the Digital Leadership variable. Q value² of 0.290 is a measure of the predictive power of the model used. In contrast to R-square, which assesses model fit, Q² focuses more on the model's ability to make predictions effectively on new, unseen data. Q value² The lower R-square (in this case 0.290) indicates that, although the model can explain the variation in the analyzed sample, its ability to predict new data is more limited. This value is important for assessing the suitability of the model in practical applications beyond the data sample used for estimation.

Table 7. Standardized Root Mean Square Residual (SRMR).

	Saturated model	Estimated model
SRMR	0.053	0.053
d_ULS	0.126	0.126
d_G	0.126	0.126
Chi-square	193.768	193.768
NFI	0.923	0.923

Table 7 shows the evaluation metrics for two models in the context of structural equation modeling: the saturated model and the estimated model, displaying the values for SRMR, d_ULS, d_G, Chi-square, and NFI. The low SRMR value (0.053) for both models indicates an excellent fit, while the similar d_ULS and d_G values (0.126, respectively) between the two models indicate minimal error or discrepancy, meaning that the differences between the correlations are observed and those predicted by the model are very small. The high chi-square (193.768) and quite high NFI value (0.923) also confirm that the two models have a good fit in explaining the observed data. The similarity of values between the saturated and estimated models indicates that the estimated model provides an accurate representation of the data with minimal error rates, parallel to the ideal saturated model. Both show good agreement because SRMR values below 0.08 are considered acceptable (Hair et al., 2019, 2022).

Table 8. PLS-Predict.

	Q ² predict	PLS-SEM_RMSE	PLS-SEM_MAE	LM_RMSE	LM_MAE
Digital Culture	0.294	0.579	0.455	0.595	0.456
Digital Ethics	0.350	0.572	0.428	0.577	0.416
Digital Safety	0.261	0.584	0.433	0.593	0.443
Digital Skill	0.219	0.591	0.455	0.591	0.458

Table 8 presented shows the predictive evaluation metrics of two different models—Partial Least Squares Structural Equation Modeling (PLS-SEM) and Linear Modeling (LM)—for four aspects of digital literacy: Digital Culture, Digital Ethics, Digital Safety, and Digital Skills. Q² prediction for each aspect of digital literacy indicates the predictive ability of the PLS-SEM model, with the highest value recorded for Digital Ethics (0.350) and the lowest for Digital Skills (0.219), indicating variability in the predictive effectiveness of the model depending on the domain. RMSE (Root Mean Square Error) and MAE (Mean Absolute Error) for PLS-SEM and LM, respectively, indicate the prediction error, with lower values indicating higher accuracy. In general, the RMSE and MAE values for the PLS-SEM model tended to be slightly lower than those for the LM model for each aspect tested, indicating that PLS-SEM may provide slightly more accurate predictions in this context.

Discussion

The results of this research show that digital leadership influences digital literacy. Digital literacy can be interpreted as survival skills in the digital era (Eshet-Alkalai, 2004). Effective leadership is critical to navigating the ethical challenges posed by digitalization, ensuring that ethical considerations are integrated into decision-making processes. Technology plays an important role in determining future readiness, which means that more government attention should be paid to this issue (Sagarik, 2023). Leaders must balance technological advances with

ethical responsibilities, understanding the implications of their decisions on challenges like privacy, security, and transparency, as the digital leadership style enables them to make smart decisions in the digital era (Ahmadi et al., 2023; Bhatta, 2021; Bowen, 2021). Digital leadership drives change by leveraging digital resources to achieve learning and organizational goals efficiently and effectively, including funding and implementing technology-based strategic plans (Wulandari et al., 2023). Leaders must adopt a digital mindset, ensuring technology supports moral, legal, and ethical practices while promoting responsible social interaction in the digital space, avoiding the spread of harmful content (Hensellek & Simon, 2020).

Digital literacy involves more than just the ability to use software or operate digital devices; Digital literacy encompasses a wide range of complex cognitive, motor, sociological, and emotional skills that users need to function effectively in digital environments (Eshet-Alkalai, 2004). To encourage dynamic capabilities based on market orientation, digital leadership behavior has a greater influence on the development of strategic alliances (Mihardjo et al., 2019a). Digital leadership not only requires digital skills but also requires a deep understanding of analog engineering, process management, and materials, with an emphasis on how “digital” can be a method that combines diverse knowledge and skills (Zupancic et al., 2016).

Digital leadership supports good human-machine interactions so that employees have the time, incentive, and ability to participate in more creative work and investigate exploratory possibilities. Digital leadership also stimulates the spread and adoption of digital tools within the company (Wang et al., 2022). Digital leaders promote ethics by ensuring principles like responsibility, honesty, and transparency guide online activities, educating users on respecting intellectual rights and privacy, and involving vulnerable groups in policy-making to ensure inclusive perspectives (O’Shea & Suzor, 2020). Leaders must address cybersecurity challenges through increased awareness, cross-sector collaboration, investment in advanced technology, international partnerships, and regular updates to security policies (Sagarik, 2023). This includes implementing strong security measures such as biometric authentication and antivirus software (Sammons & Cross, 2017) and organizing regular training to combat digital fraud, prepare for threats, and emphasize the importance of digital responsibility and morale.

Technology plays a critical role in future readiness, necessitating policies to bridge infrastructure gaps, enhance digital literacy, and transform public services through advanced technology (Sagarik, 2023). Digital skills, encompassing digital thinking, communication, and analysis, develop vertically through supervisor guidance and horizontally via peer

collaboration (Saputra et al., 2021). Digital leaders design training programs to enhance technical capabilities, from basic software use to advanced digital infrastructure understanding. As society becomes increasingly digital, leadership must evolve to boost productivity, efficiency, and workforce preparedness for emerging challenges in the technological era (Hensellek & Simon, 2020).

In Indonesia, effective digital leadership integrates the values of original culture (Bhinneka Tunggal Ika and Pancasila) into digital activities, emphasizing tolerance, fairness, and respect in online interactions. Leaders promote a digital safety culture that prioritizes diversity and upholds digital ethics reflective of national values (Levin & Mamlok, 2021). Inclusive digital platforms should educate users on cultural diversity and foster shared digital culture, enabling knowledge exchange and production (Wang et al., 2022). Research by Saputra et al. (2021) highlights that collaboration with colleagues and external institutions significantly influences digital skills development more than vertical support. Social interactions are crucial for fostering digital competencies. Furthermore, digital leadership reshapes organizations by transforming business models, structures, and culture to align with technological advancements, ensuring adaptability in the evolving digital landscape (Cortellazzo et al., 2019; Eberl & Drews, 2021).

Economies with low digitalization are less psychologically empowering (Zeike et al., 2019), as digital leadership combines digital culture and competence. Encouraging domestic product use in digital activities enhances digital safety by reducing risks in international transactions and strengthening the local economy. Leaders must prioritize secure e-commerce practices, protect personal data and intellectual property, and promote digital rights, ensuring access, privacy, and responsible expression. Building infrastructure for safe internet access is essential for an inclusive and secure digital environment.

5. CONCLUSION

This study demonstrates that digital leadership has a strong and meaningful relationship with digital literacy, particularly in the areas of digital ethics, safety, skills, and culture, within the sampled population. Within this context, effective digital leaders contribute to raising awareness of online responsibility, implementing safeguards against cyber threats, and promoting responsible behavior in digital spaces. They also support equitable access to digital skills through training and education, enabling safer and more effective digital participation. Moreover, they play a role in sustaining digital culture by integrating local traditions into digital interactions, fostering inclusivity and cultural continuity. While these findings offer valuable

insights, they are based on a purposively selected sample and may not fully represent the broader population of Indonesia. Therefore, the conclusions should be interpreted with caution, and further research with broader sampling is recommended. This study nonetheless underscores the potential of strategic digital leadership in shaping ethical and inclusive digital ecosystems and highlights the need for continued cross-sector collaboration and infrastructure investment to support digital literacy efforts.

6. LIMITATIONS

This study focuses on the concepts of digital leadership and digital literacy as introduced by Indonesia's Ministry of Communication and Information Technology. Accordingly, the digital literacy framework used may require contextual adaptation when applied in other countries with different social, cultural, and infrastructural characteristics. Additionally, the sample is limited to individuals who are actively engaged with digital technologies, and therefore may not fully represent the general population, particularly those with limited access to digital infrastructure or internet connectivity. This study also does not account for other variables that may serve as moderators or mediators in the relationship between digital leadership and digital literacy, such as the role of family and social environment, the intensity of digital media use, and other contextual factors. These variables could be explored in future research to deepen both theoretical insights and practical applications in this area.

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