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Digital skills and self-efficacy: Unpacking their influence on faculty research engagement

Ganjar Mohamad Disastra[1*], Noermijati Noermijati[2], Dodi Wirawan Irawanto[3], Wahdiyat Moko[4]
[1,2,3,4]Management Department, Faculty of Economics and Business, Brawijaya University, Malang 65145, Indonesia;
ganjar@student.ub.ac.id (G.M.D.) nurmi@ub.ac.id (N.N.) dodi.wi@ub.ac.id (D.W.I.) moko@ub.ac.id (W.M.).

Abstract: Drawing from social cognitive theory, this study investigates the mediating role of self-efficacy in the relationship between Digital Skills and Research Engagement among faculty in Higher Education. Using a cross-sectional research design, data were collected from 211 faculty members at a Private University in Indonesia. The Partial Least Squares Structural Equation Modelling (PLS-SEM) technique was applied to test the hypotheses proposed in research model. The results indicate that only three dimensions of Digital Skills - Information and Data Literacy, Communication and Collaboration, and Problem-Solving - have a positive and significant effects on Research Engagement. On the other hand, Content Development and Safety show insignificant effects. Additionally, Self-Efficacy have a positive and significant direct effect on Research Engagement and acts as a mediator between Information and Data Literacy, Problem-Solving, and Research Engagement. These results underscore the importance of developing targeted professional development programs that enhance digital skills and self-efficacy, ultimately contributing to improved research productivity and academic success. The study highlights the need for institutions to invest in faculty training and support systems that promote digital literacy and self-efficacy, fostering a more engaged and effective academic workforce.

Keywords: *Digital skills, Research engagement, Self-efficacy, Social cognitive theory.*

1. Introduction

Digital skills play a crucial role in enhancing employee engagement in contemporary workplaces. As organizations increasingly integrate digital technologies into their operations, the ability of employees to effectively navigate these tools becomes essential for fostering engagement and productivity. Digital skills encompass the technical skills required to use digital tools and the cognitive and social skills necessary for effective communication and collaboration in a digital environment [1], [2]. Research indicates that employees with higher levels of digital skills are more likely to engage positively with technology and digital media, enhancing their overall engagement at work. For instance, a study found that digital literacy significantly influences employee engagement by improving acceptance of workplace digitalization and fostering an innovative culture [2]. This relationship is further supported by findings suggesting that digital literacy is a precursor to technology adoption, thereby enhancing individual performance and continuance intentions within the workplace [3].

Furthermore, integrating digital skills within organizational frameworks has been identified as a strategic approach to enhance employee engagement. By equipping employees with the necessary digital skills, organizations can foster a more engaged workforce that is better prepared to adapt to technological changes and challenges [4]. This proactive approach improves individual performance and contributes to a more cohesive and collaborative work environment, ultimately benefiting organizational outcomes [5].

* Correspondence: ganjar@student.ub.ac.id

Research engagement in higher education is a critical area of study that has garnered increasing attention in recent years. Research engagement refers to the active participation of faculty members in scholarly activities, including research, publication, and collaboration. Despite the growing recognition of the importance of research engagement, there is limited research on how digital skills have impacted faculty research engagement. Many scholars [6]–[8] highlight the importance of perceived digital skills in fostering sustainable student engagement, but similar frameworks for faculty engagement in research remain underexplored. This gap is particularly relevant in light of findings by Zhang et al. Zhang et al. (2021), which confirm the positive association between digital skills and student engagement, suggesting that similar dynamics may exist for faculty.

As higher education institutions increasingly rely on digital technologies for research collaboration and dissemination, it is essential to investigate how faculty members' digital skills influence their engagement in research activities. The lack of empirical evidence linking digital skills to faculty research engagement signifies a need for further investigation into how digital skills can enhance faculty productivity in research settings.

This study investigates the relationship between digital skills and research engagement through the lens of social cognitive theory. Social cognitive theory posits that individual behavior is influenced by the interplay of personal factors, environmental influences, and behavioral outcomes, with self-efficacy serving as a critical mediating factor in this dynamic. In the context of higher education, understanding how self-efficacy mediates the relationship between digital skills and research engagement can provide valuable insights into enhancing faculty productivity and satisfaction. As highlighted by Zhang et al. Zhang et al. (2021), Faculty members with high levels of digital skills are better equipped to navigate the complexities of modern research environments, engage in collaborative projects, and disseminate their findings effectively.

However, the mere possession of digital skills does not guarantee research engagement; self-efficacy plays a pivotal role in determining whether faculty members will apply these skills in their research endeavors. Self-efficacy, an individual's belief in their ability to perform specific tasks, significantly influences motivation and engagement in various contexts. Research by Oberländer & Bipp Oberländer & Bipp (2022) indicates that self-efficacy is closely linked to work engagement, particularly in the context of digital skills. This suggests that faculty members with high self-efficacy regarding digital skills are more likely to engage actively in research activities. Conversely, low self-efficacy may hinder faculty members from utilizing their digital skills, decreasing research engagement.

The interplay between digital skills, self-efficacy, and research engagement presents a significant research gap that warrants further exploration. By investigating the mediating role of self-efficacy in this relationship, researchers can contribute to a deeper understanding of how to enhance faculty engagement in research activities. This understanding is crucial for developing targeted interventions and support systems that empower faculty members to leverage their digital skills effectively, ultimately fostering a more vibrant research culture within higher education institutions.

2. Literature Review

2.1. Social Cognitive Theory and Self-Efficacy

Social cognitive theory (SCT), developed by Albert Bandura, offers a comprehensive framework for understanding human behavior through the interplay of personal, behavioral, and environmental influences. At the core of this theory is the concept of triadic reciprocal causation, which suggests that cognitive, affective, and biological events (personal factors), behavioral patterns, and environmental events interact dynamically to shape human behavior [10]. This perspective emphasizes the role of agency, where individuals are not just passive recipients of external influences but active participants in their development and learning processes. Bandura's work highlights the importance of self-regulation, self-reflection, and proactive behavior as mechanisms for individuals to influence their outcomes [10].

A key component of SCT is the construct of self-efficacy, which refers to an individual's belief in their capability to perform specific behaviors to achieve certain goals. Bandura's influential work on self-

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efficacy underscores its significance in influencing how people think, feel, and act, especially in behavioral change. Self-efficacy influences motivation, perseverance, and resilience in the face of challenges, playing a crucial role in various domains such as education, health, and organizational behavior. Higher levels of self-efficacy are linked to greater task engagement, increased effort, and a higher likelihood of achieving desired outcomes.

In the context of higher education, self-efficacy plays a pivotal role in faculty engagement in research activities. Faculty members who believe in their digital skills are more likely to actively participate in research, as their self-efficacy reinforces their motivation to utilize these skills effectively. This relationship is particularly relevant in an era where digital tools and technologies are integral to research processes. Understanding how self-efficacy mediates the relationship between digital skills and research engagement can offer valuable insights for developing targeted interventions aimed at enhancing faculty productivity and satisfaction.

2.2. Research Engagement

Research engagement is a construct encompassing individuals' active participation in various research activities, including the design, implementation, dissemination, and application of research findings. It is increasingly recognized as a crucial element in enhancing the quality and relevance of research, especially in fields such as health, education, and social sciences. In educational settings, research engagement is closely linked to academic performance. Studies indicate that academic engagement significantly predicts academic success, highlighting the importance of fostering engagement among students and faculty in research activities.

The benefits of research engagement are numerous. Engaging stakeholders in research can lead to more relevant and impactful research outcomes. Forsythe Forsythe et al. (2019) noted that engagement contributed to making informed research design decisions. Additionally, research engagement fosters a sense of ownership and empowerment among researchers. Tindana Tindana et al. (2017) emphasize the importance of engagement in research, noting that effective engagement methods can lead to successful outcomes and increased trust between researchers. This trust is essential for promoting ongoing collaboration and participation in future research endeavors.

Numerous studies have established a positive correlation between self-efficacy and employee engagement. For instance, a study by Ferawati Ferawati (2023) found that self-efficacy significantly influences employee engagement among employees, indicating that higher self-efficacy leads to greater engagement levels. Similarly, Jafri Jafri (2020) emphasized that self-efficacy is associated with increased employee engagement, supporting the idea that individuals who believe in their capabilities are more likely to engage actively in their work. Self-efficacy contributes to employee engagement by fostering a sense of agency and control over one's work environment. Carter et al. Carter et al. (2016) conducted a longitudinal study that demonstrated a robust positive relationship between self-efficacy, employee engagement, and job performance, underscoring the practical implications of self-efficacy in enhancing job performance and reinforcing that self-efficacy enhances engagement through increased motivation and commitment to work tasks. Furthermore, Chaudhary et al. Chaudhary et al. (2012) highlighted that self-efficacy is a significant predictor of work engagement, suggesting that organizations should enhance employees' self-efficacy to cultivate a more engaged workforce. Research by Chan et al. Chan et al. (2017) also supports the notion that self-efficacy is a vital personal resource that enables employees to manage work-life demands effectively, leading to higher levels of engagement.

Several studies have delved into the relationship between self-efficacy and faculty research engagement. For instance, the study by Wester et al. Wester et al. (2019) found that self-efficacy significantly impacts the scholarly productivity of assistant professors, indicating that those with higher self-efficacy are more likely to actively engage in research activities. These findings are in line with the research by Procházka et al. Procházka et al. (2017), which identified self-efficacy as a mediator in the relationship between transformational leadership and engagement. This alignment reinforces the idea

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that self-efficacy enhances faculty members' research engagement by increasing motivation and commitment. Thus, the following hypothesis was proposed:

H1: Self-efficacy has a positive and significant effect on research engagement

2.3. Digital Skills

The European Commission's Digital Competencies Framework (DigComp 2.0) serves as a foundational model for understanding and assessing digital skills across various domains [20]–[22]. This framework outlines key dimensions of digital skills that are not just crucial, but also have the potential to transform the educational landscape for educators and learners alike. Digital skills are defined as the ability to use digital technologies effectively and critically in various contexts, including personal, professional, and educational settings. According to the European Commission, digital skills encompasses a range of skills necessary for navigating the digital landscape [23]. This skill is not merely about technical skills but also involves critical thinking, creativity, and the ability to collaborate and communicate effectively in digital environments, fostering a sense of community among educators and learners.

DigComp 2.0 identifies five key dimensions of digital skills, each comprising specific skills that individuals should develop:

1. Information and Data Literacy: This dimension focuses on the ability to search for, evaluate, and manage digital information. It includes skills such as identifying relevant data sources, assessing the credibility of information, and using data responsibly.
2. Communication and Collaboration: This dimension emphasizes the importance of effective communication and collaboration in digital contexts. It includes skills related to sharing information, participating in online communities, and using digital tools for collaboration.
3. Digital Content Creation: This dimension involves the ability to create and edit digital content, including text, images, and multimedia. It encompasses skills such as coding, graphic design, and content management, which are essential for producing high-quality digital materials.
4. Safety: This dimension addresses the importance of online safety and security. It includes skills related to protecting personal data, understanding digital rights, and recognizing online threats such as cyberbullying and misinformation.
5. Problem Solving: This dimension focuses on the ability to identify and solve technical problems using digital tools. It involves skills such as troubleshooting, adapting to new technologies, and applying digital solutions to real-world challenges.

2.4. The Relationship Between Digital Skills and Self-Efficacy

Self-efficacy is a critical factor influencing how faculty members approach digital technologies. Research by Wang & Chu [24] found that self-efficacy significantly impacts faculty members' self-perception of their digital skills, suggesting that those with higher self-efficacy are more likely to engage with digital tools and integrate them into their teaching and research practices. This relationship is further supported by Mannila et al. (2018), who emphasized that enhancing self-efficacy in digital skills is crucial for faculty development and effective technology integration in education.

The relationship between digital skills and self-efficacy has been explored in various studies. For instance, Hanifah et al. Hanifah et al. (2023) reported a positive correlation between self-efficacy and digital skills among teachers. This finding suggests that faculty members who believe in their ability to use digital technologies are more likely to develop and enhance their digital skills, ultimately leading to improved engagement in research and teaching—moreover, Henne et al. Henne et al. (2022) demonstrated that interventions promoting digital skills can significantly enhance self-efficacy expectations among pre-service teachers. Despite the positive relationship between digital skills and self-efficacy, challenges still need to be addressed in fostering these skills among faculty. Research by Kotzebue et al. Kotzebue et al. (2021) indicate that many faculty members may need more digital skills, which can hinder their self-efficacy and engagement levels. Additionally, the transition to online

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teaching during the COVID-19 pandemic revealed disparities in digital skills among faculty, as noted by Alarcón et al. Alarcón et al. (2020), highlighting the need for ongoing training and support. Thus, the following hypothesis was proposed:

H_2: Information and Data Literacy has a positive and significant effect on self-efficacy
H_3: Communication and Collaboration skills has a positive and significant effect on self-efficacy
H_4: Digital Content Creation skills has a positive and significant effect on self-efficacy
H_5: Safety skills has a positive and significant effect on self-efficacy
H_6: Problem Solving skills has a positive and significant effect on self-efficacy

2.5. The Relationship Between Digital Skills and Research Engagement

In the contemporary academic landscape, digital skills have emerged as essential skills for faculty members, influencing their ability to engage in research activities effectively. Digital skills encompass a range of skills, including information literacy, communication, content creation, safety, and problem-solving, as outlined in the European Commission's Digital Skills Framework (DigComp 2.0)

Various studies have explored the relationship between digital skills and research engagement. For instance, Koyuncuoglu Koyuncuoglu (2022) found that university students' digital skills significantly impact their engagement in academic activities, suggesting that similar dynamics may exist for faculty. Faculty members with strong digital skills are better equipped to utilize digital tools for research collaboration, data analysis, and dissemination of findings, enhancing their overall research engagement. Párraga et al. Párraga et al. (2022) validated the DigCompEdu Check-in Questionnaire, which assesses educators' digital skills. This indicates that such frameworks are crucial for understanding and improving faculty engagement in research. The study underscores the need for faculty to self-evaluate their digital skills to identify areas for improvement, which can subsequently enhance their engagement in research activities. Falola et al. Falola et al. (2022) explored the role of sustainable e-learning platforms in improving faculty engagement, noting that access to digital resources and training can significantly impact research engagement. This finding suggests that institutions must invest in digital infrastructure and training programs to support faculty in developing the necessary skills for effective research engagement. Thus, the following hypothesis was proposed:

H_7: Information and Data Literacy has a positive and significant effect on research engagement
H_8: Communication and Collaboration skills has a positive and significant effect on research engagement
H_9: Digital Content Creation skills has a positive and significant effect on research engagement
H_{10}: Safety skills has a positive and significant effect on research engagement
H_{11}: Problem Solving skills has a positive and significant effect on research engagement

2.6. The Mediating Role of Self-Efficacy in the Relationship Between Digital Skills and Research Engagement

The mediating role of self-efficacy has been studied in various contexts beyond traditional academic settings. For instance, Procházka et al. Procházka et al. (2017) examined the connection between transformational leadership and engagement and found that self-efficacy plays a crucial role as a mediator. Cui [33] further explored this relationship by constructing a model highlighting the mediating role of self-efficacy between organizational commitment and work engagement in Chinese employees. This suggests that self-efficacy directly influences engagement and acts as a critical intermediary in the relationship between other organizational factors and employee engagement. This supports the idea that self-efficacy can enhance engagement by fostering a sense of agency and skills in individuals, motivating them to fully participate in their roles.

In the realm of research engagement, self-efficacy is particularly relevant as faculty members navigate the complexities of academic research, which often requires a combination of technical skills, collaboration, and innovation. Research by Zhao et al. Zhao et al. (2021) suggests that self-efficacy can predict higher levels of academic engagement, thereby improving academic performance. This indicates that faculty members with strong self-efficacy beliefs regarding their research capabilities are more

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likely to actively engage in research activities, leading to enhanced productivity and scholarly contributions.

Moreover, the influence of self-efficacy on research engagement is supported by studies focusing on specific populations. For example, Shao & Kang Shao & Kang (2022) found that self-efficacy mediates the relationship between peer relationships and learning engagement among adolescents, highlighting the role of self-efficacy in promoting engagement in educational contexts. This emphasizes the potential for self-efficacy to be a critical factor in promoting research engagement among faculty, especially in collaborative research environments, making the audience feel more engaged and involved in their work. Thus, the following hypothesis was proposed:

H_{12}: Self-Efficacy mediates the relationship between Information and Data Literacy and research engagement

H_{13}: Self-Efficacy mediates the relationship between Communication and Collaboration skills and research engagement

H_{14}: Self-Efficacy mediates the relationship between Digital Content Creation skills and research engagement

H_{15}: Self-Efficacy mediates the relationship between Safety skills and research engagement

H_{16}: Self-Efficacy mediates the relationship between Problem Solving skills and research engagement

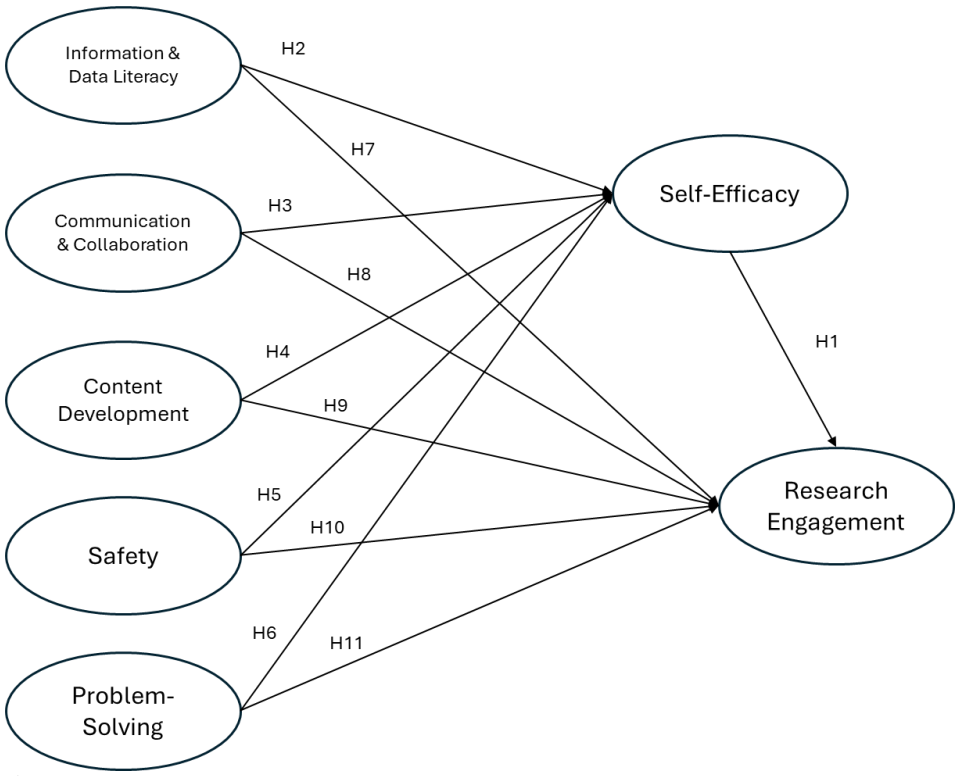

Figure 1.
Propose research model.

This research is based on Social Cognitive Theory and introduces a framework in Figure 1 that integrates digital skills, self-efficacy, and research engagement. The model serves as both a theoretical concept and a practical tool to help university management enhance faculty research engagement, ultimately leading to increased research productivity. The study uses Social Cognitive Theory to investigate whether individuals' mastery of digital skills can boost self-efficacy and, consequently, promote greater research engagement. The proposed model consists of seven main components: Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Safety, Problem Solving, Research Efficacy, and Research Engagement.

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3. Method

3.1. Samples and Procedures

Faculty research performance significantly influences the quality of education in Indonesia. It enriches the educational experience, fosters innovation, and addresses societal issues Kurniawati et al. Kurniawati et al. (2021). However, challenges such as low incentives and limited resources hinder research productivity [37]. Improving research performance is essential for elevating the country's higher education quality and attracting more resources [38]. Additionally, academic career advancement in Indonesia depends on faculty members' research engagement. Fostering a research-oriented culture within institutions is crucial for supporting faculty in their research endeavors [39].

We conducted a cross-sectional research design to gather data from faculty members at private universities in Indonesia. The data was collected from sample respondents to test hypothesized relationships (Saunders et al., 2009; Sekaran, 2010). We chose a cross-sectional survey design for two main reasons. Firstly, cross-sectional designs are useful and provide more information when hypotheses are developed based on strong and well-founded theories. Secondly, our research investigates the mediating role of psychological states based on competing theoretical perspectives.

In total, 300 questionnaires were distributed with a cover letter explaining the study's purpose, ensuring participant anonymity, and inviting voluntary participation. We received 217 questionnaires back, resulting in a response rate of 72.3%. After screening the data and eliminating incomplete responses, we had 211 complete responses for further analysis. Table 1 showed female dominance (54.5%) and included relatively young employees aged 30 to 40 (48.4%). Additionally, the majority of the respondents are assistant professors (88.15%), and the dominant job tenure of the respondents was 5 to 10 years.

Table 1.
Demographic characteristics of respondents (n = 211).

Profiles	Frequency	%
AGE		
Under 30	8	3.79%
> 30 - 40	102	48.34%
> 40 - 50	87	41.23%
> 50 - 60	13	6.16%
Above 60	1	0.47%
Gender		
Male	96	45.50%
Female	115	54.50%
Tenure		
Less Than 5 Years	30	14.22%
> 5 - 10	124	58.77%
> 10 - 15	52	24.64%
Above 15 Year	5	2.37%
Academic Position		
Lecturer	33	5.21%
Assistant Professor	260	88.15%
Associate Professor	25	6.64%

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3.2. Measures

We used validated scales to measure constructs of the study. All the items were measured with five-point Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree).

Digital Skills. We used five-dimensions digital skills from DigComp 2.0 develop by [20], Vuorikari et al. (2016), and Carretero et al. (2017), including Information and Data Literacy, Communication and Collaboration, Content Development, Safety, and Problem Solving skills. All the dimensions measurement was referred to DigComp 2.0, whereas Information and Data Literacy dimension was measured by three-item measurement and the other dimensions was measured by two-item measurements. The sample item of the measurement was "*I can use digital technology to find the research data needed*" and "*I can analyze data using the right application to solve research problems*".

Self-Efficacy. We used eight-item self-efficacy scale referred to Self-Efficacy in Research Measure (SERM) developed by Phillips & Russel (1994), along with the short version SERM-S by Kahn & Scott (1997). A sample item of the scale was "*I am confident that I can apply research methods appropriately*" and "*I am confident that I can present research results at scientific conferences*"

Research Engagement. We used six-item research engagement scale referred from Schaufeli et al., (2006). This measurement focuses on the psychological state of engagement. It assesses the extent to which employees feel energized, dedicated, and absorbed in their work. A sample item of the scale was "*I feel excited when doing research*" and "*I can work for a long time when doing research*".

4. Results & Discussion

We used Partial Least Squares–Structural Equation Modeling (PLS-SEM), a variance-based approach, to analyze the data and test the hypothesized research model using SmartPLS 3 software [43]. This method is more suitable for testing existing theories in an exploratory manner and for research models involving complex structures such as multiple mediation, which is the case with our current research [44]. We analyzed the data and reported the results following the guidelines and recommendations recently proposed by Hair et al. (2017) and Ringle et al. (2015).

4.1. Evaluation of Measurement Model

The first step in PLS-SEM analysis involves assessing the measurement model. This is done to establish the reliability and validity of the constructs. The assessment includes examining indicator reliability, internal consistency reliability, convergent validity, and discriminant validity of the constructs. The results of the measurement model assessment are shown in Tables 2 and 3.

The results in Table 2 show that all item loadings are above the threshold value of 0.60, and the composite reliability (CR) values exceed 0.70. This indicates that the constructs are reliable (Hair et al., 2017). Additionally, the average variance extracted (AVE) values are higher than 0.50, and the heterotrait–monotrait (HTMT) ratios in Table 3 are below the threshold of 0.85. These AVE values and HTMT ratios confirm that the constructs have both convergent and discriminant validity. Overall, the measurement model is considered suitable for structural analysis (Hair et al., 2017; Ringle et al., 2020).

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Table 2.
Evaluation of measurement model results.

Construct	Items	Loading	Cronbach's Alpha	CR	AVE
Data & information literacy (LDI)	LDI1	0.835	0.769	0.867	0.684
	LDI2	0.833			
	LDI3	0.814			
Communication (COM)	COM1	0.945	0.885	0.946	0.897
	COM2	0.95			
Content development (CONT)	CONT1	0.865	0.731	0.881	0.787
	CONT2	0.909			
Safety (SAFE)	SAFE1	0.809	0.583	0.827	0.705
	SAFE2	0.869			
Problem solving (SOLV)	SOLV1	0.924	0.803	0.91	0.835
	SOLV2	0.904			
Self-efficacy (EFIC)	EFIC1	0.74	0.891	0.913	0.568
	EFIC2	0.706			
	EFIC3	0.728			
	EFIC4	0.765			
	EFIC5	0.754			
	EFIC6	0.799			
	EFIC7	0.745			
	EFIC8	0.786			
Research engagement (ENG)	ENG1	0.764	0.849	0.888	0.57
	ENG2	0.8			
	ENG3	0.769			
	ENG4	0.733			
	ENG5	0.659			
	ENG6	0.794			

Table 3.
Descriptive statistics, correlations and discriminant validity (HTMT Criterion).

	Mean	SD	COM	CONT	EFIC	ENG	LDI	SAFE	SOLV
COM	4.280	0.641	*0.947*	0.594	0.307	0.417	0.664	0.659	0.662
CONT	4.393	0.652	0.479	*0.887*	0.345	0.416	0.609	0.882	0.677
EFIC	4.195	0.693	0.273	0.28	*0.753*	0.586	0.564	0.442	0.55
ENG	4.014	0.859	0.372	0.337	0.523	*0.755*	0.607	0.455	0.586
LDI	4.256	0.652	0.546	0.455	0.47	0.498	*0.827*	0.642	0.65
SAFE	4.197	0.727	0.484	0.582	0.319	0.326	0.435	*0.839*	0.815
SOLV	4.225	0.657	0.556	0.519	0.468	0.491	0.508	0.563	*0.914*

Note: Italic elements in diagonal are square root of AVE. Values below the diagonal elements are the correlations between constructs. Values above diagonal elements are the HTMT ratios. COM = Communication, CONT = Content Development, EFIC = Self-Efficacy, ENG = Research Engagement, LDI = Data & Information Literacy, SAFE = Safety, SOLV = Problem Solving, SD = Standard Deviation.

4.2. Evaluation of Structural Model

We initially assessed the coefficient of determination (R^2 value) to measure predictive accuracy and the cross-validated redundancy index (Stone–Geisser's Q^2) to evaluate the predictive relevance of the model. The proposed model explained 39.3% of the variance (R^2 = 0.393) in Research Engagement,

indicating a satisfactory level of predictive accuracy (Hair et al., 2017). Similarly, the Q^2 values obtained through blindfolding were 0.163 for Self-Efficacy and 0.205 for Research Engagement. Since these Q^2 values are greater than zero, they demonstrate the strong predictive relevance of the model (Hair et al., 2017). Additionally, we examined the path coefficients and their significance. We validated our hypotheses using a bootstrapping procedure with 5,000 bootstrap samples, the no sign changes option, and 95% bias-corrected confidence intervals.

In Table 4 and Figure 2, the results of the structural path analysis are presented. H1 predicted that self-efficacy has a significant direct effect on research engagement, and the result shows a significant positive relationship (β = 0.311, P Values = 0.000), thus supporting H1.

H2, H3, H4, H5, and H6 predicted that the dimensions of Digital Skills, including Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Safety, and Problem-Solving, have a positive and significant direct effect on Self-Efficacy. Our findings confirm the positive and significant effect shown by Information and Data Literacy (β = 0.353, P Values = 0.000) and Problem-Solving (β = 0.344, P Values = 0.000), thereby supporting H2 and H6 as expected.

H7, H8, H9, H10, and H11 predicted that the dimensions of Digital Skills have a positive and significant direct effect on Research Engagement. Our findings reinforce the positive and significant effect shown by Information and Data Literacy (β = 0.11, P Values = 0.001) and Problem-Solving (β = 0.107, P Values = 0.002), thereby supporting H2 and H6 as anticipated.

H12, H13, H14, H15, and H16 predicted the mediating role of Self-Efficacy in the relationship between Digital Skills and Research Engagement. The results show that Self-Efficacy significantly mediates the relationship between Information and Data Literacy, Problem Solving, and Research Engagement. Hence, only H12 and H16 are supported.

Table 4.
Evaluation of structural model results.

Endogenous construct	R square	Q square
EFIC	0.301	0.163
ENGAGE	0.393	0.205

Hypotheses	Direct effects	Path coefficients	P values	Conclusion
H1	EFIC -> ENGAGE	0.311	0.000	Accepted
H2	LDI -> EFIC	0.353	0.000	Accepted
H3	COM -> EFIC	-0.12	0.132	Rejected
H4	CONT -> EFIC	-0.029	0.713	Rejected
H5	SAFE -> EFIC	0.047	0.589	Rejected
H6	SOLV -> EFIC	0.344	0.000	Accepted
H7	LDI -> ENGAGE	0.215	0.005	Accepted
H8	COM -> ENGAGE	0.052	0.489	Rejected
H9	CONT -> ENGAGE	0.039	0.644	Rejected
H10	SAFE -> ENGAGE	-0.029	0.715	Rejected
H11	SOLV -> ENGAGE	0.204	0.024	Accepted
Hypotheses	**Indirect effects**	**Path coefficients**	**P values**	**Conclusion**
H12	LDI -> EFIC -> ENGAGE	0.11	0.001	Accepted
H13	COM -> EFIC -> ENGAGE	-0.037	0.159	Rejected

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Hypotheses	Direct effects	Path coefficients	P values	Conclusion
H14	CONT -> EFIC -> ENGAGE	-0.009	0.712	Rejected
H15	SAFE -> EFIC -> ENGAGE	0.015	0.597	Rejected
H16	SOLV -> EFIC -> ENGAGE	0.107	0.002	Accepted

Notes: COM = Communication, CONT = Content Development, EFIC = Self-Efficacy, ENG = Research Engagement, LDI = Data & Information Literacy, SAFE = Safety, SOLV = Problem Solving.

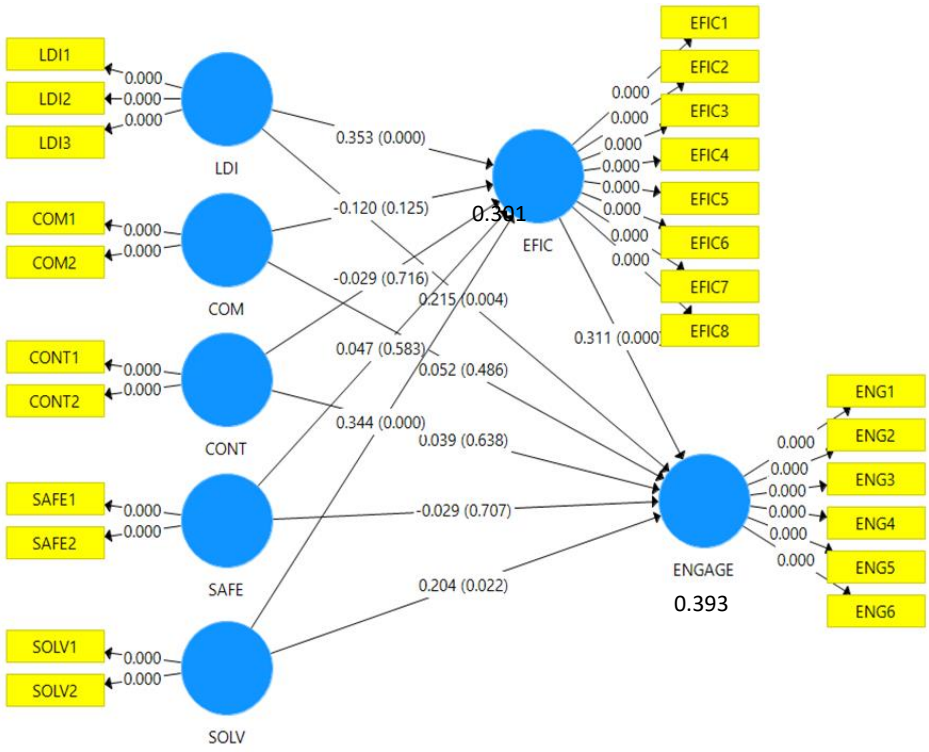

Figure 2.
PLS path analysis results.
Note: COM = Communication, CONT = Content Development, EFIC = Self-Efficacy, ENG = Research Engagement, LDI = Data & Information Literacy, SAFE = Safety, SOLV = Problem Solving.

5. Discussion

This study tries to examine the relationship between Digital Skill dimensions and Research Engagement and the mediating role of Self-Efficacy in those relationships. This section discusses the implications of these findings, places them in the context of existing literature, and explores potential reasons for the observed differences.

The results of this study emphasize the strong positive correlation between self-efficacy and research engagement among faculty members. The findings suggest that faculty members with higher levels of self-efficacy are more likely to actively participate in research, which contributes to their overall academic performance and institutional success. This is consistent with the findings of Procházka et al. (2017) and Portento et al. (2022), which emphasize that self-efficacy is significantly correlated with academic performance and engagement, suggesting that faculty with strong self-efficacy are better positioned to navigate the complexities of research. Wu et al. (2020) also demonstrated that

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self-efficacy positively influences academic performance, confirming that engaged faculty are more likely to produce impactful research outputs. Furthermore, the findings of this study align with the work of Luo et al. (2023), which highlights the mediating role of self-efficacy in enhancing academic engagement. This implies that nurturing self-efficacy among faculty can lead to increased research engagement, thereby improving overall academic performance and institutional reputation.

The study findings demonstrate a complex relationship between specific digital skills and faculty research engagement, as well as faculty self-efficacy. The findings reveal that only two digital skills have a positive and significant impact on self-efficacy and research engagement among faculty: information literacy and problem-solving. Conversely, other digital skills, such as communication and collaboration skills, content development skills, and safety skills, showed an insignificant impact on self-efficacy.

The positive relationship between information literacy and self-efficacy is particularly noteworthy. Information literacy involves the ability to effectively locate, evaluate, and utilize information, which is crucial for faculty engaged in research. Faculty members with strong information literacy are likely to feel more confident in navigating digital resources, assessing the credibility of information, and applying this knowledge in their academic work. This finding aligns with the work of Sánchez-Canut (2023), who emphasized that information literacy is foundational for developing self-efficacy in academic contexts, as it empowers faculty to engage with research materials more effectively. The positive correlation between information literacy and research engagement is a crucial finding. Faculty with strong information literacy can navigate the digital landscape, critically evaluate information quality, and integrate findings into their research. This finding aligns with the work of Procházka et al., (2017), which emphasizes the role of information literacy in enhancing academic engagement and productivity. On the other hand, problem-solving skills are crucial for faculty resilience when facing challenges in research and teaching. Approaching problems with confidence can significantly enhance self-efficacy. Astuti et al. (2021) found that individuals with strong problem-solving skills are more likely to have higher self-efficacy, especially in complex and dynamic environments. Problem-solving skills are also essential for faculty engagement in research, enabling them to tackle complex challenges with innovative solutions. Septiana et al. (2021) emphasize the importance of problem-solving skills in effective research practices, allowing faculty to adapt to changing circumstances and overcome obstacles. Enhancing faculty members' problem-solving competencies can lead to increased self-efficacy, fostering a more engaged and productive academic workforce.

The lack of significant impact from other digital competencies such as communication, collaboration, content development, and safety on self-efficacy and research engagement raises important questions. While these competencies are undoubtedly valuable in various contexts, their direct influence on self-efficacy and research engagement may be less pronounced than that of information literacy and problem-solving skills. For example, communication and collaboration are essential for teamwork and knowledge sharing. However, if faculty members do not feel confident in their information literacy or problem-solving abilities, they may be less likely to engage in collaborative research efforts. Moreover, the context in which these competencies are applied may also play a role in the observed discrepancies. The effectiveness of communication and collaboration competencies can be contingent upon the specific research environment and the nature of the research being conducted. In settings where individual research efforts are prioritized, the impact of collaborative competencies on self-efficacy and research engagement may be diminished. This suggests that while these competencies are important, their relevance may vary depending on the research context and the specific challenges faculty face.

The results of this study indicate that self-efficacy plays a significant role in the relationship between specific digital competencies, such as information literacy and problem-solving, and faculty research engagement. However, self-efficacy does not mediate the relationship between communication and collaboration skills, content development skills, and safety skills with research engagement. This

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detailed understanding of the mediating role of self-efficacy provides valuable insights into how different aspects of digital competencies impact faculty engagement in research activities.

The mediation of self-efficacy in the relationship between information literacy and research engagement is particularly notable. This finding is consistent with Tramontano et al. (2021), who emphasized the critical role of self-efficacy in influencing engagement in academic activities, suggesting that faculty with higher self-efficacy in information literacy are more likely to actively engage in research. Similarly, the significant mediation of self-efficacy in the relationship between problem-solving skills and research engagement underscores the importance of these competencies in academic settings. Problem-solving skills enable faculty to address complex research challenges and adapt to changing circumstances. Research by Tomczak (2023) supports this idea, indicating that individuals with strong problem-solving skills tend to exhibit higher self-efficacy, which in turn enhances their engagement in research activities.

6. Theoretical and Practical Implication

The findings of this study illuminate the intricate relationship between digital competencies and self-efficacy among faculty, with significant implications for theoretical frameworks in educational psychology and organizational behavior. This section discusses the theoretical implications of the results, particularly in relation to social cognitive theory.

6.1. Theoretical Implications

The positive relationship between digital competencies and self-efficacy aligns with Bandura's social cognitive theory, which posits that self-efficacy beliefs significantly influence individuals' motivation, behavior, and performance outcomes Hong et al. (2021). In the context of higher education, faculty members who possess strong digital competencies are likely to have higher self-efficacy regarding their ability to engage in research and teaching activities effectively. This relationship suggests that enhancing digital competencies can lead to increased self-efficacy, which in turn fosters greater engagement in research activities.

The findings support the notion that self-efficacy acts as a mediator in the relationship between digital competencies and research engagement. As faculty members develop their digital skills, their confidence in utilizing these skills effectively increases, leading to higher levels of engagement in research. This mediating role of self-efficacy is consistent with previous research that has identified self-efficacy as a critical factor influencing engagement and performance across various domains (Procházka et al., 2017).

6.2. Practical Implications

The findings of this study have significant implications for faculty development programs. Institutions should prioritize enhancing faculty members' information literacy and problem-solving skills through targeted training and resources. Workshops, seminars, and online courses that focus on these competencies can empower faculty to engage more effectively in research activities. Additionally, fostering a culture of collaboration and communication within research teams can help mitigate the limitations of these competencies by encouraging knowledge sharing and collective problem-solving.

Furthermore, addressing the barriers that faculty face in developing these competencies is crucial. As highlighted by Yang et al. (2021), many faculty members may lack access to adequate training and resources, which can hinder their ability to enhance their digital competencies. Institutions should consider investing in comprehensive professional development initiatives that provide ongoing support and resources for faculty to build their digital skills.

7. Limitation and Recommendations for Future Research

The study has yielded significant findings, but it is important to acknowledge its limitations, which could be areas for further research. Firstly, the study's sample was limited to private universities in

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Indonesia. Future research could include public universities in Indonesia or universities in other countries. Secondly, there was a minimal response to the questionnaire from faculty members with the professor title, potentially impacting the representation of digital competence among professors in the population. Further research could involve a more extensive participation of faculty members with the professor title. Lastly, the study did not account for differences in digital skills mastery among the respondents, suggesting a potentially large digital skill gap. Therefore, future research should investigate these relationships and their implications for faculty development and institutional practices.

8. Conclusion

In conclusion, this study underscore the importance of understanding the relationship between digital competencies and self-efficacy in the context of faculty research engagement. By integrating insights from social cognitive theory, this research contributes to a deeper understanding of how digital competencies can enhance self-efficacy and, consequently, research engagement among faculty.

References

[1] W. Jia and X. Huang, "Digital Literacy and Vocational Education: Essential Skills for the Modern Workforce," *Int. J. Acad. Res. Bus. Soc. Sci.*, vol. 13, no. 5, 2023, doi: 10.6007/ijarbss/v13-i5/17080.

[2] A. J. Chan, L. W. Hooi, and K. S. Ngui, "Do Digital Literacies Matter in Employee Engagement in Digitalised Workplace?," *J. Asia Bus. Stud.*, vol. 15, no. 3, pp. 523–540, 2021, doi: 10.1108/jabs-08-2020-0318.

[3] E. Marsh, "Understanding the Effect of Digital Literacy on Employees' Digital Workplace Continuance Intentions and Individual Performance," pp. 1638–1659, 2021, doi: 10.4018/978-1-7998-7297-9.ch080.

[4] Z. Lokmic-Tomkins, L. Cochrane, T. Celeste, and M. Burnie, "An Interdisciplinary Partnership Approach to Improving the Digital Literacy Skills of Nursing Students to Become Digitally Fluent, Work-Ready Graduates," 2021, doi: 10.3233/shti210679.

[5] S. Pandey and D. S. Sushil, "Redesigning Employee Engagement Practices in the Digital Era," *Asian J. Manag. Commer.*, vol. 4, no. 1, pp. 235–241, 2023, doi: 10.22271/27084515.2023.v4.i1c.167.

[6] H. J. Kim, A. J. Hong, and H. Song, "The Relationships of Family, Perceived Digital Competence and Attitude, and Learning Agility in Sustainable Student Engagement in Higher Education," *Sustainability*, vol. 10, no. 12, p. 4635, 2018, doi: 10.3390/su10124635.

[7] E. Heidari, M. Mehrvarz, R. Marzooghi, and S. Stoyanov, "The Role of Digital Informal Learning in the Relationship Between Students' Digital Competence and Academic Engagement During the <scp>COVID</Scp>-19 Pandemic," *J. Comput. Assist. Learn.*, vol. 37, no. 4, pp. 1154–1166, 2021, doi: 10.1111/jcal.12553.

[8] Y. Zhang, A. M. P. Llorente, and M. C. Sánchez-Gómez, "Digital Competence in Higher Education Research: A Systematic Literature Review," *Comput. Educ.*, vol. 168, p. 104212, 2021, doi: 10.1016/j.compedu.2021.104212.

[9] M. Oberländer and T. Bipp, "Do Digital Competencies and Social Support Boost Work Engagement During the COVID-19 Pandemic?," *Comput. Human Behav.*, vol. 130, p. 107172, 2022, doi: 10.1016/j.chb.2021.107172.

[10] A. Bandura, "Social Cognitive Theory: An Agentic Perspective," *Asian J. Soc. Psychol.*, vol. 2, no. 1, pp. 21–41, 1999, doi: 10.1111/1467-839x.00024.

[11] L. P. Forsythe *et al.*, "Patient Engagement in Research: Early Findings From the Patient-Centered Outcomes Research Institute," *Health Aff.*, vol. 38, no. 3, pp. 359–367, 2019, doi: 10.1377/hlthaff.2018.05067.

[12] P. Tindana *et al.*, "Developing the Science and Methods of Community Engagement for Genomic Research and Biobanking in Africa," *Glob. Heal.*, vol. 2, 2017, doi: 10.1017/gheg.2017.9.

[13] N. Ferawati, "The Influence of Perceived Organizational Support and Self Efficacy on Employee Engagement in Generation Z DKI Jakarta," *Growth*, vol. 1, no. 01, pp. 26–32, 2023, doi: 10.59422/growth.v1i01.166.

[14] M. H. Jafri, "Moderating Role of Self-Efficacy on Benign Envy—Employee Engagement Relationship," *Bus. Perspect. Res.*, vol. 8, no. 2, pp. 232–243, 2020, doi: 10.1177/2278533719887454.

[15] W. R. Carter, P. Nesbit, R. Badham, S. K. Parker, and L. K. Sung, "The Effects of Employee Engagement and Self-Efficacy on Job Performance: A Longitudinal Field Study," *Int. J. Hum. Resour. Manag.*, vol. 29, no. 17, pp. 2483–2502, 2016, doi: 10.1080/09585192.2016.1244096.

[16] R. Chaudhary, S. Rangnekar, and M. K. Barua, "Relationships Between Occupational Self Efficacy, Human Resource Development Climate, and Work Engagement," *Team Perform. Manag.*, vol. 18, no. 7/8, pp. 370–383, 2012, doi: 10.1108/13527591211281110.

[17] X. W. Chan, T. Kalliath, P. Brough, M. P. O'Driscoll, O. L. Siu, and C. Timms, "Self-Efficacy and Work Engagement: Test of a Chain Model," *Int. J. Manpow.*, vol. 38, no. 6, pp. 819–834, 2017, doi: 10.1108/ijm-11-2015-0189.
[18] K. L. Wester, L. D. Borders, L. M. González, and P. L. Waalkes, "Factors Contributing to Scholarly Productivity of Assistant Professors in Counseling," *Couns. Educ. Superv.*, vol. 58, no. 3, pp. 225–237, 2019, doi: 10.1002/ceas.12152.
[19] J. Procházka, H. Gilová, and M. Vaculík, "The Relationship Between Transformational Leadership and Engagement: Self-Efficacy as a Mediator," *J. Leadersh. Stud.*, vol. 11, no. 2, pp. 22–33, 2017, doi: 10.1002/jls.21518.
[20] K. Ala-mutka, "Mapping Digital Competence : Author : Kirsti Ala-Mutka," *JRC Eur. Comm.*, no. January 2011, pp. 1–60, 2011, doi: 10.13140/RG.2.2.18046.00322.
[21] S. Carretero, R. Vuorikari, and Y. Punie, *The Digital Competence Framework for Citizens With Eight*, no. May. 2017.
[22] R. Vuorikari, Y. Punie, and L. Van Den Brande, *The Digital Competence Framework for Citizens*. 2016.
[23] O. Stoika, "Teacher's Digital Competence in the European Educational Discourse," *Mod. High. Educ. Rev.*, no. 8, 2023, doi: 10.28925/2617-5266.2023.813.
[24] Z. Wang and Z. Chu, "Examination of Higher Education Teachers' Self-Perception of Digital Competence, Self-Efficacy, and Facilitating Conditions: An Empirical Study in the Context of China," *Sustainability*, vol. 15, no. 14, p. 10945, 2023, doi: 10.3390/su151410945.
[25] L. Mannila, L.-Å. Nordén, and A. Pears, "Digital Competence, Teacher Self-Efficacy and Training Needs," 2018, doi: 10.1145/3230977.3230993.
[26] S. S. A. Hanifah, N. Ghazali, A. F. M. Ayub, and R. Roslan, "Predicting Teachers' Use of Digital Technology," *Int. J. Eval. Res. Educ.*, vol. 12, no. 2, p. 555, 2023, doi: 10.11591/ijere.v12i2.24237.
[27] A. Henne, P. Möhrke, L. Thoms, and J. Huwer, "Implementing Digital Competencies in University Science Education Seminars Following the DiKoLAN Framework," *Educ. Sci.*, vol. 12, no. 5, p. 356, 2022, doi: 10.3390/educsci12050356.
[28] L. v. Kotzebue *et al.*, "The Framework DiKoLAN (Digital Competencies for Teaching in Science Education) as Basis for the Self-Assessment Tool DiKoLAN-Grid," *Educ. Sci.*, vol. 11, no. 12, p. 775, 2021, doi: 10.3390/educsci11120775.
[29] R. Alarcón, E. d. P. Jiménez, and M. I. d. Vicente-Yagüe, "Development and Validation of the DIGIGLO, a Tool for Assessing the Digital Competence of Educators," *Br. J. Educ. Technol.*, vol. 51, no. 6, pp. 2407–2421, 2020, doi: 10.1111/bjet.12919.
[30] D. Koyuncuoglu, "Analysis of Digital and Technological Competencies of University Students," *Int. J. Educ. Math. Sci. Technol.*, vol. 10, no. 4, pp. 971–988, 2022, doi: 10.46328/ijemst.2583.
[31] L. M. Párraga, M. del C. L. Cejudo, and J. B. Osuna, "Validation of the DigCompEdu Check-in Questionnaire Through Structural Equations: A Study at a University in Peru," *Educ. Sci.*, vol. 12, no. 8, p. 574, 2022, doi: 10.3390/educsci12080574.
[32] H. O. Falola, O. Ogueyungbo, A. Adeniji, and E. Adesina, "Exploring Sustainable E-Learning Platforms for Improved Universities' Faculty Engagement in the New World of Work," *Sustainability*, vol. 14, no. 7, p. 3850, 2022, doi: 10.3390/su14073850.
[33] X.-N. Cui, "Organizational Commitment, Self-Efficacy and Work Engagement Among Chinese Employees in Foreign IT Companies: Basis for Improved Work Performance Framework," *Int. J. Res. Stud. Manag.*, vol. 11, no. 7, 2023, doi: 10.5861/ijrsm.2023.1086.
[34] H. Zhao, X. Liu, and C. Qi, "'Want to Learn' and 'Can Learn': Influence of Academic Passion on College Students' Academic Engagement," *Front. Psychol.*, vol. 12, 2021, doi: 10.3389/fpsyg.2021.697822.
[35] Y. Shao and S. Kang, "The Association Between Peer Relationship and Learning Engagement Among Adolescents: The Chain Mediating Roles of Self-Efficacy and Academic Resilience," *Front. Psychol.*, vol. 13, 2022, doi: 10.3389/fpsyg.2022.938756.
[36] M. Kurniawati, C. Saleh, and M. R. K. Muluk, "Academic Career Development in Indonesia and the United Kingdom: A Systematic Literature Review," *Jpi (Jurnal Pendidik. Indones.*, vol. 10, no. 3, p. 409, 2021, doi: 10.23887/jpi-undiksha.v10i3.32159.
[37] D. Toyibah, "The Gender Gap and Career Path of the Academic Profession Under the Civil Service System at a Religious University in Jakarta, Indonesia," *Komunitas Int. J. Indones. Soc. Cult.*, vol. 10, no. 1, pp. 1–13, 2018, doi: 10.15294/komunitas.v10i1.12228.
[38] A. A. Musyaffa, "Examining It-Based Human Resources Strategies in Islamic Higher Education and Islamic Boarding Schools in Indonesia," *Tafkir Interdiscip. J. Islam. Educ.*, vol. 4, no. 3, pp. 519–534, 2023, doi: 10.31538/tijie.v4i3.664.
[39] Fathurrahman and A. Muhtarom, "Analysis of Increasing the Three Pillars of Higher Education Development in Human Resources Behavior," 2019, doi: 10.2991/coema-19.2019.42.
[40] J. C. Phillips and R. K. Russel, "Research Self-Efficacy, the Research Training Environment, and Research Productivity among Graduate Students in Counseling Psychology," *Counceling Psychol.*, vol. 22, no. 4, pp. 628–6, 1994.
[41] J. H. Kahn and N. A. Scott, "Predictors of Research Productivity and Science-Related Career Goals Among Counceling Psychology Doctoral Students," *Counceling Psychol.*, vol. 25, no. 1, pp. 38–67, 1997.
[42] W. B. Schaufeli, A. B. Bakker, and M. Salanova, "The Measurement of Work Engagement With a Short Questionnaire," *Educ. Psychol. Meas.*, vol. 66, no. 4, pp. 701–716, 2006, doi: 10.1177/0013164405282471.
[43] C. M. Ringle, S. Wende, and J. M. Becker, *SmartPLS 3*. Boenningstedt: SmartPLS GmbH, 2015.

[44] J. F. Hair, G. T. M. Hult, C. M. Ringle, and M. Sarstedt, *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). Thousand Oaks.* 2017.

[45] K. M. B. Portento, A. M. T. Borboran, and E. A. Paredes, "Self-Efficacy as a Mediator Between Motivation and Engagement and Academic Performance," *J. Math. Stat. Stud.*, vol. 3, no. 2, pp. 37–41, 2022, doi: 10.32996/jmss.2022.3.2.4.

[46] H. Wu, S. Li, J. Zheng, and J. Guo, "Medical Students' Motivation and Academic Performance: The Mediating Roles of Self-Efficacy and Learning Engagement," *Med. Educ. Online*, vol. 25, no. 1, 2020, doi: 10.1080/10872981.2020.1742964.

[47] Q. Luo, L. Chen, D. Yu, and K. Zhang, "The Mediating Role of Learning Engagement Between Self-Efficacy and Academic Achievement Among Chinese College Students," *Psychol. Res. Behav. Manag.*, vol. Volume 16, pp. 1533–1543, 2023, doi: 10.2147/prbm.s401145.

[48] S. Sánchez-Canut, "Professional Digital Competence: Definition, Frameworks, Measurement, and Gender Differences: A Systematic Literature Review," *Hum. Behav. Emerg. Technol.*, vol. 2023, pp. 1–22, 2023, doi: 10.1155/2023/8897227.

[49] M. Astuti, Z. Arifin, F. Mutohhari, and M. Nurtanto, "Competency of Digital Technology: The Maturity Levels of Teachers and Students in Vocational Education in Indonesia," *J. Educ. Technol.*, vol. 5, no. 2, 2021, doi: 10.23887/jet.v5i3.35108.

[50] M. W. Septiana, Z. Akbar, and A. Maksum, "The Role of Academic Efficiency on Student Learning Engagement," *Int. J. Multicult. Multireligious Underst.*, vol. 8, no. 7, p. 268, 2021, doi: 10.18415/ijmmu.v8i7.2818.

[51] C. Tramontano, C. Grant, and C. Clarke, "Development and Validation of the E-Work Self-Efficacy Scale to Assess Digital Competencies in Remote Working," *Comput. Hum. Behav. Reports*, vol. 4, p. 100129, 2021, doi: 10.1016/j.chbr.2021.100129.

[52] M. T. Tomczak, "Do the Young Employees Perceive Themselves as Digitally Competent and Does It Matter?," *Cent. Eur. Manag. J.*, vol. 31, no. 4, pp. 522–534, 2023, doi: 10.1108/cemj-04-2022-0226.

[53] G. Hong, Y. Ou, Z. Zhang, M. Ni, X. Zhou, and L. Liao, "The Relationship Between Family Support and E-Learning Engagement in College Students: The Mediating Role of E-Learning Normative Consciousness and Behaviors and Self-Efficacy," *Front. Psychol.*, vol. 12, 2021, doi: 10.3389/fpsyg.2021.573779.

[54] J. Yang, M. Y. Peng, S. Wong, and W.-L. Chong, "How E-Learning Environmental Stimuli Influence Determinates of Learning Engagement in the Context of COVID-19? SOR Model Perspective," *Front. Psychol.*, vol. 12, 2021, doi: 10.3389/fpsyg.2021.584976.

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