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Workforce Skills and SME Competitiveness in Indonesia: The Mediating Role of Digital Adoption Depth

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ABSTRACT

Digital adoption may generate different competitive value across SMEs depending on how deeply technologies are integrated into business functions. This study examines the relationship between workforce skills and SME competitiveness in Indonesia and the mediating role of digital adoption depth. A cross-sectional survey of 100 SME owners across six Indonesian provinces was analysed using partial least squares structural equation modelling (PLS-SEM). Workforce skills comprised digital proficiency, problem-solving ability, adaptability, and managerial competence, while digital adoption depth reflected technology integration across business functions. Results showed that workforce skills were positively associated with digital adoption depth (β = .312) and SME competitiveness (β = .262). Digital adoption depth had the strongest relationship with competitiveness (β = .450) and significantly mediated the relationship between workforce skills and competitiveness (β = .140), indicating complementary mediation. The model explained 34.5% of competitiveness variance. These findings highlight the importance of combining workforce development with deeper digital integration to strengthen SME competitiveness.

Keywords: Workforce Skills; Digital Adoption Depth; SME Competitiveness; Small and Medium-Sized Enterprises; Indonesia.

INTRODUCTION

Digital technologies have become increasingly embedded in the competitive environment of small and medium-sized enterprises (SMEs). Digital marketing, e-commerce, electronic payments, business applications, and data-supported tools allow smaller firms to reach customers, process transactions, coordinate operations, and respond more rapidly to market change. Yet greater access to these technologies does not mean that firms derive comparable benefits from them. SMEs may use similar digital tools while differing substantially in how extensively those tools are incorporated into their business activities. The relevant question is therefore no longer simply whether SMEs adopt digital technologies, but how deeply those technologies become integrated into the organisation and which internal capabilities enable such integration.

This issue is particularly relevant in Indonesia, where micro, small, and medium-sized enterprises constitute the overwhelming majority of the business population. OECD data indicate that Indonesia had approximately 56.14 million MSMEs in 2024, representing 99.90% of all businesses and contributing 59.64% of national gross domestic product (OECD, 2026). The wider digital environment has also continued to expand. BPS-Statistics Indonesia reported that 72.78% of the population accessed the internet in 2024, compared with 69.21% in 2023 (BPS-Statistics Indonesia, 2025a). These figures indicate increasingly widespread connectivity, but population-level internet access should not be interpreted as evidence that businesses have reached an equivalent level of digital integration.

The distinction between digital access and productive organisational use remains important. The OECD (2024) identifies limited business digitalisation and persistent skill deficiencies as constraints on Indonesia's digital transformation. Fewer than 10% of Indonesian firms provide training to their workers, compared with almost one-third of firms in East Asia. At the same time, technological change is increasing demand not only for technical proficiency but also for higher-order capabilities such as problem-solving, critical thinking, leadership, and the ability to adapt to changing work requirements. Expanding infrastructure or encouraging firms to participate in digital platforms is therefore unlikely to be sufficient when enterprises lack the human capabilities required to translate technological access into productive business practice.

Workforce capability is especially consequential in SMEs because smaller firms typically operate with fewer specialised employees, more limited resources, and less formalised organisational structures than larger enterprises. BPS-Statistics Indonesia (2025b) continues to identify limitations in human-resource quality and managerial capability among the challenges faced by micro and small industries. In SMEs, employees commonly perform overlapping functions and must adjust quickly to changing operational and customer requirements. Workforce skills in this context therefore extend beyond technical proficiency. They include the ability to use relevant digital tools, solve business problems, adapt to changing work requirements, and apply managerial and business judgement to organisational activities.

The resource-based view (RBV) provides a useful basis for understanding why these capabilities may be associated with competitiveness. Barney (1991) argues that differences in firm outcomes arise partly from heterogeneity in the resources and capabilities available to firms and the ways in which those resources are deployed. Many contemporary digital technologies are increasingly accessible through common platforms, marketplaces, payment systems, and commercial applications. Access to the same technological resources therefore offers only a limited basis for differentiation. By contrast, workforce capabilities embedded in employees' knowledge, experience,

learning, and organisational practice are less readily reproduced. A workforce able to combine digital proficiency with problem-solving, adaptability, and managerial competence may consequently constitute a strategically valuable organisational resource.

Workforce skills, however, do not automatically translate into stronger competitive outcomes. Their organisational value depends partly on how they are mobilised in business practice. This reasoning is consistent with the dynamic capabilities perspective, which emphasises the capacity of firms to adapt and reconfigure resources as technological and market conditions change (Teece, 2007). Employees with stronger capabilities may be better able to evaluate technological options, learn new systems, resolve implementation difficulties, and connect digital tools with existing business activities. Technology therefore becomes organisationally consequential not simply when it is acquired, but when it is integrated sufficiently into the activities through which the firm engages customers, conducts transactions, manages information, and makes decisions.

This distinction calls for a more precise conceptualisation of digital adoption. Much of the SME digitalisation literature identifies adoption through the presence or use of particular technologies. Such measures are useful for establishing whether firms have crossed an initial threshold of technology uptake, but they may obscure substantial differences among adopters. An SME that uses social media primarily as an additional promotional channel differs from one that integrates digital customer interaction, online sales, payments, administration, and information-supported decision-making across its business activities. Recent research therefore distinguishes the breadth of digital adoption the range of technologies employed from its depth, which reflects the extent to which technologies are substantively and strategically integrated into organisational activities.

Evidence from Indonesia already points towards the importance of differences in the level and form of technology use. Affandi et al. (2024), drawing on 5,035 ultra-micro, micro, and small enterprises across 17 provinces, examined digitalisation through five business processes: e-procurement, point-of-sale systems, e-marketing, e-commerce, and digital payments. Their Digital Adoption Index incorporated not only the presence of technologies but also differences in their level of use, and digital adoption was positively associated with sales growth. Although their sample extends beyond the small and medium enterprises examined in the present study, their findings demonstrate that business digitalisation is multidimensional and cannot be reduced to a simple adopter–non-adopter distinction.

Human and organisational conditions also influence firms' engagement with digital technologies. Faiz et al. (2024), analysing 419 Indonesian SMEs, found that human resources, digital culture, top-management support, adoption costs, and trading-partner pressure significantly influenced digital technology adoption. This evidence shows that technology adoption cannot be understood as an isolated technological decision. Whether firms can incorporate technologies into their activities depends partly on the organisational and human capabilities available to them. However, the principal concern of their study is the determinants of adoption rather than how broader workforce capabilities may be translated into competitive outcomes through deeper technological integration.

Several studies have examined mechanisms closer to this relationship. Purba and Balqiah (2024), using 359 SMEs, found that employee skills, information technology, and digital strategy positively influenced SME digitalisation and that digitalisation mediated their relationships with financial performance. Prakasa and Jumani (2024), based on 330

small businesses in East Java, similarly reported that digital business transformation mediated the relationship between digital capability and business performance. These studies establish that internal capabilities can generate business outcomes through digitalisation. They also mean that merely demonstrating a mediating role for technology adoption between human capability and firm performance would offer limited additional insight.

Recent research further sharpens the unresolved issue. Harsasi et al. (2026) show that routinized digital technology use is positively associated with both organisational performance and competitiveness among Indonesian MSMEs. Their findings emphasise that technological readiness and sustained organisational use should not be treated as equivalent. International evidence adds another distinction. Hu et al. (2026) differentiate digital adoption breadth from digital adoption depth and show that strategic technological integration has stronger organisational consequences than the simple accumulation of technologies. Although their empirical setting involves Spanish wineries rather than Indonesian SMEs, the distinction is theoretically useful for understanding why firms that have adopted similar technologies may obtain different organisational benefits.

Taken together, this literature suggests that the remaining issue is not whether workforce capabilities, digital technologies, and firm outcomes are related. Those relationships are increasingly well established. The more specific question is whether broader workforce skills are associated with SME competitiveness partly through the depth with which digital technologies become integrated into business functions. This question shifts attention from initial technological uptake towards the organisational process through which human capabilities and digital resources are combined.

Accordingly, this study distinguishes workforce skills from digital adoption depth. Workforce skills refer to the combined capabilities of organisational members to use digital technologies, solve business-related problems, adapt to changing requirements, and apply managerial and business knowledge. Digital adoption depth refers to the extent to which digital technologies are substantively integrated into key business functions rather than merely being available or initially adopted. These functions include digital marketing and customer interaction, online sales and e-commerce, digital transactions and payments, digital administration and operations, and information-supported decision-making. Workforce skills therefore capture what organisational members are capable of doing, whereas digital adoption depth captures how extensively digital resources are embedded across relevant business activities.

The outcome examined is SME competitiveness rather than financial performance alone. Competitiveness refers to the enterprise's relative capacity to respond to changing customer requirements, differentiate its offerings, adapt to competitive pressures, and maintain or improve its position relative to comparable firms. Financial outcomes such as sales growth and profitability can reflect successful competition, but they represent realised economic results rather than the broader organisational capacity to compete. Examining competitiveness therefore makes it possible to assess whether workforce capability and deeper digital integration are associated with the firm's relative market and organisational position.

The study consequently addresses a specific gap in the Indonesian SME literature. Existing research has established relationships between employee skills and digitalisation, digital capabilities and business performance, and substantive technology use and competitiveness. What remains less developed is an explanation of whether a multidimensional workforce capability—combining digital proficiency, problem-solving ability, adaptability, and managerial competence—is associated with SME

competitiveness through digital adoption depth across business functions. This formulation moves beyond binary technology adoption while avoiding the assumption that technology ownership, technology use, and deeper organisational integration represent the same phenomenon.

The study makes three contributions. First, it conceptualises workforce skills as a multidimensional organisational capability comprising digital proficiency, problem-solving ability, adaptability, and managerial competence rather than reducing human capability to technical digital skills. Second, it focuses explicitly on digital adoption depth, distinguishing initial technology uptake from substantive integration across business functions. Third, it examines SME competitiveness as an outcome distinct from financial performance and tests whether digital adoption depth represents an intervening pathway linking workforce capability with competitive positioning. The study thereby brings the RBV and the dynamic capabilities perspective together in a theoretically differentiated way: the RBV explains the strategic relevance of heterogeneous workforce capabilities, while the dynamic capabilities perspective helps explain why learning, adaptation, and resource reconfiguration matter when those capabilities are deployed in a changing technological environment.

Accordingly, the study examines the relationship between workforce skills and SME competitiveness among SMEs operating in Indonesia and assesses the mediating role of digital adoption depth. It addresses the following research question: To what extent does digital adoption depth mediate the relationship between workforce skills and SME competitiveness among SMEs in Indonesia?

LITERATURE REVIEW

Theoretical Foundation

This study primarily draws on the resource-based view (RBV) to explain why workforce skills may contribute to SME competitiveness and uses the dynamic capabilities perspective to clarify how such capabilities may acquire greater organisational value through deeper digital integration. The two perspectives serve complementary rather than interchangeable roles. The RBV focuses on heterogeneity in firm resources and capabilities, whereas the dynamic capabilities perspective draws attention to how firms adapt, mobilise, and reconfigure those resources as technological and market conditions change.

The RBV conceptualises firms as heterogeneous bundles of tangible and intangible resources and proposes that differences in the development and deployment of those resources can contribute to differences in competitive outcomes (Barney, 1991). This argument is particularly relevant in contemporary SME environments, where many digital technologies are increasingly accessible to competing firms. Social-media platforms, e-commerce marketplaces, digital payment systems, and commercially available business applications can often be obtained from the same providers and used by firms operating in similar markets. Access to these technologies alone therefore offers a limited explanation for why some SMEs achieve stronger competitive positions than others.

Human capabilities provide a potentially more heterogeneous resource base. In this study, workforce skills refer to the combined capabilities of organisational members to use digital technologies, solve business-related problems, adapt to changing requirements, and apply managerial and business knowledge to organisational activities. These capabilities are especially relevant to SMEs because smaller enterprises commonly operate with limited functional specialisation. Owners and employees may perform overlapping operational, marketing, administrative, technological, and customer-

facing responsibilities, making their ability to learn and apply knowledge directly relevant to firm-level activities.

The dynamic capabilities perspective complements this resource-based explanation by emphasising the importance of adaptation and resource reconfiguration under conditions of technological and market change (Teece, 2007). From this perspective, acquiring a technology does not by itself constitute organisational transformation. Firms must learn how to use it, resolve implementation problems, connect it with existing resources, and incorporate it into activities that support changing business requirements. The perspective is therefore useful for explaining why the organisational value of workforce skills may depend partly on how those skills support the deployment of digital technologies.

This reasoning provides the theoretical basis for **digital adoption** depth**.** Digital adoption breadth concerns the range or number of technologies used by a firm, whereas digital adoption depth concerns the extent to which digital technologies are substantively integrated into relevant organisational activities. Hu et al. (2026) provide empirical support for distinguishing these dimensions by showing that deeper strategic integration can be more consequential for organisational outcomes than the simple accumulation of technologies. Although their evidence comes from Spanish wineries rather than Indonesian SMEs, the distinction provides an important conceptual basis for separating technology acquisition from substantive organisational integration.

Accordingly, the framework developed in this study treats **workforce skills as an internal organisational capability, digital adoption depth as an organisational deployment pathway, and SME competitiveness as the focal outcome**. Digital adoption depth is not treated as a dynamic capability in itself. Rather, it represents the extent to which digital resources become embedded in business activities through processes that may depend on underlying learning, adaptive, problem-solving, and managerial capabilities.

Workforce Skills and Digital Adoption Depth

The adoption of digital technology depends on more than the availability, affordability, or technical characteristics of digital tools. Firms also require people who can recognise the relevance of technologies, learn how they operate, address implementation difficulties, and connect their use with business requirements. These human capabilities become particularly important when the focus moves beyond initial technology uptake towards deeper organisational integration.

Basic participation in digitalisation may require relatively limited organisational change. An SME may establish a social-media account, register on an e-commerce marketplace, introduce digital payments, or acquire a business application while leaving most existing business processes unchanged. Digital adoption depth represents a more demanding stage in which technologies become substantively incorporated into activities such as customer interaction and marketing, online sales, transactions and payments, administration and operations, and information-supported decision-making.

Workforce skills should facilitate this process in several complementary ways**. Digital proficiency** enables organisational members to understand and use technologies relevant to the business. **Problem-solving ability** helps employees identify and address difficulties arising during implementation and use. **Adaptability** enables organisational members to adjust as technologies, platforms, work practices, and customer expectations change. **Managerial competence** helps connect technological applications with operational and market priorities. Together, these capabilities should

increase an SME's ability to move beyond initial uptake towards more substantive digital integration.

Existing Indonesian evidence supports the broader relationship between human resources and digitalisation. Purba and Balqiah (2024), using data from 359 SMEs, found that employee skills positively influenced SME digitalisation and that digitalisation subsequently mediated relationships between internal organisational factors and financial performance. Faiz et al. (2024), based on 419 Indonesian SMEs, also identified human resources as a significant determinant of digital technology adoption alongside digital culture, top-management support, adoption costs, and trading-partner pressure.
These studies establish that the human dimension of SMEs is relevant to digitalisation, but they primarily examine general adoption or digitalisation rather than the **depth with which technologies become integrated across business functions**. The present study therefore extends the argument from technology uptake to substantive organisational integration. If firms with stronger workforce capabilities are better able to learn, adapt, resolve implementation problems, and align technologies with business requirements, they should also exhibit greater digital adoption depth.
Therefore:
H1: Workforce skills are positively associated with digital adoption depth among SMEs.

Workforce Skills and SME Competitiveness
SME competitiveness refers to an enterprise's capacity to maintain or strengthen its relative position by responding effectively to customers, markets, operational requirements, and competitive pressures. It is reflected in capabilities such as responsiveness to changing customer needs, innovation or differentiation relative to competitors, resilience under changing competitive conditions, and the ability to maintain a favourable competitive position.

Competitiveness is related to, but conceptually distinct from, financial performance. Sales growth, profitability, and return on investment represent realised economic outcomes. Competitiveness instead concerns the organisational and market position that may enable firms to generate and sustain such outcomes. This distinction is important because improvements in the capabilities needed to compete may precede observable changes in financial results.

The RBV provides a direct theoretical basis for linking workforce skills with competitiveness. Employees with stronger problem-solving abilities may address operational difficulties more effectively; adaptable employees may respond more rapidly to changes in customers and markets; managerial competence can strengthen coordination and prioritisation; and digital proficiency can improve the firm's ability to operate in an increasingly technology-intensive environment. Unlike standardised technological applications that can often be obtained by competitors, combinations of knowledge, experience, adaptability, and business judgement embedded in organisational members may be more difficult to reproduce.

Evidence from Indonesian MSMEs supports the broader relevance of human capability to competitive outcomes. Abbas et al. (2025), studying 150 MSME actors in Kendari, reported a significant positive relationship between human-resource competence and competitive advantage. Their construct differs from the higher-order workforce-skills construct employed here, but their findings support the broader proposition that differences in human capability are relevant to the competitive position of smaller firms.
The present study extends this proposition by conceptualising workforce skills as a multidimensional capability comprising **digital proficiency, problem-solving ability,**

adaptability, and managerial competence. This broader specification recognises that competitiveness in SMEs may depend on the capacity of organisational members to address both technological and non-technological demands. Stronger workforce skills should therefore be associated directly with stronger SME competitiveness, independently of their relationship with digital adoption depth.
Therefore:
H2: Workforce skills are positively associated with SME competitiveness.

Digital Adoption Depth and SME Competitiveness
Digital technologies can contribute to SME competitiveness by widening market access, facilitating customer interaction, accelerating transactions, improving information flows, supporting administrative and operational activities, and strengthening information-supported decision-making. These potential benefits, however, depend on how technologies are incorporated into the organisation.

Evidence from Indonesia already suggests that differences in the level of technology use matter. Affandi et al. (2024), using data from 5,035 ultra-micro, micro, and small enterprises across 17 provinces, developed a Digital Adoption Index covering e-procurement, point-of-sale systems, e-marketing, e-commerce, and digital payments. Their measure incorporated differences in technology use rather than relying exclusively on whether a technology was present, and higher digital adoption was positively associated with sales growth.

More recent research provides a closer connection between substantive technology use and competitiveness. Harsasi et al. (2026), based on 404 Indonesian MSME owners and managers, distinguish technological readiness from **routinized digital technology use** and find that routinized use is positively related to both organisational performance and competitiveness. Their results reinforce the argument that technological resources become more consequential when they move beyond readiness or initial experimentation and become meaningfully used within the organisation.

Routinization and digital adoption depth should nevertheless remain conceptually distinct**. Routinization concerns the regularity and normalisation of technology use,** whereas **digital adoption depth concerns the extent of substantive integration across relevant business functions**. A technology may be used repeatedly for one narrow purpose while remaining disconnected from other organisational activities. Conversely, deeper integration implies that digital technologies contribute across activities such as customer interaction, sales, transactions, administration, operations, and decision-making. The concepts can therefore overlap empirically without being equivalent.

The conceptual significance of depth is further supported by Hu et al. (2026), who distinguish digital adoption breadth from digital adoption depth and find stronger organisational consequences for strategic integration than for the simple accumulation of technologies. Their study examines Spanish wineries rather than Indonesian SMEs, so its empirical results should not be transferred directly to the Indonesian setting. Nevertheless, it demonstrates why measures that distinguish technological quantity from organisational integration can provide a more precise account of digitalisation.

For SMEs, deeper digital integration should increase the likelihood that technology contributes to customer responsiveness, market engagement, operating effectiveness, and managerial use of information. Digital adoption depth should therefore be associated with a stronger competitive position.
Therefore:

H3: Digital adoption depth is positively associated with SME competitiveness.

The Mediating Role of Digital Adoption Depth

The preceding arguments suggest that workforce skills may be associated with SME competitiveness both directly and indirectly through digital adoption depth. The mediation argument is based on a distinction between **organisational capability and organisational deployment**. Workforce skills capture what organisational members are capable of doing, whereas digital adoption depth captures the extent to which digital resources become substantively integrated into business activities.

Two SMEs may have access to identical digital platforms while using them in markedly different ways. One enterprise may treat an e-commerce platform simply as an additional sales channel, whereas another may connect digital sales with customer interaction, payment processes, administration, operational information, and managerial decision-making. The technological resources available to the firms may be similar, but the extent of organisational integration differs.

Workforce capabilities provide one explanation for this difference. Digital proficiency can improve employees' ability to understand technological tools; problem-solving skills can help resolve implementation difficulties; adaptability can support learning as technologies and market requirements change; and managerial competence can help connect digital practices with broader organisational priorities. Digital adoption depth therefore provides a theoretically plausible pathway linking workforce capability with competitive outcomes.

Previous Indonesian research has established related mediation mechanisms. Purba and Balqiah (2024) found that digitalisation mediated relationships between internal SME factors, including employee skills, and financial performance. Prakasa and Jumani (2024), using 330 small businesses in East Java, found that digital business transformation mediated the relationship between digital capability and business performance. Abbas et al. (2025) also examined technology adoption as an intervening variable between human-resource competence and MSME competitive advantage.

These studies mean that the novelty of the present research does not lie in introducing technology as a mediator between human capability and firm outcomes for the first time. Rather, its contribution lies in specifying **a different level of the digitalisation process**. The study asks whether broader workforce skills are associated with SME competitiveness through the **depth of digital integration across business functions**, rather than through general technology adoption or digitalisation alone.

This distinction is theoretically consequential. Initial adoption establishes that a firm has begun using a digital technology. Digital adoption depth captures the extent to which the technology becomes incorporated into the firm's substantive business activities. If workforce skills are associated with deeper digital integration and deeper integration is associated with stronger competitiveness, a significant indirect relationship should emerge.
Therefore:
H4: Digital adoption depth mediates the positive relationship between workforce skills and SME competitiveness.

Conceptual Framework

The conceptual model contains three analytically distinct constructs. **Workforce skills** constitute the exogenous organisational capability, **digital adoption depth** serves as the mediating construct, and **SME competitiveness** represents the endogenous

outcome. The model is grounded primarily in the RBV and complemented by the dynamic capabilities perspective.
The hypotheses are represented as follows:
H1: Workforce Skills → Digital Adoption Depth
H2: Workforce Skills → SME Competitiveness
H3: Digital Adoption Depth → SME Competitiveness
H4: Workforce Skills → Digital Adoption Depth → SME Competitiveness

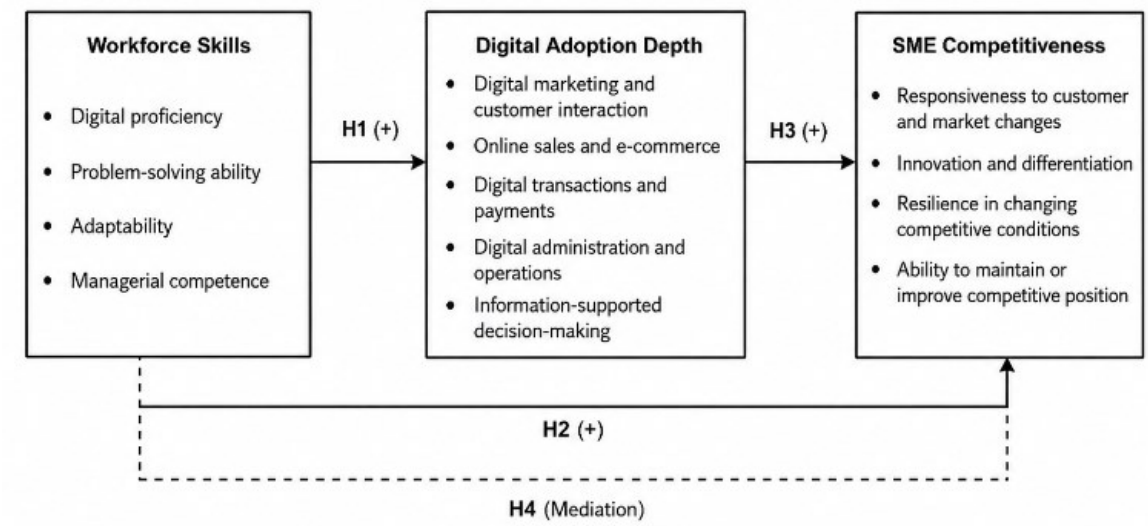

Figure 1. Conceptual Framework

As presented in **Figure 1**, the model specifies a direct relationship between workforce skills and SME competitiveness (H2), together with an indirect pathway through digital adoption depth (H1 and H3). H4 evaluates whether the indirect relationship through digital adoption depth is statistically supported. Because the study uses cross-sectional data, these pathways represent theoretically specified structural relationships and should not be interpreted as definitive evidence of temporal causality.

RESEARCH METHOD

Research Design

This study employed a quantitative cross-sectional survey to examine the relationships among workforce skills, digital adoption depth, and SME competitiveness. The enterprise was the unit of analysis, while the business owner served as the key informant. Owners were selected because they are generally directly involved in workforce management, technology-related decisions, business operations, and responses to market conditions within SMEs. The questionnaire therefore required respondents to evaluate the capabilities and practices of the enterprise rather than their individual characteristics alone.

The empirical model specified workforce skills as the exogenous construct, digital adoption depth as the mediating construct, and SME competitiveness as the endogenous construct. The model examined both the direct relationship between workforce skills and competitiveness and the indirect relationship operating through digital adoption depth. Because all observations were collected at a single point in time, the estimated structural relationships are interpreted as theoretically specified associations rather than definitive evidence of temporal causality.

Partial least squares structural equation modelling (PLS-SEM) was used to estimate the model. PLS-SEM was appropriate for the measurement structure employed in this study because the model combines reflective and formative measurement, incorporates a reflective–formative higher-order construct, and estimates direct and indirect structural relationships. The analysis was conducted using SmartPLS 4 (Ringle et al., 2024).

Population and Sample

The target population comprised owners of small and medium-sized enterprises operating in several Indonesian provinces. The empirical study focused specifically on **small and medium enterprises (SMEs)** rather than the broader category of micro, small, and medium enterprises. This restriction was adopted to maintain consistency between the study population, conceptual framework, and research objective.

Enterprise classification followed Government Regulation of the Republic of Indonesia No. 7 of 2021. For businesses already in operation, annual sales were used as the classification criterion. A small enterprise was defined as a business with annual sales exceeding IDR 2 billion and not exceeding IDR 15 billion, while a medium-sized enterprise was defined as a business with annual sales exceeding IDR 15 billion and not exceeding IDR 50 billion.

A **purposive sampling** strategy was employed because respondents needed sufficient knowledge of workforce capabilities, digital practices, and the competitive position of their enterprises. An enterprise was eligible when: (1) the respondent was the business owner; (2) the enterprise met the annual-sales criterion for a small or medium-sized enterprise; (3) the business had been operating for at least one year; and (4) the enterprise employed at least one worker in addition to the owner. The final criterion was included to ensure that workforce skills represented an enterprise-level workforce capability rather than solely the individual capability of the business owner.

The analytical sample comprised **100 SME owners from several Indonesian provinces**. Information on province, business sector, business age, number of employees, and enterprise size was collected to characterise the sample. Because the study employed purposive rather than probability sampling, the sample should not be interpreted as statistically representative of the Indonesian SME population. The results therefore provide evidence from a multi-provincial sample of SMEs rather than national population estimates.

Sample adequacy was assessed using the inverse square root method proposed by Kock and Hadaya (2018), rather than the conventional ten-times rule. Assuming a significance level of .05, statistical power of .80, and a minimum anticipated standardised path coefficient of approximately .25, the method yields a minimum sample requirement of approximately 99 observations. The analytical sample of 100 observations therefore met this sensitivity threshold. This assessment does not imply equivalent statistical power for substantially smaller relationships or population-level representativeness.

Measures

The survey instrument comprised screening questions, business-profile questions, and measures of workforce skills, digital adoption depth, and SME competitiveness. Items were informed by previous studies and adapted to the conceptual definitions employed in this research. The operationalisation of the three constructs is summarised in Table 1.

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Table 1. Operationalisation of the Study Constructs

Construct	Operational definition	Dimensions/indicators	Measurement model	Scale	Main sources
Workforce Skills (WS)	The combined capabilities of the enterprise's workforce to use digital technologies, solve business-related problems, adapt to changing requirements, and apply managerial and business knowledge to organisational activities	Digital proficiency; problem-solving ability; adaptability; managerial competence	Reflective–formative higher-order construct	Five-point Likert scale	Purba & Balqiah (2024); theoretically adapted
Digital Adoption Depth (DAD)	The extent to which digital technologies are substantively integrated into key business functions rather than merely being available or initially adopted	Digital marketing and customer interaction; online sales and e-commerce; digital transactions and payments; digital administration and operations; information-supported decision-making	Formative composite	Five-point integration scale	Affandi et al. (2024); Hu et al. (2026)
SME Competitiveness (COMP)	The enterprise's perceived capacity to maintain	Relative competitive position; responsiveness to changing customer needs;	Reflective construct	Five-point Likert scale	Harsasi et al. (2026)

Construct	Operational definition	Dimensions/indicators	Measurement model	Scale	Main sources
	or strengthen its competitive position relative to comparable competitors	innovation/differentiation; resilience under changing competitive conditions			

Workforce Skills

Workforce skills were conceptualised as a **reflective–formative higher-order construct** comprising four lower-order dimensions: digital proficiency, problem-solving ability, adaptability, and managerial competence. Each lower-order dimension was represented by multiple reflective indicators.

Digital proficiency captures the workforce's ability to understand, learn, and use digital technologies relevant to the enterprise. Problem-solving ability reflects the capacity to identify and address operational and technology-related problems. Adaptability captures the ability to adjust to technological change, changing customer requirements, and modifications in work processes. Managerial competence reflects the capability to coordinate activities, prioritise tasks, and apply managerial and business knowledge to organisational requirements.

At the lower-order level, indicators were specified reflectively because they represent manifestations of their corresponding capability dimensions. At the higher-order level, the four dimensions jointly form the broader workforce-skills construct and were therefore specified formatively. The higher-order construct was estimated using the **disjoint two-stage approach**. In the first stage, the four reflective lower-order components were estimated and their construct scores obtained. In the second stage, these scores served as formative indicators of the higher-order workforce-skills construct.

To maintain the enterprise as the unit of analysis, workforce-skill items were framed with reference to the workforce of the respondent's business rather than the owner's individual skills. Items were assessed on a five-point Likert scale ranging from **1 = strongly disagree to 5 = strongly agree.**

Digital Adoption Depth

Digital adoption depth was conceptualised as the extent to which digital technologies are **substantively integrated into key business functions**, rather than merely being present or initially adopted. The functional domains were informed by Affandi et al. (2024), while the distinction between technology accumulation and deeper organisational integration was informed by Hu et al. (2026).

Five areas of integration were examined: (1) digital marketing and customer interaction, (2) online sales and e-commerce, (3) digital transactions and payments, (4) digital administration and operations, and (5) information-supported decision-making. These areas represent different ways in which digital technologies can become incorporated into the activities of an SME.

Digital adoption depth was specified as a **formative composite** because the five domains collectively define the construct and are not assumed to be interchangeable manifestations of a single underlying condition. Greater integration in one business function does not necessarily imply equivalent integration in another. For example, an enterprise may integrate digital payments extensively while maintaining relatively limited use of digital information in managerial decision-making.

The indicators were assessed using a five-point integration scale ranging from **1 = not used or not integrated in this business function** to **5 = extensively integrated into this business function.** This formulation intentionally captures the **depth of functional integration** rather than the frequency or routinisation of technology use.

SME Competitiveness

SME competitiveness was specified as a reflective construct capturing the enterprise's perceived capacity to maintain or strengthen its position relative to comparable competitors. The construct comprises four manifestations: relative competitive position, responsiveness to changing customer needs, innovation or differentiation relative to competitors, and resilience under changing competitive conditions.

The construct was informed by Harsasi et al. (2026) while remaining conceptually distinct from financial performance. Respondents evaluated competitiveness relative to comparable businesses rather than reporting sales, profitability, or other realised financial outcomes. Items were measured on a five-point Likert scale ranging **from 1 = strongly disagree to 5 = strongly agree.**

Data Collection and Quality Control

Data were collected through a structured questionnaire administered to eligible SME owners across several Indonesian provinces. Screening questions were presented before the substantive measures to verify ownership status, annual-sales category, business age, and workforce size. Only respondents whose enterprises met all eligibility criteria proceeded to the analytical sample.

Annual sales were recorded using categorical ranges rather than exact monetary values. This approach reduced the sensitivity associated with disclosing business revenue while allowing enterprises to be classified according to the small- and medium-enterprise thresholds established under Government Regulation No. 7 of 2021. Province, business sector, years of operation, number of employees, and enterprise size were also recorded to describe sample characteristics.

Participation was voluntary. Respondents were informed about the academic purpose of the study, the confidentiality of their responses, and the use of the data in aggregate form. Personally identifying information was not required for the statistical analysis.

Several procedural measures were incorporated to reduce potential common-method bias associated with the use of a single key informant. Measures of the predictor, mediator, and outcome constructs were presented in separate questionnaire sections; item wording was kept concise and non-leading; and respondents were informed that there were no objectively correct or preferred answers. The questionnaire also maintained distinct response formats for the attitudinal workforce-skills and competitiveness measures and the functional-integration measure of digital adoption depth.

Before PLS-SEM analysis, observations were screened for respondent eligibility, missing responses, duplicate submissions, implausible response patterns, and extensive straight-lining. Only observations meeting the eligibility and data-quality criteria were retained.

Data Analysis

Data were analysed using SmartPLS 4 through sequential assessment of the measurement and structural models.

For the reflective lower-order dimensions of workforce skills and the reflective SME-competitiveness construct, measurement quality was assessed through indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Outer loadings of approximately .70 or higher were considered desirable. Internal consistency reliability was evaluated using rho_A and composite reliability, while average variance extracted (AVE) values of at least .50 were used to establish convergent validity. Discriminant validity among the reflective constructs was evaluated using the heterotrait-monotrait ratio (HTMT).

The reflective–formative higher-order workforce-skills construct was estimated using the **disjoint two-stage approach**. In the first stage, the reflective lower-order constructs digital proficiency, problem-solving ability, adaptability, and managerial competence were estimated and their construct scores obtained. In the second stage, these construct scores were used as formative indicators of workforce skills.

Because both the higher-order workforce-skills construct and digital adoption depth were formatively specified, their assessment focused on collinearity and the significance and relevance of the formative components. Variance inflation factor (VIF) values were examined for potential collinearity, and outer weights were evaluated for their magnitude and statistical significance. The corresponding outer loadings and theoretical relevance of components were also considered when interpreting formative indicators rather than relying exclusively on the statistical significance of the outer weights.

Convergent validity of the formative constructs was evaluated through **redundancy analysis** using global criterion measures corresponding to workforce skills and digital adoption depth. Reliability coefficients and AVE were not applied to the formative higher-order construct or digital adoption depth because internal-consistency criteria assume interchangeable reflective indicators and are therefore not appropriate for formative measurement.

Following satisfactory measurement-model assessment, the structural model was examined for predictor collinearity, explanatory power, effect sizes, statistical significance, and predictive performance. The analysis included inner VIF values, standardised path coefficients, coefficients of determination (R^2 and adjusted R^2), effect sizes (f^2), and out-of-sample predictive assessment using PLSpredict.

The statistical significance of outer weights and structural paths was evaluated through **10,000 bootstrap resamples** and 95% confidence intervals. H1 was assessed through the relationship between workforce skills and digital adoption depth, H2 through the direct relationship between workforce skills and SME competitiveness, and H3 through the relationship between digital adoption depth and SME competitiveness.

H4 was evaluated using the **specific indirect effect** of workforce skills on SME competitiveness through digital adoption depth. Mediation was considered statistically supported when the bootstrapped confidence interval of the specific indirect effect excluded zero. The pattern of mediation was interpreted by considering the direction and

significance of both the indirect and remaining direct relationships rather than assuming complete or partial mediation in advance.

Finally, the model's out-of-sample predictive performance was examined using **PLSpredict with 10-fold cross-validation**. Q^2_predict values were examined for predictive relevance, while prediction errors from the PLS-SEM model were compared with those generated by a linear-model benchmark using root mean square error (RMSE) and mean absolute error (MAE). Predictive performance was interpreted at the indicator level for the endogenous constructs rather than inferred from explanatory power alone.

RESULTS

Sample Characteristics

The analytical sample comprised 100 SME owners who satisfied the eligibility and data-quality criteria. All respondents owned enterprises classified as small or medium-sized businesses, had operated their businesses for at least one year, and employed at least one worker in addition to the owner.

The sample covered six Indonesian provinces. West Java accounted for the largest proportion of respondents (22%), followed by East Java (20%), DKI Jakarta (18%), Central Java (15%), Bangka Belitung (13%), and South Sumatra (12%). Trade represented the largest business sector (29%), followed by food and beverage (24%), services (21%), manufacturing and production (16%), and other activities (10%).

Most enterprises were classified as small businesses (82%), while 18% were medium-sized enterprises. Regarding business age, 39% had operated for one to five years, 37% for six to ten years, and 24% for more than ten years. Nearly half of the enterprises employed between two and five workers (46%), 39% employed between six and nineteen workers, and 15% employed twenty or more workers.

Table 2. Sample Characteristics

Characteristic	Category	n	%
Province	West Java	22	22.0
	East Java	20	20.0
	DKI Jakarta	18	18.0
	Central Java	15	15.0
	Bangka Belitung	13	13.0
	South Sumatra	12	12.0
Business sector	Trade	29	29.0
	Food and beverage	24	24.0
	Services	21	21.0
	Manufacturing/production	16	16.0
	Other sectors	10	10.0
Enterprise size	Small enterprise	82	82.0
	Medium enterprise	18	18.0
Business age	1–5 years	39	39.0
	6–10 years	37	37.0
	>10 years	24	24.0
Number of employees	2–5	46	46.0
	6–19	39	39.0
	≥20	15	15.0

Given the purposive sampling strategy, these characteristics describe the analytical sample and should not be interpreted as representing the national distribution of Indonesian SMEs.

Reflective Measurement Model

The measurement model was assessed before examining the structural relationships. The reflective assessment covered the four lower-order dimensions of workforce skills—digital proficiency, problem-solving ability, adaptability, and managerial competence—and SME competitiveness.

As shown in Table 3, all indicator loadings exceeded .70 and ranged from .750 to .860. Composite reliability values ranged from .833 to .895, while rho_A values ranged from .770 to .850. Average variance extracted (AVE) values ranged from .625 to .684 and therefore exceeded the .50 criterion for convergent validity. Taken together, these results indicate satisfactory indicator reliability, internal consistency reliability, and convergent validity.

Table 3. Reflective Measurement Model

Construct	Indicator	Loading	rho_A	Composite Reliability	AVE
Digital Proficiency	DP1	.790	.790	.854	.662
	DP2	.840			
	DP3	.810			
Problem-Solving Ability	PS1	.760	.780	.839	.636
	PS2	.830			
	PS3	.800			
Adaptability	AD1	.800	.820	.866	.684
	AD2	.860			
	AD3	.820			
Managerial Competence	MC1	.750	.770	.833	.625
	MC2	.820			
	MC3	.800			
SME Competitiveness	COMP1	.780	.850	.895	.682
	COMP2	.840			
	COMP3	.820			
	COMP4	.860			

Discriminant validity was assessed using the heterotrait-monotrait ratio (HTMT). As reported in Table 4, all HTMT values were below .85. The highest value was observed between problem-solving ability and adaptability (.81). Although these two capability dimensions were comparatively closely related, the value remained within the conservative criterion for discriminant validity.

Table 4. HTMT Assessment

Construct	DP	PS	AD	MC	COMP
Digital Proficiency (DP)	—				
Problem-Solving Ability (PS)	.67	—			
Adaptability (AD)	.64	.81	—		
Managerial Competence (MC)	.61	.74	.72	—	
SME Competitiveness (COMP)	.55	.62	.65	.68	—

The results therefore supported the reliability and validity of the reflective lower-order constructs used in the subsequent higher-order and structural analyses.

Higher-Order Workforce Skills and Digital Adoption Depth

Workforce skills were evaluated as a reflective–formative higher-order construct comprising digital proficiency, problem-solving ability, adaptability, and managerial competence. Following the disjoint two-stage procedure, the scores of the four lower-order constructs were used as formative components of the higher-order workforce-skills construct.

As shown in Table 5, all four dimensions contributed positively and significantly to workforce skills. Digital proficiency produced the largest outer weight (.321), followed by adaptability (.304), problem-solving ability (.287), and managerial competence (.276). VIF values ranged from 1.60 to 2.03, indicating no problematic collinearity among the four formative components.

Table 5. Higher-Order Workforce Skills Assessment

Component	Outer Weight	Outer Loading	t-value	p-value	VIF
Digital Proficiency	.321	.781	3.84	<.001	1.71
Problem-Solving Ability	.287	.744	3.21	.001	1.92
Adaptability	.304	.769	3.56	<.001	2.03
Managerial Competence	.276	.732	3.08	.002	1.60

Redundancy analysis produced a coefficient of .88 between the higher-order workforce-skills construct and its global criterion measure, supporting convergent validity.

Digital adoption depth was assessed as a formative composite representing substantive digital integration across five business functions. Information-supported decision-making showed the largest outer weight (.301), followed by digital marketing and customer interaction (.284), online sales and e-commerce (.238), digital administration and operations (.221), and digital transactions and payments (.205).

Table 6. Formative Digital Adoption Depth Assessment

Indicator	Business Function	Outer Weight	Outer Loading	t-value	p-value	VIF
DAD1	Digital marketing and customer interaction	.284	.762	3.46	.001	2.48
DAD2	Online sales and e-commerce	.238	.718	2.91	.004	2.73
DAD3	Digital transactions and payments	.205	.681	2.42	.016	2.31
DAD4	Digital administration and operations	.221	.703	2.67	.008	2.58
DAD5	Information-supported decision-making	.301	.794	3.79	<.001	3.04

VIF values ranged from 2.31 to 3.04. The VIF for information-supported decision-making (DAD5) was marginally above the conservative value of 3.00 but remained well below 5.00, indicating no critical multicollinearity. All formative outer weights were statistically significant and theoretically relevant and were therefore retained.

The redundancy coefficient for digital adoption depth was .83, providing additional support for the convergent validity of the formative composite. Overall, the assessment supported the use of both the higher-order workforce-skills construct and digital adoption depth in the structural model.

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Structural Model and Hypothesis Testing

Following satisfactory measurement-model assessment, the structural model was examined. Inner VIF values ranged from 1.00 to 1.11, indicating no substantial collinearity among the predictor constructs.

The model explained **9.7% of the variance in digital adoption depth (R^2 = .097; adjusted R^2 = .088)** and **34.5% of the variance in SME competitiveness (R^2 = .345; adjusted R^2 = .331)**. The comparatively modest R^2 for digital adoption depth indicates that workforce skills represent one relevant antecedent of deeper digital integration but leave substantial variation to be explained by other organisational, technological, financial, and environmental factors. Workforce skills and digital adoption depth jointly accounted for approximately one-third of the variance in SME competitiveness.
The structural-path results are reported in Table 7.

Table 7. Structural Model and Hypothesis Testing

Hypothesis	Structural Relationship	β	t-value	p-value	95% CI	f^2	Result
H1	Workforce Skills → Digital Adoption Depth	.312	3.19	.001	[.126, .492]	.108	Supported
H2	Workforce Skills → SME Competitiveness	.262	2.91	.004	[.093, .428]	.095	Supported
H3	Digital Adoption Depth → SME Competitiveness	.450	4.92	<.001	[.272, .614]	.279	Supported

Workforce skills were positively associated with digital adoption depth (β = .312, t = 3.19, p = .001), supporting H1. SMEs with stronger workforce capabilities reported greater substantive integration of digital technologies across business functions.

Workforce skills were also positively associated with SME competitiveness (β = .262, t = 2.91, p = .004), supporting H2. This relationship remained statistically significant after digital adoption depth was incorporated into the model.

Digital adoption depth exhibited the strongest direct structural relationship with SME competitiveness (β = .450, t = 4.92, p < .001), supporting H3. SMEs reporting deeper integration of digital technologies across their business activities also reported stronger competitive positions.

Effect-size analysis showed relatively small contributions of workforce skills to digital adoption depth (f^2 = .108) and SME competitiveness (f^2 = .095). Digital adoption depth showed a moderate contribution to the explanation of SME competitiveness (f^2 = .279).

Mediating Role of Digital Adoption Depth

H4 examined whether digital adoption depth mediated the relationship between workforce skills and SME competitiveness. The specific indirect relationship was positive and statistically significant **(β = .140, t = 2.64, p = .008)**, with a 95% bootstrap confidence interval of [.052, .247]. Because the confidence interval excluded zero, H4 was supported.

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Table 8. Direct, Indirect, and Total Relationships

Relationship	β	t-value	p-value	95% CI
Workforce Skills → SME Competitiveness (direct)	.262	2.91	.004	[.093, .428]
Workforce Skills → Digital Adoption Depth → SME Competitiveness (indirect)	.140	2.64	.008	[.052, .247]
Workforce Skills → SME Competitiveness (total)	.402	4.18	<.001	[.220, .566]

The direct relationship between workforce skills and SME competitiveness remained positive and statistically significant after the indirect pathway was considered. Because the direct and indirect relationships were both positive and significant, the observed pattern is **consistent with complementary mediation**.

The specific indirect relationship represented approximately **34.9% of the total estimated relationship** between workforce skills and SME competitiveness. This proportion is reported descriptively rather than used as the principal criterion for determining mediation.

Taken together, the mediation results indicate that workforce skills are associated with SME competitiveness through two complementary pathways. One relationship operates directly, while another operates through the depth with which digital technologies are integrated into business functions.

Predictive Assessment

The out-of-sample predictive performance of the model was assessed using PLSpredict with 10-fold cross-validation. Positive Q^2_predict values were obtained for all indicators of the two endogenous constructs, digital adoption depth and SME competitiveness, indicating predictive relevance relative to the indicator-mean benchmark.

For digital adoption depth, Q^2_predict values ranged from .041 to .105. PLS-SEM prediction errors were also generally lower than those generated by the linear-model benchmark.

Table 9. PLSpredict Assessment for Digital Adoption Depth

Indicator	Q^2_predict	PLS RMSE	LM RMSE	PLS MAE	LM MAE
DAD1	.084	.982	1.006	.782	.799
DAD2	.063	1.014	1.031	.811	.824
DAD3	.041	1.038	1.049	.826	.835
DAD4	.071	.997	1.018	.794	.808
DAD5	.105	.951	.984	.758	.782

The predictive results for SME competitiveness were stronger. Q^2_predict values for its four indicators ranged from .241 to .307. For each indicator, both RMSE and MAE produced by PLS-SEM were lower than the corresponding linear-model benchmark.

Table 10. PLSpredict Assessment for SME Competitiveness

Indicator	Q^2_predict	PLS RMSE	LM RMSE	PLS MAE	LM MAE
COMP1	.241	.843	.876	.671	.698
COMP2	.286	.812	.849	.649	.676
COMP3	.263	.828	.861	.661	.688
COMP4	.307	.796	.835	.638	.670

Overall, the PLSpredict results indicate relatively modest out-of-sample predictive performance for digital adoption depth and stronger predictive performance for SME competitiveness. This pattern is consistent with the substantially higher explanatory power obtained for SME competitiveness in the structural model.

Summary of Hypothesis Testing

The results of the four hypothesis tests are summarised in Table 11.

Table 11. Summary of Hypothesis Testing

Hypothesis	Proposed Relationship	β	Result
H1	Workforce Skills → Digital Adoption Depth	.312	Supported
H2	Workforce Skills → SME Competitiveness	.262	Supported
H3	Digital Adoption Depth → SME Competitiveness	.450	Supported
H4	Workforce Skills → Digital Adoption Depth → SME Competitiveness	.140	Supported

Overall, the findings support the proposed conceptual model. Workforce skills were positively associated with both digital adoption depth and SME competitiveness, while digital adoption depth showed the strongest direct structural relationship with competitiveness. The significant specific indirect relationship further supports the proposed mediating role of digital adoption depth. The results are therefore consistent with a model in which workforce capability and the substantive integration of digital technologies jointly account for variation in SME competitiveness.

DISCUSSION

The findings support the proposed relationships among workforce skills, digital adoption depth, and SME competitiveness, while also revealing a more differentiated pattern than a simple technology–performance relationship. Workforce skills are positively associated with both digital adoption depth and competitiveness, while digital adoption depth shows the strongest direct structural relationship with SME competitiveness. The significant indirect relationship further indicates that part of the association between workforce skills and competitiveness operates through deeper digital integration. Taken together, the results suggest that the competitive relevance of workforce capability lies not only in what organisational members are able to contribute directly, but also in their capacity to support the substantive integration of digital technologies across business functions.

Workforce Skills and Digital Adoption Depth

The positive relationship between workforce skills and digital adoption depth (β = .312) supports H1. SMEs with stronger digital proficiency, problem-solving ability, adaptability, and managerial competence tend to report deeper integration of digital technologies into their business activities. This pattern reinforces the argument that substantive digitalisation depends on more than technological availability. It also requires organisational members who can understand technological tools, address implementation difficulties, adjust their use as conditions change, and connect them with business requirements.

The result is consistent with previous Indonesian research. Purba and Balqiah (2024), using data from 359 SMEs, found that employee skills positively influenced SME digitalisation, while Faiz et al. (2024), based on 419 Indonesian SMEs, identified human resources as a significant determinant of digital technology adoption alongside digital culture, top-management support, adoption costs, and trading-partner pressure. These studies establish the importance of human resources for SME digitalisation.

The present findings extend this argument by focusing on a broader configuration of workforce capability and a more specific stage of digitalisation. Digital proficiency may enable employees to operate technological tools, but deeper integration requires more than technical competence. Problem-solving ability supports responses to implementation difficulties, adaptability facilitates learning as technologies and market requirements change, and managerial competence helps align digital applications with organisational priorities. Workforce capability therefore appears relevant not only to whether firms engage with technology but also to how substantively that technology becomes incorporated into business functions.

This interpretation is also consistent with Sagala and Őri (2024), whose systematic review identifies organisational learning and IT alignment as central elements of SME digital transformation. Their analysis suggests that digital transformation depends on the capacity to learn, experiment, and align technological resources with organisational requirements rather than simply accumulating new technologies.

At the same time, workforce skills explain only 9.7% of the variance in digital adoption depth. This relatively modest explanatory power is theoretically informative. It indicates that workforce capability is an important but incomplete explanation for differences in digital integration among SMEs. Faiz et al. (2024) show that digital adoption is also shaped by factors such as managerial support, digital culture, adoption costs, and trading-partner pressure. Affandi et al. (2024) similarly identify differences in firm characteristics, business conditions, infrastructure, and contextual factors associated with variations in digital adoption among Indonesian enterprises.

Workforce skills should therefore be understood as an enabling capability for deeper digital integration rather than a sufficient condition for it. Capable employees may increase an SME's ability to integrate technology into business activities, but this capacity continues to operate within technological, organisational, financial, and environmental constraints.

Workforce Skills and SME Competitiveness

The positive direct relationship between workforce skills and SME competitiveness (β = .262) supports H2. Importantly, this relationship remains statistically significant after digital adoption depth is included in the structural model. Workforce capability therefore retains relevance for competitiveness beyond its association with deeper digital integration.

This finding is consistent with the resource-based view, which attributes differences in competitive outcomes partly to heterogeneity in internal resources and capabilities (Barney, 1991). Many digital applications can be accessed by competing firms through common platforms or technology providers. Workforce capabilities, by contrast, are embedded in combinations of knowledge, experience, learning, problem-solving, adaptability, and organisational practice and may therefore be less readily reproduced. These capabilities can contribute to SME competitiveness through several routes. Problem-solving ability can improve responses to operational challenges, adaptability can support adjustment to changing customer and market requirements, managerial competence can strengthen coordination and prioritisation, and digital proficiency can improve the firm's capacity to operate in an increasingly technology-intensive business environment. Their value is therefore not confined to explicitly digital activities.

The finding is broadly consistent with Abbas et al. (2025), who reported a positive relationship between human-resource competence and competitive advantage among MSMEs in Kendari. Although their human-resource competence construct differs from

the multidimensional workforce-skills construct employed here, both findings support the broader proposition that human capability is relevant to the competitive position of smaller enterprises.

The present study develops this proposition by modelling workforce skills as a higher-order capability comprising digital proficiency, problem-solving ability, adaptability, and managerial competence. This broader specification is particularly appropriate to SMEs, where limited functional specialisation frequently requires organisational members to contribute across operations, customer relations, administration, technology use, and business decision-making.

The smaller coefficient for workforce skills relative to digital adoption depth should not be interpreted as evidence that workforce capability is secondary. Instead, the pattern highlights a distinction between possessing organisational capabilities and deploying them through business processes. Workforce skills retain a direct association with competitiveness, but part of their organisational value appears to be linked to the way those capabilities support the integration of digital resources.

This interpretation is consistent with the RBV while also providing a role for the dynamic capabilities perspective. The cross-sectional results do not demonstrate a dynamic capability directly, but they are compatible with a process-oriented explanation in which learning, adaptation, and the reconfiguration of organisational resources matter when firms respond to technological and market change (Teece, 2007).

Digital Adoption Depth and SME Competitiveness

Digital adoption depth shows the strongest direct structural relationship with SME competitiveness (β = .450), supporting H3. SMEs reporting more substantive integration of digital technologies across business functions also tend to report stronger competitive positions.

This finding is consistent with Indonesian evidence from Affandi et al. (2024). Their study of 5,035 ultra-micro, micro, and small enterprises across 17 provinces developed a Digital Adoption Index encompassing e-procurement, point-of-sale systems, e-marketing, e-commerce, and digital payments. Importantly, their measure incorporated differences in the level of technology use rather than simply distinguishing adopters from non-adopters, and digital adoption was positively associated with sales growth.

More recent evidence from Harsasi et al. (2026) provides a particularly relevant comparison. Their study of 404 Indonesian MSME owners and managers found that routinized digital technology use was positively associated with both organisational performance and competitiveness. Their results reinforce the broader argument that technological readiness or initial adoption alone is unlikely to capture the organisational value of digitalisation.

Routinized digital use and digital adoption depth should nevertheless remain analytically distinct. Routinization concerns the regularity and normalisation of technology use within organisational routines. Digital adoption depth, as operationalised in the present study, concerns the extent to which digital technologies are substantively integrated across different business functions. A technology may be used frequently for one isolated activity without being connected to sales, transactions, administration, customer interaction, or decision-making. Conversely, deeper adoption implies broader functional integration rather than simply repeated use.

The distinction is reinforced by Hu et al. (2026), who differentiate digital adoption breadth from digital adoption depth and find stronger organisational consequences for strategic integration than for the accumulation of technologies. Their empirical context—Spanish wineries differs from Indonesian SMEs, and their findings should therefore not be transferred directly. Nevertheless, their distinction provides useful conceptual support for understanding why firms with similar technological portfolios may experience different organisational outcomes.

The present findings also help contextualise mixed results within Indonesia. Abbas et al. (2025), for example, did not find a significant direct relationship between technology adoption and competitive advantage, although technology adoption was incorporated into their mediation model linking human-resource competence with competitive advantage.

This difference should not be interpreted simply as conflicting evidence. The studies differ in samples, measurement approaches, outcome constructs, and the conceptualisation of technological engagement. One plausible interpretation is that broad measures of technology adoption may group together enterprises that differ substantially in the depth of actual organisational integration. Such an interpretation remains tentative and requires direct comparative testing.
The combined evidence therefore points to an important conceptual distinction: digital access, initial uptake, routinized use, adoption breadth, and adoption depth represent related but non-equivalent dimensions of digitalisation. Competitive benefits may become more evident when technologies move beyond isolated or initial use and become integrated into the organisational processes through which SMEs interact with customers, undertake transactions, coordinate operations, and use information in decision-making.

The Mediating Role of Digital Adoption Depth
The mediation analysis provides the central explanatory insight of the study. Workforce skills have a significant positive indirect relationship with SME competitiveness through digital adoption depth (β = .140), while the direct relationship between workforce skills and competitiveness remains statistically significant. This pattern is consistent with complementary mediation and supports H4.

The results suggest that workforce skills are associated with competitiveness through two related pathways. The first is direct: stronger workforce capabilities are linked with problem-solving, adaptation, coordination, customer responsiveness, and managerial judgement. The second operates through digital integration: stronger workforce capabilities are associated with greater digital adoption depth, which in turn is associated with stronger competitiveness.

Previous studies have identified related indirect relationships. Purba and Balqiah (2024) found that digitalisation mediated relationships between internal SME factors, including employee skills, and financial performance. Prakasa and Jumani (2024) similarly found that digital business transformation mediated the relationship between digital capability and business performance among small businesses in East Java. Abbas et al. (2025) also examined technology adoption as an intervening variable between human-resource competence and competitive advantage.

The contribution of the present model therefore does not lie in demonstrating for the first time that technology can mediate the relationship between organisational capabilities and firm outcomes. Instead, it lies in specifying digital adoption depth as the intervening

construct and in distinguishing broader workforce capability from deeper functional integration of digital technologies.

This distinction matters because workforce skills represent what organisational members are capable of doing, whereas digital adoption depth represents how extensively technological resources become incorporated into substantive business activities. The results suggest that part of the competitive relevance of workforce skills is associated with this organisational deployment pathway.

The persistence of the direct relationship between workforce skills and competitiveness is equally important. Digital adoption depth does not account for the entire relationship between workforce capability and competitive position. The findings therefore do not support a substitution argument in which technological integration replaces human capability. They are instead more consistent with resource complementarity: workforce capabilities retain independent relevance, while deeper digital integration represents an additional pathway through which those capabilities are associated with competitiveness.

From an RBV perspective, this helps explain why access to similar technologies may produce different outcomes across firms. Technologies may be broadly accessible, but the capabilities required to integrate them with firm-specific knowledge, activities, and organisational priorities remain heterogeneous.

The dynamic capabilities perspective adds a process-oriented interpretation. Workforce skills support learning and adaptation, while deeper digital integration reflects one way in which organisational practices may be reconfigured around technological opportunities. Digital adoption depth should therefore not itself be labelled a dynamic capability. Rather, it is treated here as an organisational deployment pathway through which underlying capabilities become connected with technology-enabled business practices.

CONCLUSION

This study examined the relationship between workforce skills and SME competitiveness in Indonesia and assessed the mediating role of digital adoption depth. The findings support the proposed model. Workforce skills are positively associated with both digital adoption depth and SME competitiveness, while digital adoption depth shows the strongest direct relationship with competitiveness. The significant indirect relationship further indicates that deeper digital integration represents one pathway through which workforce skills are associated with competitive outcomes. The remaining direct relationship suggests that digital adoption depth complements rather than substitutes for the competitive relevance of workforce capability.

The study contributes to the SME digitalisation literature in three ways. First, it conceptualises workforce skills as a multidimensional organisational capability comprising digital proficiency, problem-solving ability, adaptability, and managerial competence. Second, it moves beyond binary technology adoption by focusing on digital adoption depth, understood as the substantive integration of digital technologies across key business functions. Third, it identifies a significant mediating pathway linking workforce skills, digital adoption depth, and SME competitiveness. These findings are consistent with a capability–deployment–competitiveness logic in which heterogeneous workforce capabilities, as emphasised by the resource-based view, acquire additional organisational relevance when combined with deeper digital integration. The dynamic capabilities perspective complements this interpretation by highlighting the importance of learning and adaptation as firms respond to technological change.

The findings also have practical implications. SME digitalisation should not be reduced to acquiring technologies or participating in digital platforms. Greater attention is needed to how technologies are integrated into customer interaction, sales, transactions, operations, administration, and decision-making. Workforce development should therefore accompany digitalisation initiatives by strengthening not only technical proficiency but also problem-solving, adaptability, and managerial competence. SME-support programmes may likewise be more effective when technological assistance is combined with capability development and support for substantive business integration. Several limitations should be considered. The cross-sectional design does not establish temporal causality, and reciprocal relationships between workforce capability, digital integration, and competitiveness remain possible. The purposive sample of 100 SME owners from several provinces also limits population-level generalisation and detailed comparisons across sectors and regions. In addition, reliance on owners as single informants introduces potential common-source bias, while SME competitiveness is measured perceptually rather than through objective market or financial indicators. Finally, the modest variance explained in digital adoption depth indicates that workforce skills represent only one element of a broader digitalisation process.

Future research should therefore employ longitudinal and multi-informant designs, larger and more diverse samples, and combinations of perceptual and objective performance measures. Additional antecedents such as access to finance, technological costs, infrastructure, organisational culture, managerial commitment, and competitive pressure should also be examined. Further studies could distinguish adoption breadth, depth, intensity, and routinisation to determine whether different patterns of digital engagement produce different competitive outcomes.

Overall, the study indicates that SME competitiveness depends not simply on possessing digital technologies or workforce capabilities, but on how these resources are combined. Workforce skills provide the human capability to learn, adapt, solve problems, and exercise managerial judgement, while digital adoption depth reflects the extent to which technological resources become substantively integrated into business activities. Strengthening SME competitiveness therefore requires attention to both human capability and the depth of digital integration

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