Volume 4 Number 2 (2026)
July-December 2026
Page: 767-792

E-ISSN: 2986-6502
DOI: 10.37680/ssa.10955

Social Science Academic

AI Adoption, AI Literacy, and Employee Performance: The Mediating Role of Work Autonomy in MSMEs

Arif Tirtana[1], Sudarmiatin[1], Agus Hermawan[1], Wening Patmi Rahayu[1]

[1] Universitas Negeri Malang; Indonesia

Received: 18/08/2026 Revised: 16/09/2026 Accepted: 09/10/2026

Abstract

This study aims to examine the effects of AI Adoption and AI Literacy on Employee Performance and to investigate the mediating role of Work Autonomy in the MSME context. A quantitative cross-sectional design was employed using questionnaire data from 300 respondents, analyzed with Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS 3. The measurement model was assessed through reliability, convergent validity, and discriminant validity, while the structural model was evaluated using path coefficients and indirect effects. The results indicate that AI Adoption and AI Literacy are positively and significantly associated with both Work Autonomy and Employee Performance, and Work Autonomy is positively and significantly associated with Employee Performance. Work Autonomy also partially mediates the relationships between AI Adoption and Employee Performance and between AI Literacy and Employee Performance. This study contributes to the literature by integrating AI Adoption, AI Literacy, and Work Autonomy into a single framework to explain Employee Performance in MSMEs. The findings highlight Work Autonomy as an important mechanism through which employees' AI adoption and literacy can translate into improved performance, offering a more nuanced understanding of the human and organizational implications of AI in the workplace.

Keywords

AI Adoption; AI Literacy; Work Autonomy; Employee Performance; MSMEs.

Corresponding Author
Arif Tirtana
Universitas Negeri Malang, Indonesia; arif.tirtana.2604139@students.um.ac.id

1. INTRODUCTION

Employee performance is a fundamental concern in human resource management (HRM) because employees' ability to accomplish their tasks effectively determines the productivity, competitiveness, and sustainability of organizations. This issue is particularly important in micro, small, and medium-sized enterprises (MSMEs), where limited human and financial resources require organizations to maximize the contribution of their employees. Recent evidence confirms that HRM practices play an important role in shaping employee performance in micro, small, and medium-sized enterprises (MSMEs), particularly through mechanisms related to employee development, motivation, satisfaction, and the management of work processes (Hasibuan et al., 2026). Therefore, improving employee

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performance should remain a central HRM priority, especially for MSMEs that operate with relatively lean organizational structures and often require employees to perform multiple roles.

However, maintaining high employee performance in MSMEs is not without challenges. MSMEs commonly operate under resource constraints, including limited access to skilled human resources, financial resources, technological infrastructure, and managerial capabilities. These constraints may affect employees' ability to complete tasks efficiently, respond to changing customer demands, and make timely work-related decisions. A recent systematic review of AI adoption in MSMEs highlights that resource limitations, skill shortages, and infrastructure constraints remain important challenges in realizing the performance benefits of AI within smaller firms (Landini & Machado, 2026). From an HRM perspective, these conditions indicate the need for approaches that do not merely increase organizational efficiency but also enable employees to perform their tasks more effectively.

One emerging approach is the utilization of artificial intelligence (AI) as a workplace resource. AI applications can assist employees in information processing, communication, customer service, marketing, accounting, decision-making, and other routine activities. The increasing availability of relatively affordable AI applications has made AI adoption increasingly relevant for MSMEs that previously faced substantial barriers to advanced technologies. Recent research specifically examining MSMEs suggests that AI adoption can support organizational performance in resource-constrained environments by improving firms' capabilities and enabling more effective utilization of technological resources (Landini & Machado, 2026). Nevertheless, the performance implications of AI should not be understood solely at the organizational level because the implementation of AI ultimately changes how employees perform their work.

Importantly, AI adoption does not automatically translate into higher employee performance. The benefits of AI depend on how employees interact with and integrate AI into their work processes. Recent research focusing specifically on AI adoption and employee performance in MSMEs argues that AI can reduce repetitive work and improve access to information, but its contribution to employee performance depends on complementary factors such as digital skills, organizational support, employee trust, ethical governance, and work redesign (Dong, 2026). This suggests that the relationship between AI adoption and employee performance should be examined through an employee-centered HRM perspective rather than assuming that the presence of AI technology itself is sufficient to improve performance.

Another factor that may influence the effectiveness of AI in the workplace is employees' AI literacy. AI literacy refers to employees' ability to understand, evaluate, interact with, and appropriately utilize AI technologies in work-related contexts. While AI adoption reflects the extent to which organizations or employees utilize AI technologies, AI literacy represents the human capability required to use these

technologies effectively. This distinction is important because the availability and adoption of AI do not necessarily indicate that employees possess sufficient knowledge and skills to interact with AI systems productively. Employees with higher levels of AI literacy are more likely to understand the capabilities and limitations of AI, critically evaluate AI-generated information, and integrate AI tools appropriately into their work processes (Long & Magerko, 2020). In the context of MSMEs, where employees often operate with limited organizational resources and may perform multiple roles, AI literacy can become particularly important because it enables employees to identify appropriate applications of AI and maximize the benefits of AI-enabled technologies (Landini & Machado, 2026).

AI literacy may also influence employees' ability to manage and perform their work effectively in AI-enabled environments. From an HRM perspective, this suggests that the benefits of AI adoption depend not only on the availability and utilization of AI technologies but also on employees' ability to understand and use these technologies effectively (Dong, 2026). Therefore, examining AI literacy alongside AI adoption provides a more comprehensive employee-centered perspective for understanding the factors that may influence work autonomy and, ultimately, employee performance.

Beyond its potential influence on work autonomy, AI literacy may directly contribute to employee performance by enabling employees to use AI technologies more effectively in completing their work. Employees with higher AI literacy are better able to identify appropriate applications of AI, evaluate AI-generated outputs, and integrate AI tools into their tasks while recognizing their limitations (Long & Magerko, 2020). These capabilities may improve employees' ability to process information, solve work-related problems, make informed decisions, and complete tasks effectively. In this sense, AI literacy represents not merely knowledge about AI but an employee capability that can help individuals translate AI technologies into improved work practices and performance outcomes. Therefore, employees with higher levels of AI literacy are expected to demonstrate better employee performance in MSMEs.

One important employee-centered mechanism that may explain these relationships is work autonomy. In AI-enabled work environments, employees may receive information, recommendations, automation, and decision support that can influence how they organize and perform their tasks. AI adoption can therefore provide employees with additional resources that may increase their ability to exercise discretion in performing their work (Belhaj et al., 2026). Similarly, employees with higher AI literacy may be better equipped to determine how AI can be appropriately incorporated into their tasks and to evaluate AI-generated information, potentially strengthening their ability to exercise discretion in their work (Dong, 2026). Recent empirical research in SMEs provides evidence that AI integration is associated with work autonomy and identifies work autonomy as a mechanism linking AI integration with employee engagement (Belhaj et al., 2026). Thus, work autonomy may serve as an important

employee-level mechanism through which both AI adoption and AI literacy relate to employee performance.

Nevertheless, an important research gap remains. Existing research on AI adoption in MSMEs has predominantly examined organizational-level outcomes, including firm performance, competitiveness, revenue growth, innovation, and organizational capabilities (Landini & Machado, 2026). Although emerging employee-level research has begun to demonstrate that work autonomy is associated with employee performance, much of this evidence has been generated in specific service-sector contexts, such as hotels, rather than among MSME employees more broadly (Rasheed et al., 2026). In addition, recent research on the mediating role of work autonomy has focused on the link between AI integration and employee engagement rather than employee performance (Belhaj et al., 2026). At the same time, although AI literacy has increasingly been recognized as an important employee capability for effectively interacting with AI technologies, limited research has examined how AI literacy contributes to employee performance through work autonomy, particularly in the context of MSMEs. Furthermore, limited research has simultaneously examined AI adoption and AI literacy as antecedents of work autonomy and employee performance within an integrated employee-level HRM framework. Moreover, existing findings are mixed: AI use has been associated with both greater and lower autonomy (Giering & Kirchner, 2025; Xu et al., 2025), and AI adoption showed no direct effect on employee performance in some MSME studies (Mahmud et al., 2025; Tamam et al., 2025), which calls for testing the underlying mechanism rather than assuming it. These gaps indicate the need for further research to explain how both technological adoption and employee AI capability contribute to employee performance and whether work autonomy serves as a mechanism through which these factors are translated into improved work outcomes among MSME employees. This study addresses these gaps in three ways. First, it moves the analysis from the firm level to the employee level in MSMEs. Second, it examines AI adoption (a technological resource) and AI literacy (a human capability) together in one model. Third, it tests work autonomy as the mechanism linking both to employee performance, rather than to engagement or organizational outcomes.

Accordingly, this study proposes work autonomy as a mediating mechanism linking AI adoption and AI literacy to employee performance. The proposed perspective shifts the discussion from whether AI improves organizational performance toward a more employee-centered HRM question: how do AI adoption and employees' AI literacy contribute to better employee performance? By examining AI adoption and AI literacy as antecedents, work autonomy as a mediating mechanism, and employee performance as the primary outcome, this study integrates the emerging literature on AI-enabled work with the established HRM concern of employee performance. The study therefore aims to examine the

effects of AI adoption and AI literacy on employee performance and to determine whether work autonomy mediates these relationships among employees in MSMEs.

Literature Review

Dynamic Capability View

The Dynamic Capability View (DCV) explains how organizations develop and reconfigure resources and capabilities to respond to rapidly changing environments. Dynamic capabilities involve sensing emerging opportunities and threats, seizing opportunities through strategic actions, and transforming or reconfiguring organizational resources and processes (Teece, 2007). In the context of MSMEs, this perspective is particularly relevant because limited resources require firms to continuously adapt their capabilities to technological and market changes. Recent research suggests that AI adoption can be understood within this dynamic capability process, as MSMEs increasingly use AI to identify opportunities, improve decision-making, and transform existing business processes (Cimino et al., 2025).

From a DCV perspective, AI adoption represents a strategic response through which MSMEs seize technological opportunities and reconfigure existing work processes. The value of AI, however, does not depend solely on technological implementation but also on how AI is integrated into employees' daily activities. By providing information, decision support, and task assistance, AI can change how employees organize and perform their work, potentially increasing their discretion and control. Recent evidence from MSMEs indicates that AI integration can significantly enhance work autonomy, suggesting that AI adoption may contribute to employee-level transformation through changes in work design (Belhaj et al., 2026).

Accordingly, work autonomy can be viewed as an employee-level manifestation of the organizational and human capability reconfiguration enabled by AI adoption and AI literacy, while employee performance represents an important outcome of this transformation. AI adoption provides technological resources that can reshape how work is organized, whereas AI literacy represents employees' capability to understand, evaluate, and effectively utilize these resources. Thus, consistent with DCV, this study proposes that MSMEs can translate technological adoption and employee AI capabilities into improved employee performance by creating work conditions that provide employees with sufficient autonomy and technological support. This perspective provides the theoretical foundation for examining the mediating role of work autonomy in the relationships between AI adoption, AI literacy, and employee performance.

AI Adoption

Artificial intelligence (AI) adoption refers to the extent to which an organization accepts, implements, and integrates AI technologies into its business activities and organizational processes. In

the SME context, AI adoption encompasses the incorporation of AI-enabled applications into activities such as decision-making, customer service, marketing, operations, and other business processes. Recent systematic reviews indicate that AI adoption in MSMEs is increasingly associated with improvements in efficiency, decision-making, innovation, and competitiveness, although its benefits depend on organizational readiness, available resources, skills, and strategic alignment (Landini & Machado, 2026).

Rather than treating AI as an isolated technological investment, MSMEs need to integrate AI into existing routines and capabilities to generate meaningful organizational value. Empirical evidence from 12,108 European MSMEs demonstrates that digital and innovation capabilities play an important role in driving AI adoption, supporting the view that AI adoption is embedded within broader organizational capabilities. More recent research further demonstrates that AI-enabled dynamic capabilities in MSMEs emerge through processes of sensing, seizing, and reconfiguring, particularly through leadership, team learning, and human–AI interaction (Arroyabe et al., 2024).

Accordingly, in this study, AI adoption is conceptualized as the extent to which MSMEs integrate AI technologies into their organizational and work processes to support business activities and respond to changing environmental demands. This conceptualization is consistent with recent SME research that defines AI adoption in terms of the extent to which AI has been integrated into firm processes (Cimino et al., 2025). Within the proposed model, AI adoption represents the initial strategic capability through which MSMEs leverage AI to transform how work is organized and performed, potentially creating greater work autonomy and ultimately improving employee performance (Landini & Machado, 2026).

AI Literacy

AI literacy refers to an individual's ability to understand, evaluate, and effectively interact with artificial intelligence technologies in work and everyday contexts. It involves not only knowledge of how AI works, but also the ability to critically evaluate AI outputs, recognize its limitations, and use AI appropriately and responsibly. (Long & Magerko, 2020) conceptualized AI literacy as a set of competencies that enables individuals to critically evaluate AI technologies, communicate and collaborate effectively with AI, and use AI as a tool. More recent research further emphasizes that AI literacy includes conceptual understanding, practical skills, and ethical awareness, allowing employees to make informed decisions when integrating AI into their work activities.

In organizational contexts, AI literacy is increasingly important because employees are expected to interact directly with AI-based technologies in performing their tasks. (Naveed et al., 2026) highlighted AI literacy as an important employee capability in digital workplaces, particularly because employees need to understand AI technologies and their implications for work. Similarly, (Passlack et al., 2026) emphasized that AI literacy is important for knowledge workers to interact with AI responsibly, including understanding AI capabilities, limitations, and potential risks. Thus, employees with higher

AI literacy are better positioned to understand how AI can be integrated into their work, evaluate AI-generated information, and use AI as a technological resource rather than simply relying on its outputs.

Recent empirical evidence also demonstrates the relevance of AI literacy to employee outcomes. (X. Liu et al., 2025), through the development and validation of a generative AI literacy scale, found that AI literacy is associated with job performance, indicating that employees who possess stronger AI-related knowledge and capabilities may be better able to leverage AI technologies to support their work. Similarly, (Naveed et al., 2026) found a significant relationship between AI literacy and work performance among academicians, with employee engagement serving as a mediating mechanism. Therefore, in the context of MSMEs, AI literacy can be conceptualized as employees' knowledge, skills, and critical ability to understand, evaluate, and use AI technologies effectively and responsibly in performing their work, potentially enabling them to utilize AI more effectively and improve their work outcomes.

AI literacy may also influence employees' work autonomy by strengthening their ability to independently determine how AI technologies can be incorporated into their work. Employees who understand AI capabilities and limitations are better positioned to select appropriate AI applications, evaluate AI-generated outputs, and make informed decisions about when and how AI should be used. This capability can increase employees' confidence in managing AI-enabled tasks and provide greater discretion in determining work methods and organizing their activities. Thus, AI literacy may function not only as a capability for improving AI use and employee performance but also as an individual resource that enables employees to exercise greater autonomy in their work. Accordingly, employees with higher levels of AI literacy are expected to experience greater work autonomy.

Work Autonomy

Work autonomy refers to the extent to which employees perceive that they have discretion, control, and flexibility in determining how their work is performed. It includes freedom in deciding work methods, task execution, work pace, and the organization of work activities. In the context of AI-enabled workplaces, autonomy has become increasingly important because AI can change how employees organize and perform their tasks. (Xavier, 2025), based on a mixed-method experimental study involving 480 participants, found that AI integration significantly increased employees' perceived job autonomy, suggesting that AI can provide employees with greater control and discretion in performing their work.

However, the relationship between AI and work autonomy is not necessarily automatic (Giering & Kirchner, 2025), using data from the German Socio-Economic Panel, found that although AI use was initially associated with greater autonomy, this relationship became insignificant after accounting for other digital technologies, education, and occupational characteristics. This finding indicates that the

influence of AI on autonomy depends on the broader technological and organizational context. Similarly, (Xu et al., 2025) found that AI had a significant negative effect on work autonomy among digital workers, demonstrating that AI may either increase or reduce employee autonomy depending on the nature of work and how the technology is implemented.

Work autonomy is also relevant to employee performance (Zhou et al., 2026), found that work autonomy positively influenced employee performance and mediated the relationship between perceived organizational digital empowerment and employee performance. In Indonesia, (Wisobroto et al., 2025) likewise found that work autonomy had a positive and significant effect on employee performance among employees of PT Jasa Raharja Bali. Therefore, work autonomy can be conceptualized as an important mechanism through which technological resources, including AI, may influence employee performance, particularly when employees are given sufficient discretion and control to integrate AI into their work activities.

Employee Performance

Employee performance refers to the extent to which employees effectively accomplish the tasks and responsibilities assigned to them and contribute to organizational objectives. In the context of MSMEs, employee performance is particularly important because limited human resources often require employees to perform multiple functions and contribute directly to operational activities and business outcomes. Recent research emphasizes that employee performance in MSMEs is influenced not only by employees' individual capabilities but also by the organizational resources, technologies, and work environments that support them. In this regard, employee performance represents an important HRM outcome through which organizations can evaluate whether their resources and work practices effectively translate into individual contributions.

The increasing adoption of AI has created new opportunities for organizations to support employee performance through improved information processing, task assistance, decision-making, and problem solving. Recent empirical evidence demonstrates that AI adoption can positively influence employee productivity and organizational performance, although the magnitude of these effects depends on how AI is integrated into the work environment. For example, research in an organizational setting found significant positive relationships between AI and employee productivity, indicating that AI can contribute to improved employee-level outcomes when appropriately implemented (Kassa & Worku, 2025). Similarly, a recent study of MSMEs argues that AI adoption can improve productivity, work quality, customer responsiveness, and performance adaptability when supported by appropriate digital skills, organizational support, and work redesign (Dong, 2026).

However, the relationship between AI adoption and employee performance should not be considered automatic. Evidence from Malaysian MSMEs, for example, shows that AI adoption did not

directly improve employee performance but contributed to performance through knowledge sharing, suggesting that the benefits of AI depend on the mechanisms through which employees use and integrate the technology into their work (Mahmud et al., 2025). Similarly, recent research among MSMEs in Malang City found that AI utilization did not have a direct significant effect on employee performance, although it produced an indirect effect through job satisfaction (Tamam et al., 2025). These findings are particularly relevant to the present study because they indicate that AI adoption alone may be insufficient to improve employee performance. Instead, the way AI transforms employees' work experiences, capabilities, and ability to utilize technological resources may determine whether technological adoption ultimately generates better performance. In addition to technological adoption, employees' AI literacy may also contribute directly to their performance by enabling them to understand AI capabilities, evaluate AI-generated outputs, and use AI technologies appropriately in completing their work (Naveed et al., 2026). Employees with higher AI literacy are therefore better positioned to utilize AI effectively and translate its capabilities into improved work practices and performance outcomes. Accordingly, this study positions employee performance as the primary HRM outcome and proposes that work autonomy may explain how both AI adoption and AI literacy are translated into improved employee performance.

Research Hypotheses

The Impact of AI Adoption on Work Autonomy

AI adoption enables MSMEs to incorporate emerging technologies into existing work processes and reconfigure how organizational resources are utilized. When AI is integrated into employees' daily work activities, it provides information, recommendations, automation, and decision support that can expand employees' discretion in organizing and executing their work. From the Dynamic Capability View (DCV), AI adoption represents a technological capability that reshapes work processes and enables employees to exercise greater control over how work is performed. Recent empirical evidence supports this relationship. (Xavier, 2025) demonstrated that AI integration significantly increased employees' perceived job autonomy, suggesting that AI functions not only as an automation mechanism but also as a technological resource that expands employees' control over their work. Similarly, evidence from SMEs shows that AI integration is positively associated with employees' work autonomy (Belhaj et al., 2026). However, this relationship is not uniform: the association between AI use and autonomy became insignificant after accounting for other digital technologies and occupational characteristics (Giering & Kirchner, 2025), and AI had a negative effect on the autonomy of digital workers (Xu et al., 2025). Whether AI adoption increases autonomy among MSME employees is therefore an empirical question that this study tests. In the context of MSMEs, where employees frequently perform multiple responsibilities and work with relatively limited organizational resources,

AI adoption is therefore expected to increase employees' discretion and flexibility in organizing their work.

H1: AI adoption has a positive effect on work autonomy among employees of MSMEs.

The Effect of AI Adoption on Employee Performance

AI adoption can provide employees with technological resources that facilitate information processing, decision-making, problem-solving, and the completion of routine tasks. Consequently, AI may contribute to improved employee productivity and performance when it is appropriately integrated into organizational work processes. Evidence from MSMEs indicates that AI adoption can contribute to employee performance, particularly when supported by knowledge sharing, digital skills, organizational support, and appropriate work redesign. (Mahmud et al., 2025), for example, examined AI adoption in Malaysian MSMEs and found that knowledge sharing represents an important mechanism linking AI adoption with employee performance. Similarly, recent research specifically examining AI adoption and employee performance in MSMEs argues that AI can improve productivity, work quality, customer responsiveness, and performance adaptability when supported by appropriate organizational conditions (Dong, 2026). These findings suggest that AI adoption can provide an important technological foundation for improving employee performance.

H2: AI adoption has a positive effect on employee performance among employees of MSMEs.

The Impact of AI Literacy on Work Autonomy

In addition to AI adoption, employees' AI literacy may play an important role in shaping their work autonomy. AI literacy enables employees to understand the capabilities and limitations of AI technologies, critically evaluate AI-generated information, and use AI tools appropriately in completing their work. Employees with higher levels of AI literacy may therefore have greater confidence and competence in determining how AI can be incorporated into their tasks, selecting appropriate AI-supported approaches, and evaluating the outputs generated by AI. These capabilities can provide employees with greater discretion in determining work methods, making work-related decisions, and organizing the way tasks are performed. Previous research emphasizes that AI literacy represents an important human capability for effectively interacting with AI technologies and realizing their benefits in work contexts (Long & Magerko, 2020). Furthermore, as AI increasingly becomes integrated into workplace activities, employees' ability to understand and critically engage with AI may influence how effectively they can exercise control over their work (Dong, 2026). Therefore, employees with higher levels of AI literacy are expected to experience greater work autonomy because they are better equipped to understand, evaluate, and utilize AI as a resource for managing and performing their work.

H3: AI literacy has a positive impact on work autonomy among employees of MSMEs.

The Impact of AI Literacy on Employee Performance

AI literacy may play an important role in enhancing employee performance in MSMEs. Employees with higher levels of AI literacy are better equipped to understand AI capabilities and limitations, evaluate AI-generated information, and utilize AI tools effectively to support their work. These capabilities can help employees complete tasks more efficiently, make better-informed decisions, solve work-related problems, and adapt to AI-enabled changes in their work environment. AI literacy therefore represents an important employee capability that may determine how effectively individuals can translate the potential benefits of AI technologies into improved work outcomes. Previous research suggests that AI literacy enables individuals to interact effectively with AI systems and apply AI-related knowledge and skills appropriately in various contexts(Long & Magerko, 2020). In the workplace, employees who are more capable of understanding and critically engaging with AI may be better positioned to use AI as a resource for improving task execution and work effectiveness (Dong, 2026). Therefore, higher levels of AI literacy are expected to contribute positively to employee performance in MSMEs.

H4: AI literacy has a positive impact on employee performance among employees of MSMEs.

2.6.5. The Influence of Work Autonomy on Employee Performance

Work autonomy provides employees with greater discretion to determine how, when, and through which methods work is performed. Such autonomy allows employees to adapt their work practices according to task requirements and manage their responsibilities more independently. Recent empirical evidence demonstrates that work autonomy is positively associated with employee service job performance and work innovation, indicating that employees who perceive greater autonomy in performing their work may achieve better performance outcomes (Rasheed et al., 2026). In addition, research on organizational digital empowerment shows that work autonomy plays an important role in explaining employee performance, further supporting the importance of autonomy as an employee-level mechanism through which technological resources can generate performance benefits(Zhou et al., 2026). Thus, employees who experience greater work autonomy are expected to demonstrate higher levels of performance.

H5: Work autonomy has a positive influence on employee performance among employees of MSMEs.

2.6.6. The Mediating Role of Work Autonomy in the Relationship between AI Adoption and Employee Performance

The Dynamic Capability View suggests that organizational resources do not automatically generate performance outcomes; rather, value emerges through the processes by which resources are

integrated, deployed, and transformed into capabilities. Accordingly, the performance benefits of AI adoption may depend on how AI changes employees' work experiences and enables them to perform their responsibilities more effectively. Evidence from SMEs indicates that AI integration is positively associated with work autonomy (Belhaj et al., 2026), while empirical evidence indicates that work autonomy is positively associated with employee performance outcomes. This suggests that work autonomy may serve as an important employee-level mechanism through which technological adoption is translated into individual performance. Therefore, when MSMEs integrate AI into work processes in ways that enhance employees' discretion and control, the resulting increase in work autonomy is expected to contribute to improved employee performance. In this sense, AI adoption may influence employee performance not only directly but also indirectly by providing employees with greater autonomy in organizing and performing their work.

H6: Work autonomy mediates the positive relationship between AI adoption and employee performance among employees of MSMEs.

The Mediating Role of Work Autonomy in the Relationship between AI Literacy and Employee Performance

Following the same Dynamic Capability View logic as in H6, the benefits of employees' AI literacy may depend not only on their ability to understand and use AI technologies but also on how such capabilities influence their work experiences and enable them to perform their responsibilities more effectively. Employees with higher AI literacy are better equipped to understand AI capabilities, evaluate AI-generated information, and determine how AI can be appropriately utilized in their work (Long & Magerko, 2020). These capabilities may enable employees to make more informed decisions about how AI is incorporated into their tasks and provide them with greater discretion in organizing and performing their work, thereby strengthening their work autonomy. In turn, greater work autonomy provides employees with greater discretion and control over work methods, decision-making, and task organization, which may enable them to manage their responsibilities more independently and achieve better work outcomes. Empirical evidence demonstrates a positive relationship between work autonomy and employee performance, indicating that employees with greater control over their work are better positioned to manage their tasks and achieve desired performance outcomes (Rasheed et al., 2026). Therefore, AI literacy may contribute to improved employee performance through greater work autonomy, suggesting that work autonomy serves as an important employee-level mechanism through which employees' AI-related capabilities are translated into performance outcomes.

H7: Work autonomy mediates the positive relationship between AI literacy and employee performance among employees of MSMEs.

This study investigates the relationships among AI Adoption, AI Literacy, Work Autonomy, and Employee Performance. AI Adoption and AI Literacy are positioned as the independent constructs, with Work Autonomy proposed as a mediating mechanism through which these factors influence Employee Performance. Based on the hypothesized relationships, a conceptual framework was developed to provide a systematic representation of the proposed model, as illustrated in Figure 1.

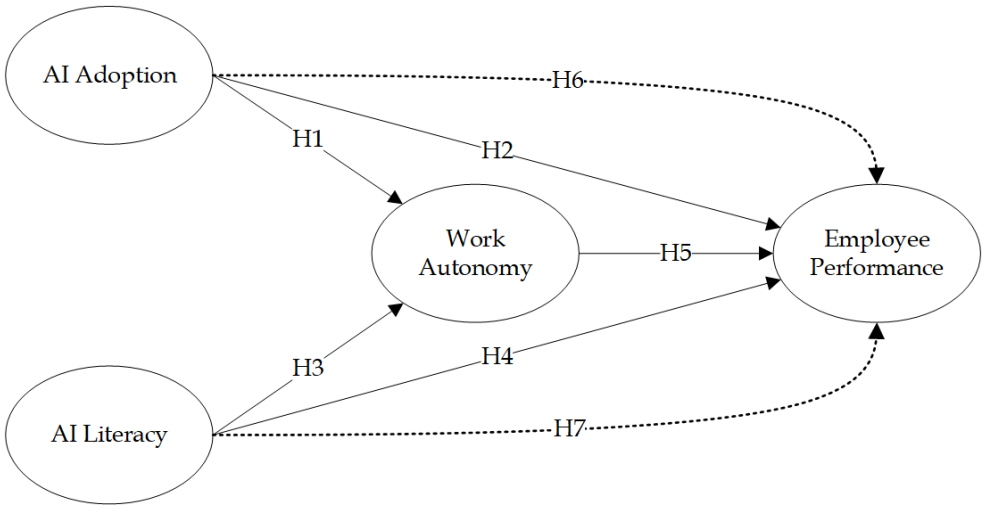


Figure 1. Research Model

2. METHOD

2.1. Research Design

This study employed a quantitative cross-sectional survey to examine the relationships among AI adoption, AI literacy, work autonomy, and employee performance among MSME employees in Malang City, Indonesia. Data were collected using a structured questionnaire and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM), which is appropriate for prediction-oriented research involving multiple latent constructs. The research procedure included literature review and framework development, sampling and instrument determination, data collection, measurement model assessment, hypothesis testing, and interpretation of findings and conclusions (Hair et al., 2021)

2.2. Population and Sample

The population of this study comprised employees working in Micro, Small, and Medium-sized Enterprises (MSMEs) in Malang City, Indonesia, who had experience using Artificial Intelligence (AI) in their work-related activities. A non-probability sampling technique using purposive sampling was employed to ensure that the selected respondents met the specific characteristics required by the research model. The inclusion criteria were that respondents (1) were employees working in MSMEs located in Malang City and (2) had experience using AI to support their work-related activities. These criteria were established because the proposed research model examines AI adoption as a technological

factor influencing employees' perceived autonomy and employee performance, making direct experience with AI an essential characteristic of the target respondents.

Following the recommendations for PLS-SEM sample size determination, which emphasize sufficient statistical power and consideration of model complexity, this study determined a minimum sample size of 300 respondents. A sample of 300 respondents was considered adequate for examining the direct relationships proposed in H1, H2, H3, H4, and H5 as well as the mediating relationship proposed in H6 and H7. Accordingly, this study used 300 valid questionnaires obtained from MSME employees who fulfilled the predetermined inclusion criteria. The use of 300 valid responses was intended to provide sufficient statistical power and reliable parameter estimates for evaluating the measurement and structural models using PLS-SEM (Hair et al., 2021).

2.3. Variable Measurement and Data Collection Techniques

This study employed both primary and secondary data sources. Primary data were collected through a structured questionnaire distributed to eligible MSME employees in Malang City, Indonesia, while secondary data were obtained from relevant scholarly sources, including journal articles, books, research reports, and other credible academic publications. All constructs were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The measurement items were adapted from previously validated instruments and contextualized to reflect the use of Artificial Intelligence (AI) in the workplace among MSME employees. The research instrument comprised four constructs: AI Adoption, AI Literacy, Work Autonomy, and Employee Performance. The measurement dimensions, items, and corresponding sources are presented in Table 1. The collected data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to evaluate the measurement and structural models and test the proposed hypotheses.

Table 1. Research Instrument

Variable	Measurement Items	Reference
AI Adoption (X_1)	AI has been integrated into my work activities.	(Y. Liu & Du, 2025)
	I use AI to support my work activities.	(Lupiyoadi et al., 2025)
AI Literacy (X_2)	I understand the basic concepts and capabilities of artificial intelligence (AI).	(Ng et al., 2021)
	I can select appropriate AI tools for different work tasks.	
	I can evaluate whether information generated by AI is accurate and reliable.	
	I understand the ethical issues associated with the use of AI in my work.	
Work Autonomy (Z)	I have the freedom to decide how I perform my work tasks.	(Datta et al., 2025)
	I have control over the scheduling of my work activities.	

Variable	Measurement Items	Reference
Employee Performance (Y)	I have the freedom to modify or adjust the procedures used to evaluate my work.	(Widyastuti et al., 2024)
	I am able to complete my work tasks effectively.	
	I take on additional responsibilities when needed.	
	I can adapt effectively to changes in my work environment.	

2.4. Data Analysis

This study employed individual employees as the unit of analysis. A quantitative research approach was adopted to examine the relationships among AI Adoption, AI Literacy, Work Autonomy, and Employee Performance and to test the proposed hypotheses. The collected data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM), which was employed to evaluate both the measurement and structural models. The analysis examined the direct effects of AI Adoption and AI Literacy on Work Autonomy and Employee Performance, as well as the effect of Work Autonomy on Employee Performance. In addition, the analysis assessed the mediating role of Work Autonomy in the relationships between the independent variables and Employee Performance.

3. FINDINGS AND DISCUSSION

The analysis was based on 300 valid responses from employees working in Micro, Small, and Medium-sized Enterprises (MSMEs) in Malang City, Indonesia, who had experience using Artificial Intelligence (AI) in their work activities. The demographic characteristics of the respondents provide an overview of their personal and employment profiles and offer important contextual information for interpreting the subsequent findings. The distribution of respondent characteristics is presented in Table 2.

Table 2. Respondent Profile

Characteristics	Category	Frequency (n)	Percentage (%)
Gender	Male	158	52.7
	Female	142	47.3
Age	18–24 years	72	24.0
	25–34 years	119	39.7
	35–44 years	69	23.0
	45–54 years	31	10.3
	≥55 years	9	3.0
Education	Senior High School	83	27.7
	Diploma	42	14.0

Characteristics	Category	Frequency (n)	Percentage (%)
	Bachelor's Degree	148	49.3
	Master's Degree or above	27	9.0
Work Experience	<1 year	36	12.0
	1–3 years	87	29.0
	4–6 years	82	27.3
	7–10 years	61	20.3
	>10 years	34	11.3
MSME Sector	Trade/Retail	82	27.3
	Food and Beverage	76	25.3
	Services	65	21.7
	Manufacturing/Production	43	14.3
	Creative/Digital Business	21	7.0
	Other	13	4.3
Position	Staff/Employee	174	58.0
	Supervisor/Coordinator	67	22.3
	Manager	34	11.3
	Owner/Employee	25	8.3
AI Experience	<1 year	96	32.0

The study analyzed 300 valid responses from employees working in MSMEs in Malang City, Indonesia. The respondent profile shows a relatively balanced gender distribution, with 52.7% male and 47.3% female respondents. In terms of age, the largest proportion of respondents was between 25 and 34 years old (39.7%), followed by those aged 18–24 years (24.0%) and 35–44 years (23.0%). Only a small proportion of respondents were aged 45–54 years (10.3%) and 55 years or above (3.0%).

Regarding educational background, nearly half of the respondents held a bachelor's degree (49.3%), followed by those with a senior high school education (27.7%), diploma qualifications (14.0%), and a master's degree or above (9.0%). In terms of work experience, the largest group had 1–3 years of experience (29.0%), followed by respondents with 4–6 years (27.3%), 7–10 years (20.3%), more than 10 years (11.3%), and less than one year (12.0%).

The respondents represented diverse MSME sectors, with Trade/Retail accounting for the largest proportion (27.3%), followed by Food and Beverage (25.3%), Services (21.7%), Manufacturing/Production (14.3%), Creative/Digital Business (7.0%), and Other sectors (4.3%). Regarding organizational position, most respondents were Staff/Employees (58.0%), followed by Supervisors/Coordinators (22.3%), Managers (11.3%), and Owners/Employees (8.3%). For AI experience, 32.0% of respondents reported having less than one year of experience using AI. Overall, the respondent profile indicates that the sample includes employees with diverse demographic,

educational, occupational, and sectoral backgrounds, providing a relevant basis for examining AI Adoption, AI Literacy, Work Autonomy, and Employee Performance.

3.1. Descriptive Statistics

Descriptive statistical analysis was conducted to provide an overview of the distribution of respondents' responses for each research indicator. The results show that all indicators have a mode of 3, indicating that the most frequently selected response was "Somewhat Agree" (CS). The mean scores of the indicators range from 2.82 to 3.16, suggesting that, overall, respondents' perceptions of the variables were at a moderate level. The highest mean score was recorded for X2.2 (3.16), while the lowest was recorded for Y2 (2.82). These results indicate that respondents generally tended to provide moderate rather than strongly positive responses across the indicators. Overall, the descriptive findings provide an initial overview of the respondents' perceptions before further analysis is conducted to examine the relationships among the research variables.

Table 3. Descriptive Analysis

Item	SA		A		SWA		D		SD		Modus	Mean
	f	%	f	%	f	%	f	%	f	%		
X1.1	11	3.67	67	22.33	156	52.00	59	19.67	7	2.33	3	3.05
X1.2	6	2.00	58	19.33	146	48.67	81	27.00	9	3.00	3	2.90
X2.1	10	3.33	83	27.67	129	43.00	71	23.67	7	2.33	3	3.06
X2.2	18	6.00	83	27.67	136	45.33	55	18.33	8	2.67	3	3.16
X2.3	16	5.33	78	26.00	143	47.67	58	19.33	5	1.67	3	3.14
X2.4	21	7.00	82	27.33	128	42.67	60	20.00	9	3.00	3	3.15
Z1	6	2.00	57	19.00	163	54.33	67	22.33	7	2.33	3	2.96
Z2	5	1.67	62	20.67	166	55.33	64	21.33	3	1.00	3	3.01
Z3	2	0.67	50	16.67	160	53.33	74	24.67	14	4.67	3	2.84
Y1	5	1.67	60	20.00	151	50.33	76	25.33	8	2.67	3	2.93
Y2	3	1.00	43	14.33	160	53.33	86	28.67	8	2.67	3	2.82
Y3	4	1.33	62	20.67	156	52.00	68	22.67	10	3.33	3	2.94

Among the indicators, X2.2 recorded the highest mean score of 3.16, followed by X2.4 (3.15) and X2.3 (3.14), indicating relatively moderate perceptions among respondents. In contrast, Y2 recorded the lowest mean score of 2.82, followed by Z3 (2.84) and X1.2 (2.90), reflecting comparatively lower but still moderate perceptions. Overall, the mean scores ranged from 2.82 to 3.16, indicating that respondents' perceptions across the indicators were generally moderate, with limited variation between indicators. These descriptive findings provide an initial overview of respondents' responses and support the subsequent assessment of the measurement and structural models.

3.2. Validity Test

In this study, validity testing was assessed through convergent and discriminant validity. Convergent validity was evaluated based on the outer loading values and Average Variance Extracted (AVE). The results of the convergent validity assessment are presented in Table 4.

Table 4. Convergent Validity

Construct	Item Code	Outer Loadings	CR	AVE
AI Adoption	X1.1 ← X1	0.903	0.901	0.819
	X1.2 ← X1	0.907		
AI Literacy	X2.1 ← X2	0.890	0.938	0.792
	X2.2 ← X2	0.889		
	X2.3 ← X2	0.894		
	X2.4 ← X2	0.887		
Employee Performance	Y1 ← Y	0.871	0.908	0.767
	Y2 ← Y	0.882		
	Y3 ← Y	0.875		
Work Autonomy	Z1 ← Z	0.867	0.899	0.749
	Z2 ← Z	0.874		
	Z3 ← Z	0.855		

Table 4 presents the results of the convergent validity test. The outer loading values for all indicators range from 0.855 to 0.907, exceeding the recommended threshold of 0.70. Furthermore, the Composite Reliability (CR) values range from 0.901 to 0.938, while the Average Variance Extracted (AVE) values range from 0.749 to 0.819. These results indicate that all constructs meet the required criteria for convergent validity and composite reliability.

Table 5. Discriminant Validity: Fornell and Larcker Criterion

Construct	AI Adoption	AI Literacy	Employee Performance	Work Autonomy
AI Adoption	**0.905**			
AI Literacy	0.548	**0.890**		
Employee Performance	0.833	0.861	**0.878**	
Work Autonomy	0.802	0.764	0.876	**0.865**

Note: Diagonal values (bolded) are the square root of AVE, off-diagonal values are correlation coefficients

Table 5 presents the results of the discriminant validity assessment using the Fornell-Larcker criterion. For most construct pairs, the diagonal values, representing the square root of AVE, are higher than the corresponding correlation coefficients between constructs, indicating that these constructs share greater variance with their own indicators than with other constructs. However, the correlation between Work Autonomy and Employee Performance (0.876) slightly exceeds the square root of AVE for Work Autonomy (0.865), suggesting a marginal Fornell-Larcker violation for this construct pair.

Given that the Fornell-Larcker criterion has been shown to have limited sensitivity in detecting discriminant validity issues, particularly among highly correlated constructs (Henseler et al., 2015), discriminant validity was further examined using the more robust Heterotrait-Monotrait (HTMT) ratio, as presented in Table 6.

Table 6. Discriminant Validity: Heterotrait-Monotrait Ratio (HTMT)

Construct	X1	X2	Y	Z
AI Adoption				
AI Literacy	0.650			
Employee Performance	0.887	0.879		
Work Autonomy	0.896	0.877	0.845	

Note: The threshold value for HTMT is that if the variables do not have similarities, the threshold is <0.90

Table 6 presents the results of the discriminant validity assessment using the Heterotrait-Monotrait (HTMT) ratio. The HTMT values range from 0.650 to 0.896. All values are below the threshold of 0.90, indicating that the constructs demonstrate adequate discriminant validity.

3.3. Reliability Test

Table 4 also presents the results of the reliability test through composite reliability (CR), which assesses the internal consistency reliability of the constructs. The rule of thumb for composite reliability is 0.70. The CR values for X1, X2, Y, and Z are 0.901, 0.938, 0.908, and 0.899, respectively. All CR values exceed the recommended threshold of 0.70, indicating that all constructs demonstrate adequate internal consistency reliability and can therefore be considered reliable.

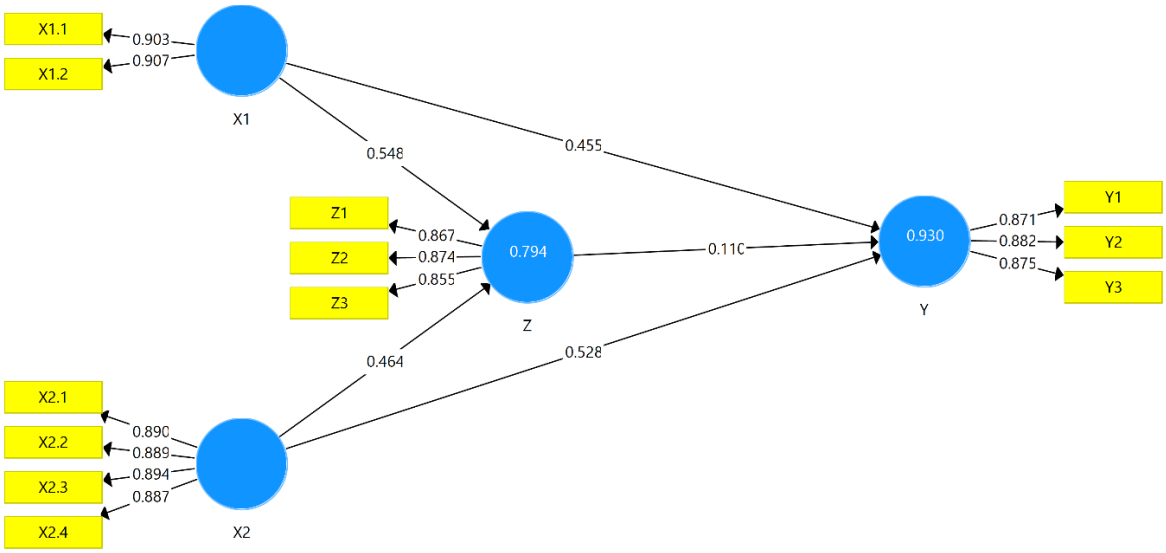


Figure 2. Path Diagram

3.4. Collinearity Test

The collinearity test is carried out by examining the VIF values. According to(Hair et al., 2021), a VIF value below 5 indicates that there is no critical collinearity among the predictor constructs, so that collinearity does not pose a problem for the estimation of the research model.

Table 7. Inner VIF Values

Effect	VIF
AI Adoption → Employee Performance	2.890
AI Literacy → Employee Performance	2.477
AI Adoption → Work Autonomy	1.429
AI Literacy → Work Autonomy	1.429
Work Autonomy → Employee Performance	4.866

Table 7 shows that all VIF values range from 1.429 to 4.866, which are below the recommended threshold of 5. Therefore, the collinearity test meets the recommended criteria, indicating that there is no critical collinearity among the predictor constructs in the structural model. Thus, collinearity does not pose a concern for the estimation of the proposed research model.

3.5. R Square Test

The second step is to conduct an R^2 test to assess the explanatory power of the structural model. The R Square (R^2) test results are presented in Table 8 below.

Table 8. R-square Test

Construct	R-square (Adjusted)
Employee Performance	0.929
Work Autonomy	0.793

Table 8 shows that the adjusted R-square value for Y is 0.929. This value indicates that the predictor variables included in the model can explain 92.9% of the variance in Y, while the remaining 7.1% is explained by other variables that are not included in this study. Meanwhile, the adjusted R-square value for Z is 0.793, indicating that the predictor variables in the model can explain 79.3% of the variance in Z, while the remaining 20.7% is explained by other variables outside the research model.

Overall, the adjusted R-square values of 0.929 for Y and 0.793 for Z indicate a strong explanatory power of the structural model. The relatively high R-square values demonstrate that the independent variables provide substantial explanatory power for the endogenous constructs in the proposed research model.

3.6. F Square Test

The F-squared test is conducted to determine the effect size of each exogenous variable on the endogenous variables in the structural model. The f^2 value indicates the magnitude of the contribution of an exogenous construct to an endogenous construct. According to the commonly used criteria, an f^2 value of 0.02 indicates a weak effect, 0.15 indicates a moderate effect, and 0.35 indicates a strong effect.

Table 9. F-square

Construct	f-square
AI Adoption → Employee Performance	1.023
AI Literacy → Employee Performance	1.603
AI Adoption → Work Autonomy	1.022
AI Literacy → Work Autonomy	0.733
Work Autonomy → Employee Performance	0.035

Table 9 shows that the f^2 values vary across the relationships in the structural model. The highest f^2 value is found in the influence of X2 on Y (1.603), followed by X1 on Y (1.023). These values are substantially higher than the threshold of 0.35, indicating a strong effect of both X2 and X1 on Y.

Furthermore, the influence of X1 on Z (1.022) and X2 on Z (0.733) also demonstrates a strong effect, as both f^2 values exceed 0.35. This indicates that X1 and X2 make substantial contributions to explaining the variance in Z.

Meanwhile, the relationship between Z and Y has an f^2 value of 0.035, which falls between 0.02 and 0.15 and therefore indicates a weak effect. Although the effect size is relatively small, the relationship may still be statistically significant depending on the results of the hypothesis testing.

Overall, the f^2 results indicate that X1 and X2 have strong effect sizes on both Y and Z, whereas Z has only a weak effect size on Y. These findings suggest that X1 and X2 are the most influential constructs in terms of their contribution to the endogenous variables in the proposed structural model.

3.7. Hypothesis Testing

Hypothesis testing was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) by examining the path coefficients, t-values, and p-values. The hypotheses were evaluated at a 5% significance level. A hypothesis was considered supported when the t-value exceeded the critical value of 1.65 (one-tailed) and the p-value was below 0.05. Table 10 shows the test results for the proposed hypothesis.

Table 10. Summary of Hypotheses Testing

Hypotheses	Path	Std. Beta	t-value	p-value	Decision
H1	AI Adoption → Work Autonomy	0.548	17.973	0.000***	Supported
H2	AI Adoption → Employee Performance	0.455	16.077	0.000***	Supported
H3	AI Literacy → Work Autonomy	0.464	16.332	0.000***	Supported
H4	AI Literacy → Employee Performance	0.528	21.673	0.000***	Supported
H5	Work Autonomy → Employee Performance	0.110	3.617	0.000***	Supported
H6	AI Adoption → Work Autonomy → Employee Performance	0.060	3.554	0.000***	Supported
H7	AI Literacy → Work Autonomy → Employee Performance	0.051	3.516	0.000***	Supported

note: *p<0.05; ***p<0.001

Table 10 shows that all seven hypotheses are supported. AI adoption (β = 0.548, t = 17.973) and AI literacy (β = 0.464, t = 16.332) are positively related to work autonomy (H1 and H3), and both are positively related to employee performance (H2: β = 0.455, t = 16.077; H4: β = 0.528, t = 21.673). Work autonomy is positively related to employee performance (H5: β = 0.110, t = 3.617). The indirect effects of AI adoption (H6: β = 0.060, t = 3.554) and AI literacy (H7: β = 0.051, t = 3.516) through work autonomy are also significant, although small in magnitude. All p-values are below 0.001.

3.8. Discussion

The positive association between AI adoption and work autonomy (H1; β = 0.548) is consistent with evidence that AI integration expands employees' perceived control over their work (Belhaj et al., 2026; Xavier, 2025). In MSMEs, where employees typically handle several tasks with limited managerial support, AI tools that provide information and decision support may allow employees to decide more independently how to carry out their work. The result differs, however, from studies that found an insignificant or negative relationship between AI and autonomy (Giering & Kirchner, 2025; Xu et al., 2025). One possible explanation is that the respondents were employees who already used AI in their work and who worked in small organizations, where AI may add to discretion rather than constrain it; this explanation was not tested here because organizational structure and the way AI is deployed were not measured. AI literacy was also positively associated with work autonomy (H3; β = 0.464), which is consistent with the argument that employees who understand AI capabilities and limitations are better placed to decide when and how to use AI in their tasks (Long & Magerko, 2020).

AI adoption (H2; β = 0.455) and AI literacy (H4; β = 0.528) were both positively associated with employee performance, with AI literacy showing the larger coefficient. The AI literacy result is in line with earlier studies that linked AI literacy to job performance and work performance (X. Liu et al., 2025;

Naveed et al., 2026). The AI adoption result differs from studies of MSMEs in Malaysia and Malang City in which AI adoption or utilization had no significant direct effect on employee performance and operated only through knowledge sharing or job satisfaction (Mahmud et al., 2025; Tamam et al., 2025). Differences in measurement, sample, and context may account for this discrepancy. The larger coefficient for AI literacy is consistent with the argument that using AI is not sufficient on its own and that employees' ability to evaluate and use AI matters (Dong, 2026), although the two predictors are correlated ($r = 0.548$) and their separate contributions should be interpreted with caution.

Work autonomy was positively associated with employee performance (H5), consistent with earlier findings (Rasheed et al., 2026; Wisobroto et al., 2025; Zhou et al., 2026). The coefficient was small ($\beta = 0.110$; $f^2 = 0.035$), however, and so were the indirect effects of AI adoption (H6; $\beta = 0.060$) and AI literacy (H7; $\beta = 0.051$). Because the direct effects of both predictors on employee performance remained significant alongside the indirect effects, work autonomy partially mediates these relationships, and most of the association between AI and employee performance runs through paths that are not captured in this model. Work autonomy should therefore be read as one relatively modest route through which AI adoption and AI literacy relate to employee performance, not as the main explanation. The high correlation between work autonomy and employee performance (0.876) and the marginal Fornell–Larcker violation reported above are a further reason to interpret H5 cautiously.

Theoretically, the results extend the Dynamic Capability View to the employee level by showing that AI adoption, as a technological resource, and AI literacy, as a human capability, are both associated with employee performance, with work autonomy as a partial mechanism. Practically, MSME owners and managers should pair AI tools with AI literacy training and give employees room to decide how to use these tools, rather than treating the adoption of AI alone as sufficient. These implications rest on cross-sectional, self-reported data collected from MSME employees in Malang City; the paths reported above are statistical associations and do not establish causal order (see Limitations and Future Research).

4. CONCLUSIONS

The findings indicate that AI adoption and AI literacy are positively and significantly associated with work autonomy and employee performance, and that work autonomy is positively and significantly associated with employee performance.

The mediation results further demonstrate that Work Autonomy partially mediates the relationships between AI Adoption and Employee Performance and between AI Literacy and Employee Performance. These findings suggest that AI adoption and AI literacy are related to employee

performance both directly and through greater employee autonomy, although the indirect effects are small. Because the design is cross-sectional, the results indicate associations rather than causal effects.

5.1. Limitations and Future Research

This study has several limitations that should be considered when interpreting the findings. First, the cross-sectional research design captures respondents' perceptions at a single point in time, limiting the ability to examine the temporal development of AI Adoption, AI Literacy, Work Autonomy, and Employee Performance. Future research could employ longitudinal or two-wave research designs to provide a more comprehensive understanding of how these constructs develop over time and whether their relationships remain consistent. Second, all constructs were measured using self-reported questionnaires, which may introduce common method bias and may not fully reflect actual AI use or objective employee performance. Future studies could combine survey responses with objective measures, such as system-recorded AI usage, productivity indicators, or supervisor evaluations, while also applying appropriate procedures to assess and mitigate common method variance.

Third, the use of non-probability sampling may limit the representativeness of the sample and consequently the generalizability of the findings. Future research could employ probability-based sampling techniques, such as stratified or cluster sampling, to improve sample representativeness. Finally, this study focuses on employees in the MSME context, which may limit the generalizability of the findings to other organizational sizes, industries, and geographical contexts. Future studies could replicate the model across different regions, industries, and organizational settings to examine whether the relationships among AI Adoption, AI Literacy, Work Autonomy, and Employee Performance remain consistent.

Future research could also extend the proposed model by incorporating additional mediating or moderating variables to provide a deeper understanding of the mechanisms and boundary conditions through which AI Adoption and AI Literacy influence Employee Performance. Comparative studies across different organizational and contextual settings may further reveal variations in these relationships and strengthen the theoretical and practical contributions of the research.

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