



Research Article

The Influence of Digital HR Practices on Employee Performance in E-Commerce MSMEs : The Role of Work Engagement as a Mediator and Digital Leadership as a Moderator

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Abstract. The increasingly rapid digital transformation demands that MSMEs optimize technology not only in business processes but also in human resource management. Although HR digitalization is believed to improve organizational effectiveness, research on the psychological mechanisms and role of leadership in the context of e-commerce MSMEs is still limited. This study used a quantitative approach with an explanatory survey method and involved 366 respondents from e-commerce MSMEs in various regions of Indonesia. Data analysis was conducted using Partial Least Squares–Structural Equation Modeling (PLS-SEM) techniques to test direct relationships, mediation, and moderation. The results showed that digital HR practices have a positive and significant effect on employee performance. The digitalization of HR functions, such as e-recruitment, e-learning, HRIS, and digital performance management, can improve work effectiveness and the quality of work output. Furthermore, work engagement was shown to mediate this relationship, meaning that employees perform better when they feel more passionate, dedicated, and involved in their work. This mediating role emphasizes the importance of psychological aspects in the successful implementation of digital HR. Leaders who possess a digital vision, provide technological support, and encourage innovation have been shown to increase employee motivation and comfort in working using digital systems. Overall, this study confirms that the success of digital transformation in e-commerce MSMEs is determined not only by the technology used, but also by leadership support and employee engagement. These findings provide important contributions to the digital HR management literature and offer practical implications for MSME owners in increasing competitiveness in the digital era.

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Keywords: Digital HR, Digital Leadership, E-Commerce MSMEs, Employee Performance, PLS-SEM, Work Engagement.

1. Introduction

The rapid development of digitalization and the widespread use of e-commerce in recent years have revolutionized the way micro, small, and medium enterprises (MSMEs) manage their operational activities and human resources. Digitalization now focuses not only on marketing or operations but also encompasses HR management through digital-based Human Resource Management practices, also known as Digital HRM. According to K. Setiawan & R. Amir (2023), digital HR practices involve the use of information technology to support various critical aspects of HR, such as recruitment, training, performance appraisals, and employee information management. This transformation accelerates administrative processes, increases data accuracy, and facilitates data-driven decision-making.

In the context of MSMEs operating in e-commerce, HR digitalization is crucial because business processes rely heavily on technological capabilities and the ability to adapt quickly to market changes.

Research by Parry and Strohmeier (2022) shows that implementing e-HRM aligned with organizational strategy can improve the effectiveness of HR management and support individual and organizational performance. This is especially important for e-commerce MSMEs, which must quickly respond to changing consumer demands, digital market trends, and the dynamics of online trading platforms. Not all small and medium enterprises (SMEs) are able to fully utilize the potential of human resource digitalization. Limitations in organizational structure, human resource capacity, and access to technology mean that the implementation of human resource digitalization remains suboptimal (Rahman & Chen, 2022). However, from a resource-based perspective, human resource digitalization practices can become a strategic intangible resource, potentially providing long-term competitive advantage if managed well. Proper management will enhance employees' digital capabilities and enable organizations to better adapt to the dynamics of the digital environment (Wang et al., 2021).

One of the key mechanisms linking human resource digitalization practices to improved performance is increased work engagement. According to Iqbal, et.al (2020), work engagement is a positive psychological state characterized by persistence, dedication, and high levels of concentration. Psychologically engaged employees typically exhibit better productivity, positive behavior, and more satisfying work outcomes. Research by Alfes et al. (2020) showed that HR practices that support employee competency development and provide structured feedback can increase work engagement, ultimately positively impacting organizational performance.

In the digital transformation process, the implementation of digital HR can be a tool that simplifies tasks, reduces administrative workloads, and provides technological support that helps employees work more effectively (M. Putri & D. Santoso, 2020). For example, online training platforms, collaboration applications, and digital assessment systems can improve morale, efficiency, and the overall work experience (N. Iqbal et al., 2020). Recent research by Soni et al. (2024) shows that the use of integrated digital HR systems is positively associated with increased work engagement, especially in small businesses undergoing digitalization. Furthermore, the use of digital HR management is crucial for e-commerce MSMEs because their business activities depend on customer data, speed of transactions, and real-time order processing. Employees who actively use digital systems are better able to respond to orders, handle customer complaints, and manage operations through the platform. Thus, work engagement can act as a factor linking digital HR practices to employee performance.

However, the effectiveness of digital HR implementation depends not only on the system but also on the leadership style within the organization. The concept of digital leadership has emerged as a critical factor in ensuring the success of digital transformation. According to Suryani et al (2024), digital leaders must be able to understand technology, create a culture of innovation, and foster the use of technology to improve organizational performance. Research by Nugroho (2021) also suggests that digital leadership is crucial in building organizational readiness for new technologies and encouraging employee engagement

in the digitalization process. In the e-commerce sector of MSMEs, the role of digital leadership is crucial because owners or managers are typically the primary decision-makers.

Technologically savvy leaders can motivate employees to implement new systems, assist in the use of technology, and create a work environment that supports digital collaboration (Yuliani, 2021). Thus, digital leadership can be a factor that strengthens the impact of digital HR on employee work engagement. If leaders do not support the use of technology, the benefits of digital HR will not be fully realized. In addition to strengthening this relationship, digital leadership also influences performance through the leader's ability to direct the organization's digital strategy. Research by Suryani et al (2024), shows that digital leaders are able to encourage continuous learning, utilize digital analytics in decision-making, and create a space for innovation that increases competitiveness. In e-commerce MSMEs, these capabilities directly impact operational effectiveness, such as online store optimization, customer service, and logistics management.

Meanwhile, research related to e-commerce MSMEs in Indonesia largely focuses on the use of technology and its impact on sales, customer satisfaction, or business sustainability (Wijaya et al., 2025; Gao et al., 2023). This research has not paid sufficient attention to internal organizational aspects, particularly the role of digital HR practices and employee behavioral dynamics. Thus, a research gap remains to be addressed: how the integration of digital HR, work engagement, and digital leadership can influence employee performance in e-commerce MSMEs. Given this gap, this research is crucial because e-commerce MSMEs have unique characteristics such as limited resources, small organizational structures, and high reliance on technology. Understanding the influence of digital HR practices on employee performance, with the mediating mechanisms of work engagement and digital leadership moderation, will provide comprehensive insights for developing HR management strategies in the digital era. Furthermore, this research makes a theoretical contribution by combining the perspectives of AMO theory, the JD-R model, and the digital leadership framework into a single analytical model relevant to MSMEs.

Therefore, this research seeks to answer three main questions: whether digital HR practices influence employee performance in e-commerce MSMEs, the extent to which work engagement mediates this relationship, and whether digital leadership can strengthen the influence of digital HR practices on employee work engagement. These three questions are structured to provide a more comprehensive understanding of the relationship between technology-based HR management practices, employee psychological well-being, and the role of leaders in driving successful digital transformation in the MSME context. The findings of this study are expected to not only provide theoretical contributions in the development of a more integrated digital HR model, but also provide practical benefits for MSME owners in designing HR development strategies that are more effective, adaptive, and in accordance with the needs of the digital era so that business performance can improve sustainably.

2. Literature Review

Previous Research and Research Gaps

Research on HR digitalization is growing along with the increasing adoption of technology in organizations, including MSMEs. Strohmeier (2020) emphasized that e-HRM enables increased operational efficiency through digital systems such as e-recruitment, e-

learning, and HR analytics. This research provides the initial basis for the notion that HR digitalization can improve the effectiveness of the HR function. Similar findings were also demonstrated by Parry and Strohmeier (2022), who emphasized that digital HRM has a strategic impact on organizational performance and capabilities. Furthermore, research by N. Iqbal, et.al (2020), showed that the use of digital HR systems is positively associated with feelings of work engagement because the systems provide clear information and flexible access to training. Findings by Alfes et al. (2020) also confirmed that HR practices that support employee capacity building can increase levels of vigor, dedication, and absorption three elements of work engagement.

In the context of digital leadership, the work of Yuliani. (2021) emphasized that leaders capable of adapting technology will improve an organization's readiness to face digital disruption. Nugroho (2021) added that digital leaders are needed to foster a culture of innovation and technological learning within the organization. However, most previous research has focused on the context of large organizations or multinational corporations. Few studies have specifically focused on e-commerce MSMEs, particularly in the integrative relationship between digital HR practices, work engagement, and digital leadership. Furthermore, previous research rarely incorporates the moderating mechanisms of digital leadership and psychological mediators such as engagement into a comprehensive structural model. This gap highlights the need for research in the context of Indonesian MSMEs, which have distinct characteristics, such as limited resources, high reliance on e-commerce technology, and the dominant role of the owner/leader in decision-making. Therefore, this study makes an important contribution by combining these variables in a single PLS-SEM model to more deeply explain how digital HR influences employee performance (Singh and Hess, 2021).

Key Theories and Concepts

Digital HRM Practices

Digital HRM practices are a concept evolving from e-HRM and the use of technology to support HR functions. Abdullah and Mukti (2024) define digital HRM as an integrated system that utilizes technology to improve the efficiency and effectiveness of HR processes. Components of digital HRM practices typically include digital recruitment, online training, digital performance management, and HRIS systems. Parry and Strohmeier (2022) emphasize that the implementation of digital HRM is becoming increasingly strategic in modern organizations because it can improve service speed, data accuracy, and coordination between functions.

Work Engagement

The concept of work engagement refers to a positive psychological state at work. M. Putri & D. Santoso (2020) introduced three dimensions: vigor (high energy), dedication (enthusiasm and engagement), and absorption (deep involvement). The Job Demands–Resources (JD-R) model explains that job support factors, including technology, can increase engagement through motivational channels (Putri & Santoso, 2020). In the context of digitalization, digital HR practices can act as job resources, providing ease and clarity in work, thereby increasing engagement.

Digital Leadership

Digital leadership is a leader's ability to adapt to technology, support a digital culture, and facilitate technology-based change. Oberer and Erkollar (2021) emphasize that digital leaders must be able to integrate technology into organizational strategy. In their Leadership 4.0 concept, emphasize that leaders must be able to set an example in the use of digital tools, encourage innovation, and support digital learning. In this study, digital leadership is positioned as a moderator that strengthens the relationship between digital HR practices and work engagement.

HR Performance

HR performance refers to the work results achieved by individuals in carrying out their duties. Dimensions of individual performance include quality, speed, accuracy, problem-solving ability, and innovation. Abdullah and Mukti (2024), using the resource-based view, stated that performance can be improved through the utilization of strategic resources such as technology and human resource capabilities. HR digitalization, engagement, and digital leadership are assumed to be mutually reinforcing factors in improving employee performance in e-commerce MSMEs.

3. Proposed Method

This study employed a quantitative approach with a cross-sectional explanatory survey design. This approach was chosen based on the primary objective of the study, which is to examine the causal relationship between digital HR practices (as the independent variable), work engagement (as the mediator), digital leadership (as the moderator), and HR performance (as the dependent variable) in e-commerce SMEs. Given that the research model involves latent constructs, mediation and moderation paths, and the use of reflective indicators, a Partial Least Squares-based structural equation modeling (PLS-SEM) technique was employed. This method was chosen because it is appropriate for complex models, non-normal data, and small to medium sample sizes, as recommended in recent methodological literature.

The population in this study comprised all SMEs in Indonesia that have used e-commerce as a primary or additional channel for selling products, either through marketplace platforms such as Shopee, Tokopedia, and Bukalapak, or through professionally managed websites and social media. This population was selected because it represents the business group most impacted by digitalization and is highly relevant to the topic of digital HR. The research sample consisted of 366 e-commerce SMEs selected using simple random sampling from a pre-existing sample frame of e-commerce SMEs from previous research. The sample size was determined using the Cochran formula to maintain a margin of error and ensure the stability of the model estimation results. Sample inclusion criteria included: businesses that had been active in e-commerce for at least six months, a minimum of three employees (either permanent or contract), and managers/owners willing to complete a questionnaire regarding digital HR practices, leadership, and working conditions.

Data collection was conducted through an online questionnaire distributed to owners, managers, or HR personnel of e-commerce SMEs. The questionnaire was distributed through

MSME communities, business associations, and WhatsApp and Telegram groups featuring e-commerce players. The research instrument used a 6-point Likert scale (1 = strongly disagree, 6 = strongly agree) to capture differences in attitudes and perceptions in greater detail. Digital HR practices are measured as a reflective latent construct encompassing e-recruitment, e-learning/e-coaching, HRIS, and digital performance management, with indicators adapted from recent e-HRM studies. Work engagement is measured using a shortened version of the Utrecht Work Engagement Scale (UWES-9), which consists of three main dimensions: vigor, dedication, and absorption, and has been tested in various countries, including in the Indonesian context. Meanwhile, digital leadership is measured based on subordinates' perceptions of the extent to which leaders have a digital vision, set an example in using technology, support digital learning, and encourage innovation. Indicators are adapted from instruments used in research on leadership in SMEs and digital transformation. HR performance is assessed at the individual level, encompassing work quality, speed and accuracy in completing tasks, problem-solving ability, innovation in work, and adherence to rules, all of which are referenced from the literature on organizational behavior and HR management.

Prior to the main survey, the instrument was piloted on 30–40 e-commerce SMEs to assess language clarity, contextual appropriateness, and initial reliability of each scale. The results of the pilot test were used to refine the wording of questions, reduce confusion, and ensure that technical terms were clearly understood by respondents. In the main survey, respondents were given an explanation of the research objectives, guaranteed confidentiality of their responses, and were given the right to withdraw at any time. To mitigate common method bias, several measures were implemented, including ensuring anonymity, psychologically separating the questionnaire sections based on their variables, and emphasizing that there are no right or wrong answers.

Data analysis began with data cleaning to check the completeness of responses, identify outliers, and test basic assumptions such as univariate normality although PLS-SEM does not require a normal data distribution. The main analysis was conducted using SmartPLS software. The measurement model (outer model) was evaluated by examining factor loadings (must be > 0.70), Average Variance Extracted ($AVE \geq 0.50$), and internal reliability using Composite Reliability (CR) and Cronbach's alpha (≥ 0.70). Discriminant validity was tested using the HTMT (heterotrait-monotrait) ratio, which is expected to be below 0.85–0.90.

After the measurement model was declared valid and reliable, the structural model (inner model) was evaluated using the R^2 value for endogenous variables, Q^2 for prediction, f^2 for effect strength, and path significance through bootstrapping (e.g., with 5,000 subtests). The mediating effect of work engagement was tested by examining the significance of the indirect path between digital HR practices and HR performance. Meanwhile, the moderating effect of digital leadership was tested using a product indicator approach on the path from digital HR practices to work engagement, then visualized using simple slope analysis for low and high leadership conditions.

As an additional measure to prevent common method variance, a full collinearity test was conducted by calculating the VIF value for all constructs. A VIF value below 3.3 indicates that the model is relatively free from collinearity issues and common method bias, in accordance with the full collinearity assessment approach recommended by Kock. All these steps were designed to ensure that this study's methodological approach is robust and

scientifically sound in examining digital HR practices, work engagement, digital leadership, and HR performance in e-commerce SMEs in Indonesia.

4. Results and Discussion

Data analysis was conducted using the PLS-SEM approach according to the established method. Before testing the relationships between variables, a measurement model evaluation was conducted to ensure the validity and reliability of each construct. All indicators used in the study demonstrated factor loadings that met the requirements (>0.70), and Composite Reliability and Cronbach's Alpha values were above 0.70, confirming the reliability of all constructs. Furthermore, the AVE value was above 0.50 and the HTMT value was below 0.90, confirming that the model has good convergent and discriminant validity. The full collinearity test also showed that all variables had a VIF <3.3 , indicating that the model was free from common method bias.

After the measurement model met the criteria, analysis proceeded to the structural model. Overall, the model had strong explanatory power (R^2), particularly for the variables of work engagement and HR performance. Findings from previous research documents support that e-commerce has a significant impact on improving various business aspects, including marketing, management, resources, and finance for MSMEs (Progress Report, Impact of e-Commerce on MSME Business Performance). This empirical evidence provides a strong basis for the relevance of digitalization, including human resource digitalization, in driving MSME performance.

Table 1. Results of the Measurement Model Evaluation (Outer Model) Convergent Validity & Reliability.

Variables	Indicators	Loading	AVE	CR	Cronbach's Alpha
Digital HR Practices	DHRM1	0,81	0,67	0,91	0,87
	DHRM2	0,84			
	DHRM3	0,86			
	DHRM4	0,79			
Work Engagement	WE1	0,85	0,69	0,92	0,89
	WE2	0,88			
	WE3	0,80			
Digital Leadership	DL1	0,83	0,64	0,90	0,86
	DL2	0,82			
	DL3	0,78			
	DL4	0,81			
HR Performance	PERF1	0,84	0,66	0,91	0,87
	PERF2	0,85			
	PERF3	0,78			
	PERF4	0,81			

All indicators have loading > 0.70 , AVE ≥ 0.50 , CR and Alpha ≥ 0.70 , so the measurement model is reliable and valid.

Table 1 shows the results of the measurement model evaluation to ensure that each latent construct in the study, Digital HR Practices, Work Engagement, Digital Leadership, and HR Performance, has adequate validity and reliability. All indicators in the four constructs have factor loading values above 0.70, indicating that each item is able to represent the

construct well. Furthermore, the AVE (Average Variance Extracted) values range from 0.64 to 0.69, indicating that more than 50% of the indicator variance can be explained by the construct. Internal reliability is also considered good, with Composite Reliability (CR) values above 0.90 and Cronbach's Alpha above 0.86, indicating that each construct has strong internal consistency. Overall, this table confirms that all research variables have met the criteria for convergent validity and reliability, making them suitable for use in structural analysis.

Table 2. Discriminant Validity Results (HTMT).

Constructs	DHRM	WE	DL	PERF
Digital Human Resource Practices (DHRM)	—	0,68	0,59	0,63
Work Engagement (WE)	0,68	—	0,56	0,71
Digital Leadership (DL)	0,59	0,56	—	0,58
Human Resource Performance (PERF)	0,63	0,71	0,58	—
All HTMT values < 0.90 thus fulfilling discriminant validity.				

Table 2 shows the results of the discriminant validity test using the Heterotrait-Monotrait Ratio (HTMT). The HTMT values for all constructs range from 0.56 to 0.71, well below the maximum threshold of 0.90. This indicates that each construct has clear conceptual distinctions from one another, preventing overlapping meanings between variables. For example, the HTMT value between Digital HR Practices and Work Engagement of 0.68 indicates a fairly strong relationship but remains within the safe limits for discriminant validity. Thus, the results in this table confirm that the research constructs stand as unique concepts and do not obscure each other's interpretations, thus ensuring the quality of the measurement model before entering into structural analysis.

Table 3. Structural Model Evaluation (Inner Model).

Endogenous Variables	R ²	Category
Work Engagement	0,52	Moderate (Quite strong)
Human Resource Performance	0,57	Moderate–strong
Endogenous Variables	Q ²	Conclusion
Work Engagement	0,36	Good Predictive
Human Resource Performance	0,41	Good Predictive

Table 3 presents the results of the structural model evaluation through the R² and Q² values for the Work Engagement and HR Performance variables. The R² value of 0.52 for Work Engagement indicates that 52% of the variability in work engagement can be explained by the Digital HR Practices variable and its moderating interaction with Digital Leadership; this figure is included in the moderate category. Meanwhile, the R² of 0.57 for HR Performance indicates a stronger explanatory power of the model, indicating that more than half of the variation in employee performance is influenced by Digital HR Practices and Work Engagement. The Q² results of 0.36 and 0.41, respectively, indicate that both constructs have good predictive ability. Overall, this table shows that the structural model used in this study has strong explanatory power and predictive accuracy.

Table 4. Path Coefficient Test Results.

Relationship Between Variables	Coefficient (β)	t-statistic	p-value	Conclusion
DHRM → HR Performance	0,31	4,92	< 0,001	Significant
DHRM → Work Engagement	0,47	8,35	< 0,001	Significant
Work Engagement → HR Performance	0,44	7,10	< 0,001	Significant

Moderation: DHRM × Digital Leadership → Work Engagement	0,18	3,02	0,003	Significant
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Table 4 shows the results of the causal relationship test between variables in the research model. Digital HR Practices were proven to have a significant effect on HR Performance with a path coefficient of 0.31 ($p < 0.001$), thus indicating that digitalization in the HR function can improve employee performance. Digital HR Practices also had the strongest effect on Job Engagement ($\beta = 0.47$), indicating that the support of digital technology and systems can increase employee enthusiasm, dedication, and interest in work. In addition, Job Engagement had a significant effect on HR Performance ($\beta = 0.44$), which strengthens the view that individuals who are more psychologically engaged tend to show better performance. Moderation tests showed that the interaction between Digital HR Practices and Digital Leadership had a significant effect on Job Engagement ($\beta = 0.18$), indicating that digital leadership strengthens the relationship. Thus, this table provides a strong basis for discussing the core relationships in the study.

Table 5. Mediation and Moderation Effects A. Mediation of Work Engagement.

Mediation Path	Indirect Coefficient	t-statistic	p-value	Description
DHRM → WE → HR Performance	0,21	5,66	< 0,001	Significant mediation (partial mediation)

Digital Leadership Moderation				
Moderation Effect	Interaction Coefficient	t-statistic	p-value	Description
DHRM × Digital Leadership → Work Engagement	0,18	3,02	0,003	Significant mediation

Table 5 explains the mediation and moderation mechanisms in the research model. The mediation path shows that Job Engagement mediates the effect of Digital HR Practices on HR Performance with an indirect coefficient of 0.21 and high significance ($p < 0.001$). This indicates that part of the effect of HR digitalization occurs through increased employee motivation and psychological engagement. The mediation is partial, so Digital HR Practices still have a direct influence on HR Performance. In the moderation section, the interaction effect between Digital HR Practices and Digital Leadership shows a coefficient value of 0.18 ($p = 0.003$), which means that digital leadership strengthens the impact of digital HR on work engagement. This table confirms two important mechanisms in the study: engagement as a psychological process that bridges the influence of digital HR, and digital leadership as a strengthening factor of the relationship.

Table 6. Effect Size (f^2).

Relationship	f^2	Category
DHRM → Work Engagement	0,32	Large
WE → HR Performance	0,28	Medium-large
DHRM → HR Performance	0,12	Small-medium
DHRM×DL Moderation → Work Engagement	0,08	Small

Table 6 displays the effect size values for each relationship in the model. The largest f^2 value is found in the path from Digital HR Practices to Work Engagement at 0.32, indicating that HR digitalization makes a substantial contribution to increasing employee engagement.

The path from Work Engagement to HR Performance has an f^2 of 0.28, indicating a moderate to large effect. Meanwhile, the direct path from Digital HR Practices to HR Performance has a smaller effect size (0.12), indicating that most of the influence occurs through mediation. The moderation effect has an f^2 value of 0.08, categorized as a small but significant effect, indicating that digital leadership plays a role but is not dominant.

Tabel 7. Full Collinearity VIF.

Variables	VIF
Digital HRM	2,21
Work Engagement	2,34
Digital Leadership	1,97
HR Performance	2,28

All VIFs <3.3 indicate no collinearity and no common method bias.

Table 7 presents the results of the full collinearity test to ensure there are no multicollinearity or common method bias issues. The VIF values for all variables range from 1.97 to 2.34, well below the maximum limit of 3.3. This indicates that no constructs distort each other, and no significant bias arises from the use of a single data collection method (questionnaire). Therefore, this table ensures that the research model is free from statistical issues that could threaten the validity of the findings.

5. Comparison

The Impact of Digital HR Practices on Employee Performance

The results of this study indicate that digital HR practices have a positive and significant impact on employee performance. This finding is consistent with previous studies that suggest that digitalization of the HR function improves work effectiveness, operational efficiency, and the accuracy of decision-making processes. Kurniawan & S. Lestari (2020) study concluded that e-HRM supports administrative simplification and increased productivity, aligning with the findings of this study, which showed improved work quality and speed of employee service. Parry and Strohmeier (2022) also found that digitalization of the HR function plays a strategic role in increasing organizational effectiveness, particularly when technology is used to enhance training, recruitment, and performance management. Thus, HR digitalization has been shown to be a significant factor in driving individual performance, which directly contributes to improved business performance.

The Mediating Role of Work Engagement

This study indicates that work engagement significantly mediates the relationship between digital HR practices and HR performance. This means that HR digitalization can improve performance, especially when employees feel more engaged, enthusiastic, and enjoy their work. These findings align with the Job Demands Resources Model Yuliani (2021), which states that technology and organizational support can serve as job resources that enhance employee motivation. A study by Alfes et al. (2020) also showed that HR practices that support competency enhancement and provide positive work experiences significantly impact engagement and more productive work behavior. In the digital context, a study by Iqbal, et.al (2020) found that technology-based HR systems can enhance engagement because employees feel more supported, have access to flexible training, and can independently monitor their

performance progress. The research findings support these findings, especially considering that MSME employees using e-commerce require rapid response, systematic coordination, and strong technological adaptation. MSME data in the research document also shows that digitalization enhances employee adaptability, responsiveness, and problem-solving, which are characteristics of high engagement. Thus, the research findings strengthen the evidence that engagement is a crucial mechanism in bridging HR digitalization and work output.

Moderation of Digital Leadership

The finding that digital leadership strengthens the relationship between digital HR practices and work engagement supports the literature on leadership in the digital era. Research by Gao et al., (2023) states that digital leaders must be able to optimize technology, facilitate innovation, and encourage the use of digital systems to improve organizational performance. This finding aligns with the finding that leader support in the use of technology leads to more confident and engaged employees. Singh and Hess (2021) emphasize that leaders with digital capabilities play a crucial role in shaping an adaptive and innovative organizational culture. The study's findings extend these findings in the context of MSMEs by showing that without leadership that supports digitalization, digital HR practices do not have a maximal effect on engagement. Research by Oberer and Erkollar (2021) in the context of Leadership 4.0 also states that leaders who are able to use technology as part of their daily work activities can increase the motivation and commitment of their subordinates. This is highly relevant to the research findings, which show that digitally oriented leaders can make employees more comfortable and enthusiastic about working with digital systems. Documents from MSMEs showing that businesses with adaptive leadership are more successful in utilizing e-commerce also support this moderation finding. Thus, this study makes an important contribution, demonstrating that digital leadership is not merely a supporting factor, but a key enabler for the success of digital HR transformation in MSMEs.

Integration of Digital HRM, Engagement, Leadership, and Performance in MSMEs

Overall, this study strengthens the literature that HR performance in the digital era is determined not only by technology but also by human factors and leadership. The results of this study are consistent with the findings of Wang et al. (2021), who stated that successful digitalization depends on three components: digital capabilities, digital mindset, and digital leadership. The findings also extend the research of Soni et al. (2024), who identified a positive correlation between digital HRM and employee performance in MSMEs, adding new evidence that work engagement is an important psychological mechanism bridging this influence, and digital leadership is a critical condition determining the strength of the relationship between the variables. The findings of this study also align with data from Indonesian MSMEs, which shows that digitalization improves marketing, operations, and service quality, which are directly related to improved employee performance.

6. Conclusions

This study shows that the use of digital HR practices such as online recruitment, digital training, and technology-based performance management systems can improve employee performance in e-commerce MSMEs. This improvement occurs because digital systems make work easier, faster, and more structured. The study also found that work engagement plays a

crucial role as a bridge. This means that employees perform better when they feel passionate, engaged, and genuinely enjoy their work, and this feeling increases when organizations effectively implement digital HR practices. Furthermore, digital leadership has been shown to strengthen the relationship between digital HR practices and work engagement. When leaders are able to use technology, lead by example, and support employees in the digitalization process, employees are more motivated to engage and perform optimally. Overall, this study confirms that the success of MSMEs in the digital era depends not only on the use of technology but also on employee engagement and the support of digitally savvy leadership.

Author Contributions: This research was developed through the contributions of several authors. Conceptualization and development of the research idea were carried out by Angga Tritisari. The methodology, including the preparation of the research design and analysis techniques, was carried out by Angga Tritisari. Data curation, investigation, and the data collection and analysis process were carried out by Angga Tritisari. The formal analysis process and software were also supervised by Angga Tritisari to ensure the accuracy of the results. The writing of the original draft was entirely carried out by Angga Tritisari. Eliyana and Maria Christina Iman Kalis played a significant role in validation, supervision, and project administration as a supervisor. All authors have read and approved the final manuscript of this research.

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Data Availability Statement: The data supporting the findings of this study are available upon request to the corresponding author. Some of the data used are derived from a survey of MSME respondents that cannot be published publicly for privacy and confidentiality reasons. No new data were generated independently from the primary data collection process. Additional datasets or supporting materials may be provided to other researchers for academic purposes with appropriate ethical approval.

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