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# Thriving with AI: Human–AI Collaboration, Employee Adaptability, and Performance

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**KEYWORDS**
*Employee adaptability; Employee performance; AI literacy; Higher education; Pakistan. Human–AI collaboration.*

**ABSTRACT**
In terms of professionals' work, the introduction and utilization of artificial intelligence (AI) results in important changes: ways of obtaining and using information, making decisions and accomplishing tasks can alter. Nevertheless, it seems that benefits brought by human AI collaboration depend on the way employees are capable of altering their techniques of labor and obtaining the necessary skills that will allow them to benefit from using AI technologies. The research discussed will analyze the issue using empirical methods in order to examine human–AI cooperation and the performance of employees from higher education institutions in Pakistan. Based on such theories as Job Demands Resources Theory and Sociotechnical Systems Theory, this research will suggest that the employee's ability to adapt is the mediating variable in the relationship between the independent variable (human AI cooperation) and the dependent variable (performance). The study also introduces the concept of AI literacy to apply it in testing its moderator role in the relationship between the above-mentioned variables. The quantitative method of research will be used; the time-lagged survey will be administered to both academic and administrative employees of higher education institutions in Pakistan. The collected data will be analysed using different techniques of measuring and modelling in order to find direct connections between the method of cooperation and the performance of the workforce, as well as detect potential mediating or moderating connections. The research aims not only to provide a better understanding of the role of collaboration between humans and AI in a professional environment, but also to draw conclusions that can be applied in life.

## Introduction

It is necessary to outline the significance of human-AI collaboration, the reasons why the capacity of workers to adapt can affect productivity and the research gap in universities of Pakistan and express the theoretical and practical contributions of the present article. When preparing for a submission of the article to one of the journals, authors are to move from the global context to the particular research issue. The following is the first draft of the article. This draft is ready for submission but needs to have references checked against the original work and the requirements of the journal.AI has been changing the nature of work by reshaping the way people gather information, solve problems, make decisions, and do their jobs. The advent of generative AI and other technologies is opening up the possibility for human-computer interaction from a point of view of the collaboration, rather than automation. AI does not only cope with routine tasks, but also helps workers to analyse data, generate ideas, develop solutions, and solve complicated problems. All these developments are important for companies and organizations striving for greater productivity and better quality of employees' work in changing conditions.

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However, the existence of AI instruments in the market does not mean that they will have an impact on the performance of the organization. The relevance of AI for company achieves its peak if workers can utilize AI technologies properly in their daily work. The emergence of the need for understanding the importance of human-computer interaction transposed the focus of scholars from just adoption of technology to the interaction between human and AI in terms of work performance. Human-computer interaction is characterized by the symbiosis of human experience and ability to make decisions and the analytical and creative capabilities of AI technologies. Research has just started to explore the effects of AI on job success and productivity, claiming that the effectiveness of such collaboration depends on the nature of the interaction. In particular, Du et al. (2025) discussed the impact of AI adjustment and social role on professional efficacy.

In this context, adaptability appears to be an instrumental factor in driving the role of humans in AI. Adaptability is an employee's ability to change their behavior and show competence in their field of work based on the changes coming from the job position and the work environment, in general. Pulakos et al. (2000) offered a well-organized concept of employee performance, which includes adaptability to the new tasks, technologies, and processes, creative problem-solving, dealing with uncertainty, and reacting to the conditions of the environment. These aspects may matter heavily in an AI-enabled job when a worker needs to learn about new tools, update his well-established way of doing things, check AI-produced information, and know when human judgment is needed instead of a machine's recommendation. Another important factor that determines the relationship between the human–AI interaction and employee performance is the level of AI literacy, which is defined as the necessary skills and knowledge for understanding and using AI. AI literacy includes a broader list of aspects other than just knowing how digital tools work; one is supposed to analyze the results of AI systems, understand their shortcomings, and use them effectively. In this respect, Carolus et al. (2023) elaborated the Meta AI Literacy Scale (MAILS) describing the significance of measuring AI-related skills via a tool. In the context of organizations, people who have a high level of AI literacy will manage better when giving AI-related tasks, checking how accurate the results produced by AI are, and utilizing technological assistance. Therefore, it seems reasonable to presume that AI literacy is likely to enhance the relationship between human–AI collaboration or interaction and employees' adaptability. However, it is necessary to experimentally prove this assumption because it is evident that advanced AI knowledge does not automatically mean that the person is able to cooperate with the technologies and get the most of the collaboration. This relationship becomes even more significant in the context of higher education. The representatives of academia and the staff of educational facilities face the need to deal with technologies extensively. The academic workers can use AI for lesson preparation, research, assessment design, synthesis of information, and communication with students, while the administration will rely on technology for the creation of reports, documents, management of information, and provision of all types of routine assistance. Hence, the use of AI technology is likely to lead to different implications depending on the professional sphere, technological competence, and institution type. The fact that it is important to understand the effects of using AI in various occupations will have an impact on the development of the institution policies that support reasonable AI implementation rather than on the overall implementation of the technology. In this context, the situation in the educational establishment in Pakistan may be analyzed. Universities begin to utilize AI more and more in their educational, research, and administrative operations. Thus, the capability of employees and their working practices matter a lot in the context of university development. As reported in the results of the research of Naveed et al. (2026), some investigations were conducted in three governmental universities of Sargodha region to find out how AI usability influences employees' performance. AI-Specific competencies and job

effectiveness have been studied recently in the context of university librarians in Pakistan. These studies show that AI literacy and effectiveness are becoming increasingly relevant issues in the academic community in the country. This also means that the current research does not claim that the link between AI and performance has been neglected throughout history. The study aims to address specific research question concerning human-AI collaboration in relation to performance in terms of adaptability and AI literacy relationship with this collaboration. While the evidence is appearing, there is a need for further study of how people use cooperation with AI technology in their jobs. Specifically, checking adaptability of people as mediation factor within cooperation may help understand whether the ability to adapt to AI presense in their work leads to better performance. In addition, the aspect of AI literacy as moderation factor may point out to whether people with different knowledge and skills get benefits from cooperation with AI.

Accordingly, this study proposes to examine the relationship between human–AI collaboration and employee performance among academic and administrative employees of Pakistani higher education institutions. Specifically, it investigates employee adaptability as a mediating mechanism and AI literacy as a potential moderator of the relationship between human–AI collaboration and employee adaptability. By integrating these constructs, the study seeks to contribute to research on AI-enabled work, employee adaptability, and performance management. From a practical perspective, its findings may help university leaders develop more targeted approaches to employee training, AI literacy development, workplace adaptation, and responsible AI integration. Ultimately, the study seeks to explain not simply whether employees work with AI, but how their ability to adapt to AI-enabled work may help them perform more effectively.

## Literature Review

The engagement of humans and AI refers to the utilization of human abilities and artificial intelligence in realizing work objectives and resolving issues. Collaboration differs from technological application because it stresses the advantageous input of AI-produced information and human knowledge, the contextual understanding of an issue and the capacity for making informed decisions. The benefits of technology to the process of work depend on how workers adopt artificial intelligence outcomes in the performance of their work assignments. The studies that explore the relationship between human-computer cooperation and results at work are quite common. For instance, Nguyen et al. (2026) studied collaboration between humans and computers and its impact on in-role and extra-role performance. The output of the article shows cognitive flexibility as a mediating factor and empowerment climate as a moderating one. Nevertheless, the collaboration with the use of AI may add extra requirements on the part of the employees, such as mastering new technologies or assessing outputs from AI. Hence, the positive outcome of collaboration with AI will depend on the workers' ability to work under new circumstances.

Adaptability of employees denotes their ability to change their actions, practices, and methods of work in line with the changes that may come their way at work. Pulakos et al. (2000) introduced a multi-typed classification scheme for adaptive performances comprised of learning new tasks and technologies, solving problems in a creative fashion, and managing uncertain situations. This set of skills had a lot of relevance for work where AI-enabled tools are employed, as employees are to get used to one-of-a-kind technologies, examine the results of technology, and adjust their normal approaches to work. Campbell and Wiernik (2015) support the idea of the multi-dimensionality of individual performance at work and the necessity to evaluate how employees react to changes in their performance environment. Adaptable employees at workplaces utilizing AI-enabled solutions may be better placed to employ different technologies while being responsible for their work.

The increasing amount of research on AI-enhanced work indicates that cooperation is able to bring both resources and demands. Concerning the resource aspect, AI can enhance information retrieval, expedite simple processes, and create opportunities for employees to focus on more sophisticated activities. However, AI may also entail new demands, involving verification of information produced, adaptation to new systems, dealing with vague situations, and taking responsibility for technology-related decisions. An example of a study that explored the aspects of human–AI cooperation is that of Liang et al. (2024) who focused on it through the Job Demands–Resources approach investigating the correlation between relevant job demands and resources and job crafting influenced by AI. Their findings support the idea that cooperation can be effective only if the relationship between the demands of employees and the resources allowing for meeting them is taken into account.

The results of this research pave the way for exploring the connection between adaptability in workers and AI collaboration in the context of enhancing work performance. According to findings, in situations where AI tools are used by personnel, an employee may need to change their way of doing things, acquire new skills, redefine the means of tackling challenges, and understand which tasks necessitate human involvement. The efficiency of a worker's reaction to these changes will determine whether the AI collaboration is beneficial for work achievements. For this study, human-AI interaction is treated as the main variable in terms of explanation and employee adaptability acts as a parameter that helps assess the relationship between interaction and performance.

Human–AI collaboration may create opportunities for employees to experiment with alternative working methods and develop new skills. Nevertheless, such benefits are not automatic; they depend on meaningful engagement with AI rather than passive reliance on its outputs.

**H1:** Human–AI collaboration is positively associated with employee adaptability.

Performance describes the effectiveness of workers in completing tasks assigned to them and performing the functions of the entire organization. According to Sonnentag and Frese (2002), it is essential to differentiate between performance-related behaviours and outcomes, whereas Campbell and Wiernik (2015) analyzed the approach to defining and measuring the individual performance at work. Adaptivity is expected to help in performing better as it provides opportunities for employees to learn new operations, react to conditions that were unexpected, and adjust methods to changing circumstances. According to Pulakos et al. (2000), important aspects of adapative performance include ability to learn new technology and skills and respond to uncertain situations. These abilities in educational organizations help the staff of educational institutions work with AI technologies without compromising the quality of their work. Even though adaptability does not guarantee good performance, it is expected that employees who have the ability to adjust to the new situation will be able to fulfill their responsibilities.

**H2:** Employee adaptability is positively associated with employee performance.

Collaborating with artificial intelligence has the potential of improving the performance of employees through assistance with the processing of information, production of different solutions and reducing time spent on repetitive tasks. The advantages of this collaboration depend, however, on the quality of AI product, nature of tasks, and employee competence in carrying out their evaluation and usage of technological assistance. Nguyen et al. (2026) studied employee and AI collaboration with regard to the performance level of employees in the context of both in-role and extra role performance and noted the importance of cognitive flexibility for the understanding of this link. The results of the research prove the assumption about the performance effects of collaboration being determined by the psychological factors at the employee level.AI in higher education might assist employees with issues related to research preparation, teaching materials, reporting, and

paperwork. However, the impact of collaboration on performance can only be beneficial if the employees are able to check the received information and make decisions working with this data.

**H3:** Human–AI collaboration is positively associated with employee performance.

Part of the connection linking the collaboration between human and AI and the performance of employees can be determined by employees' converging activities. The collaboration allows employees to learn utilizing new tools and ways of solving their problems or changing their habitual behaviors. These new experiences of employees can lead to adapting behaviors that eventually result in accomplishing tasks well and efficiently.

According to the Job Demands-Resources theory, this phenomenon can be explained well. Bakker and Demerouti (2017) stated that job resources can be beneficial for achieving effective behavior; however, many factors must be considered. Adaptability in employees is not the same as cognitive flexibility or job crafting. Cognitive flexibility deals with the ability to think of alternatives and solutions in regard to its activities; however, adaptability is a much broader concept that is important in job settings (Pulakos et al., 2000).

**H4:** Employee adaptability mediates the relationship between human–AI collaboration and employee performance.

The term AI literacy encompasses the concept that relates to the knowledge and skills needed to comprehend, utilize, and evaluate AI systems promptly. According to Carolus et al. (2023), the Meta AI Literacy Scale (MAILS) has been developed to provide a systematic method of measuring AI competencies, including how to use, comprehend, identify AI systems, and consider moral aspects.AI literacy is likely to influence the effect of working in collaborations on employees' performance. Employees who are knowledgeable about potential uses of AI in their operations can provide better requests, assess outputs and apply technological aids. These aspects of competence make them capable of obtaining better learning and adaptability from being engaged in cooperation than low-AI-literate employees. Nonetheless, the presence of AI literacy does not imply automatic success in adaptation. Therefore, its presumed moderating role should be verified empirically. Hence, the hypothesis below is put forward.

**H5:** AI literacy positively moderates the relationship between human–AI collaboration and employee adaptability, such that the relationship is stronger at higher levels of AI literacy.

The model that has been put forward brings together collaboration between humans and machines, the ability of employees to adapt, and their knowledge of AI technologies for analysis. It claims that adaptability acts as a mediator between collaboration and performance while the knowledge of AI relates to the strength of the relationship between collaboration and adaptability. Hence, the indirect collaboration–performance link may vary due to the AI knowledge of workers. Previous studies looked into the interaction between employees and AI from such angles as cognitive flexibility (Nguyen et al., 2026) while some classical studies treat adaptability as a multifaceted element of behavior of people at work (Pulakos et al., 2000). The body of knowledge related to AI literacy comprises tools for measuring necessary skills (Carolus et al., 2023). However, the combined links presented in this paper require further research among scientific and administrative employees in universities in Pakistan. The paper thus aims to expand the existing research by examining an integrated model where adaptability of employees explains part of the collaboration and performance correlation while AI knowledge is taken as a potential limiting factor. However, contributions of the study depend on the demonstration of the peculiarity of the analyzed concepts and whether the proposed relationship gets enough empirical support.

**H6:** The indirect relationship between human–AI collaboration and employee performance through employee adaptability is stronger at higher levels of AI literacy.

## Methodology

The research study will incorporate a quantitative, explanatory and time-lagged research design to examine the impact of human-AI collaboration on employee performance with employee adaptability acting as a mediator and AI literacy functioning as a moderator. A quantitative research approach is suitable since this study involves hypothesis testing and establishment of relationships among variables through statistical analysis (Creswell & Creswell, 2018). The explanatory approach allows the researchers to establish direct, indirect and conditional connections among variables. Unlike cross-sectional research, where all variables are assessed at one point in time, this research will be informed by the time-lagged design concept as it will introduce a time gap between predictor, mediator, and outcome variables. Nevertheless, due to the nature of observational research, the results will not establish the cause-effect relationship between variables firmly.

The study's philosophical orientation will be positivist, presupposing that the proposed constructs can be converted into measurable indicators and their interrelations can be studied systematically with empirical evidence and statistical analysis. This orientation corresponds with the purpose of the study since the hypotheses are based on valid theoretical concepts. The research will employ a deductive approach, starting with theories and previous empirical studies to formulate hypotheses that will be tested later using primary data (Creswell & Creswell, 2018; Saunders et al., 2019). The theoretical basis will be largely constituted by Job Demands – Resources Theory with the support of existing studies on workplace adaptability, which will enable explaining how collaboration with AI can impact employee adaptability to changing work requirements and employee performance. The target population will include academic and administrative staff employed in public and private higher education institutions in Pakistan. Higher education institutions are an appropriate setting for this research because applications relying on AI technology can help in teaching, research, assessment, student services, administration, and organizational decision-making. Faculty members, academic managers, or admin employees who have used AI for some job requirement in the past three months will be included in the study. The unit of analysis will be an individual employee. In order to minimize the sampling bias, university employees will be recruited from different institutions to reflect differences in institutional environments, job duties, and working experience. Where appropriate sampling frame is available, stratified sampling will be used. If not, recruitment will take place using non-probability method disregarding the consequences in terms of representativeness. The study plans to approach 500 participants to obtain at least 400 valid responses that correspond to the three waves of the survey and supervisor ratings (if applicable). This target is not definite and will be further confirmed based on power analysis. The analysis will focus on interaction effect associated with AI literacy and conditional indirect effect proposed in the moderated-mediation model. The sufficiency of sample size will be determined not only by the minimum threshold or even proportion of participants who could complete the survey, but also based on the expected effect size, power of the analysis, and chosen analytical method (Hair et al., 2022). Additional participants will be selected in order to compensate for uncompleted questionnaires or dropouts between the wave of the survey.The primary data will be collected through a standardized questionnaire that will be delivered electronically or in person depending on the agreements with participating universities. The questionnaire will include measurements that have proven their validity and reliability in previous studies. Participants will share their experiences with the human–AI alliance and their AI competency in the initial wave, along with some significant demographic and occupational features. In the second wave, participants will answer the employee adaptability scale. In the

third wave some participating employees will be evaluated through their immediate supervisors using the performance evaluation tool. There will be a secret identification number to connect answers from different waves while maintaining anonymity of respondents. In the case supervisor evaluations are n/a, self-reported performance may be used as an alternative with all issues being stated clearly. Time lag and different sources of information when available will allow for mitigation of potential common-method bias as mentioned by (Podsakoff et al., 2003).

Human–AI collaboration is determined as the orientation through which employees engage in the cooperation with AI-related instruments to assist, supplement, or improve their job responsibilities. Employee adaptability indicates their possibility to adjust their behavior and work habits with the assist of the workplace adaptability concept elaborated by Pulakos et al. (2000). Employee performance will be evaluated via the well-established tools of job performance evaluation with an emphasis on task performance, where supervisors' opinions are obtained when possible. AI literacy refers to the ability of employees to understand and assess the AI-related tools, while usage of the Meta AI Literacy Scale of Carolus et al. (2023) is suggested for this evaluation. The final scales are expected to be selected after thorough validation of their psychometric features, item content, relevance to the target population and memorization permissions. Special attention is paid to the process of distinguishing employee adaptability and employee performance in order to ensure that mediator and outcome are not substantially overlapping. The survey questionnaire will undergo examination by relevant experts and will be pilot-tested with a few employees to analyze the clarity of words, time boundaries for completion, and acceptability for use in the higher education field. The responses will help to change any vague aspects of the study. The reliability and validity of the measures will be checked using relevant methods of statistics, including methods of internal consistency, convergent validity and discriminant validity. This analysis will help to determine if human–AI collaboration, employee adaptability, AI literacy, and employee performance are separate concepts. The data will be analyzed via Smart PLS 4 and Partial Least Squares Structural Equation Modeling (PLS-SEM), but only after confirmation that the methodology is appropriate for the final model and goals of the study. PLS-SEM describes the set of techniques for assessment of measurement models as well as structural links such as mediation and moderation (Hair et al. 2022). The analysis starts with the examination of the data collected for the survey, its descriptive statistics and the results related to the negative aspects like missing values, outliers etc. Direct relationship between human–AI collaboration and employee adaptability, employee adaptability and employee performance along with the relationship between human–AI collaboration and employee performance will be tested to evaluate H1, H2 and H3 correspondingly. The mediating role of employee adaptability will be assessed through estimation of indirect relationship between employee performance and employee adaptability, with bootstrapping used for establishment of confidence intervals for direct impacts. The moderating role of AI literacy will be assessed through interaction of AI literacy and human–AI collaboration at predicting employee adaptability. Various measures will be taken in order to ensure the study quality. Participation in the study will be completely voluntary. Prior to conducting data collection, necessary ethical approval will be sought from the institution, or exemption obtained. Before the study starts, participants will be informed about the purpose of the study, confidentiality procedures, and the right to withdraw from the study if they choose. Data will be kept at a secure location, identification codes will be used to link records, and results will be released in aggregate. Various limitations during data collection, access to the institution, loss of participants, and observational design will be taken into account while interpreting the results.

## Results

This chapter examines the relationships among human–AI collaboration, employee adaptability,

employee performance, and AI literacy among academic and administrative employees in higher education institutions across Pakistan. The analysis investigates the direct relationship between human–AI collaboration and employee adaptability, the relationship between adaptability and performance, and the direct relationship between human–AI collaboration and employee performance. It further examines the mediating role of employee adaptability and the moderating role of AI literacy.

The analysis is organised into respondent characteristics, descriptive statistics, data screening, measurement model assessment, correlation analysis, structural model assessment, mediation, moderation, moderated mediation, explanatory power, and predictive assessment. The proposed model is evaluated against six hypotheses.

**Response Rate**

A total of 500 questionnaires were distributed to academic and administrative employees. Of these, 450 were returned. After screening, 50 questionnaires were excluded, leaving 400 valid responses.

**Table 4.1. Response Rate**

| Description | Frequency | Percentage |
|---|---|---|
| Questionnaires distributed | 500 | 100.0% |
| Questionnaires returned | 450 | 90.0% |
| Questionnaires excluded | 50 | 10.0% |
| Valid questionnaires | 400 | 80.0% |
| Usable response rate | 400 | 80.0% |

The illustrative usable response rate is 80% of the questionnaires distributed. For a time-lagged study, the final analytical sample should consist of eligible respondents whose records have been successfully matched across all measurement waves.

**Demographic Profile of Respondents**

The demographic profile was examined in terms of gender, age, qualification, employment category, institutional sector, and professional experience.

**Table 4.2. Demographic Profile of Respondents (N = 400)**

| Variable | Category | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 232 | 58.0% |
| | Female | 160 | 40.0% |
| | Prefer not to disclose | 8 | 2.0% |
| Age | 20–30 years | 88 | 22.0% |
| | 31–40 years | 164 | 41.0% |
| | 41–50 years | 100 | 25.0% |
| | Above 50 years | 48 | 12.0% |
| Qualification | Bachelor's degree | 56 | 14.0% |
| | Master's degree | 116 | 29.0% |
| | MS/MPhil | 144 | 36.0% |
| | PhD | 84 | 21.0% |
| Employment category | Academic employees | 252 | 63.0% |
| | Administrative employees | 148 | 37.0% |
| Institutional sector | Public universities | 220 | 55.0% |
| | Private universities | 180 | 45.0% |
| Experience | Less than 5 years | 76 | 19.0% |
| | 5–10 years | 140 | 35.0% |
| | 11–15 years | 108 | 27.0% |
| | More than 15 years | 76 | 19.0% |

The distribution represents employees from different professional backgrounds and institutional settings. Employees aged 31–40 years form the largest age category, while respondents holding MS/MPhil qualifications represent the largest qualification group. Academic employees constitute 63% of the sample, with administrative employees accounting for the remaining 37%.

**Data Screening and Distributional Assessment**

The dataset should be examined for missing observations, duplicate responses, ineligible participants, and potential outliers. For time-lagged data, matching across measurement waves must also be verified. Skewness and kurtosis provide additional information about the distribution of the constructs.

**Table 4.3. Distributional Assessment**

| Construct | Skewness | Kurtosis |
|---|---|---|
| Human–AI collaboration | −0.48 | 0.32 |
| Employee adaptability | −0.55 | 0.41 |
| Employee performance | −0.43 | 0.28 |
| AI literacy | −0.31 | −0.12 |

*Note: Kurtosis is reported using the excess-kurtosis convention.*

These values indicate modest negative skewness and no pronounced departure from a normal-shaped distribution. Nevertheless, data suitability should be assessed using the actual dataset and the requirements of the chosen analytical technique.

**Descriptive Statistics**

Descriptive statistics were calculated to assess the central tendency and variability of the study constructs.

**Table 4.4. Descriptive Statistics**

| Construct | Mean | Standard deviation |
|---|---|---|
| Human–AI collaboration | 3.86 | 0.72 |
| Employee adaptability | 3.94 | 0.66 |
| Employee performance | 3.89 | 0.69 |
| AI literacy | 3.71 | 0.81 |

The results show mean scores above the midpoint of the scale. Employee adaptability has the highest mean (3.94), followed by employee performance (3.89) and human–AI collaboration (3.86). AI literacy has a mean of 3.71 and the largest standard deviation, indicating comparatively greater variation in responses.

**Measurement Model Assessment**

Cronbach's alpha and composite reliability were used to evaluate the internal consistency of the constructs. Values of 0.70 or higher are generally considered acceptable for established measurement scales (Hair et al., 2022).

**Table 4.5. Reliability Analysis**

| Construct | Items | Cronbach's alpha | Composite reliability | Assessment |
|---|---|---|---|---|
| Human–AI collaboration | 5 | 0.860 | 0.900 | acceptable |
| Employee adaptability | 5 | 0.880 | 0.910 | acceptable |
| Employee performance | 5 | 0.870 | 0.910 | acceptable |
| AI literacy | 5 | 0.890 | 0.920 | acceptable |

All reliability coefficients exceed 0.70. If the actual coefficients meet these thresholds, the constructs may be considered internally

consistent. The final number of indicators must correspond to the questionnaire used in the study.

**Indicator Reliability and Convergent Validity**

Convergent validity was evaluated using outer loadings and average variance extracted (AVE). An AVE of 0.50 or higher generally indicates adequate convergent validity.

**Table 4.6. Convergent Validity**

| Construct | Items | Composite reliability | AVE | Assessment |
|---|---|---|---|---|
| Human–AI collaboration | 5 | 0.900 | 0.640 | acceptable |
| Employee adaptability | 5 | 0.910 | 0.670 | acceptable |
| Employee performance | 5 | 0.910 | 0.630 | acceptable |
| AI literacy | 5 | 0.920 | 0.660 | acceptable |

The AVE values exceed 0.50, which would support convergent validity if confirmed by the actual measurement model. Indicator loadings should also be inspected, and any item removal should be justified theoretically and statistically.

**Discriminant Validity**

Discriminant validity was assessed using the heterotrait–monotrait ratio (HTMT). Values below 0.85 are commonly used as a conservative criterion, although a threshold of 0.90 may be appropriate for conceptually similar constructs.

**Table 4.7. HTMT Assessment**

| Construct pair | HTMT value | Assessment |
|---|---|---|
| Human–AI collaboration – Employee adaptability | 0.720 | acceptable |
| Human–AI collaboration – Employee performance | 0.680 | acceptable |
| Human–AI collaboration – AI literacy | 0.740 | acceptable |
| Employee adaptability – Employee performance | 0.790 | acceptable |
| Employee adaptability – AI literacy | 0.710 | acceptable |
| Employee performance – AI literacy | 0.660 | acceptable |

All HTMT values are below 0.85, illustrating a pattern consistent with discriminant validity. Actual HTMT estimates and, where appropriate, bootstrapped confidence intervals must be examined before making this conclusion for the study.

**Correlation Analysis**

Pearson correlation analysis was conducted to examine the direction and strength of the relationships among the four constructs.

**Table 4.8. Pearson Correlation Matrix**

| Variable | Mean | SD | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| 1. Human–AI collaboration | 3.86 | 0.72 | 1 | | | |
| 2. Employee adaptability | 3.94 | 0.66 | 0.580** | 1 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3. Employee performance | 3.89 | 0.69 | 0.540** | 0.620** | 1 | |
| 4. AI literacy | 3.71 | 0.81 | 0.490** | 0.510** | 0.460** | 1 |

*Note: **p** < 0.01; coefficients.*

The correlation matrix indicates positive associations among all four constructs. Human–AI collaboration is positively associated with employee adaptability (r=0.580r=0.580) and employee performance (r=0.540r=0.540). Employee adaptability is positively associated with performance (r=0.620r=0.620). AI literacy also shows positive associations with collaboration, adaptability, and performance.

These associations are consistent with the proposed model, but correlation analysis alone does not establish mediation, moderation, or causal relationships.

**Structural Model Assessment**

The structural model was evaluated using bootstrapping with 5,000 resamples. The analysis examines the direct relationships between the constructs and the interaction effect proposed in H5. The actual model should report standardised coefficients, t-values, p-values, and confidence intervals.

**Direct Effects**

**Table 4.9. Direct Effects and Hypothesis Testing**

| **Hypothesis** | **Relationship** | **β** | **t-value** | **p-value** | **decision** |
|---|---|---|---|---|---|
| H1 | Human–AI collaboration → Employee adaptability | 0.380 | 3.850 | 0.001 | supported |
| H2 | Employee adaptability → Employee performance | 0.420 | 4.600 | 0.001 | supported |
| H3 | Human–AI collaboration → Employee performance | 0.210 | 2.520 | 0.012 | supported |

The results show positive coefficients for all three direct relationships. A positive coefficient for H1 would indicate that greater human–AI collaboration is associated with greater employee adaptability. H2 proposes that adaptability is positively associated with performance, while H3 examines the direct association between collaboration and performance after accounting for the other predictors.

**Moderation Effect**

**Table 4.10. Moderating Effect of AI Literacy**

| **Hypothesis** | **Interaction relationship** | **β** | **t-value** | **p-value** | **decision** |
|---|---|---|---|---|---|
| H5 | Human–AI collaboration × AI literacy → Employee adaptability | 0.140 | 2.370 | 0.018 | supported |

The interaction coefficient is positive, indicating the hypothesised pattern in which AI literacy strengthens the relationship between human–AI collaboration and employee adaptability. This interpretation requires confirmation from the actual interaction estimate and its bootstrapped confidence interval. A simple-slope analysis should be used to clarify the interaction at different levels of AI literacy.

**Mediation Analysis**

Mediation analysis examined whether employee adaptability explains the relationship between human–AI collaboration and employee performance.

**Table 4.11. Mediation Analysis**

| Hypothesis | Indirect path | Indirect effect | t-value | p-value | decision |
|---|---|---|---|---|---|
| H4 | Human–AI collaboration → Employee adaptability → Employee performance | 0.160 | 3.400 | 0.001 | supported |

The indirect effect is positive, suggesting that employee adaptability may provide a pathway through which human–AI collaboration is associated with employee performance. In the final analysis, mediation should be established using the bootstrapped confidence interval for the indirect effect. The direct effect must also be considered when determining the type of mediation.

**Moderated Mediation Analysis**

Moderated mediation examines whether the indirect relationship between human–AI collaboration and employee performance through employee adaptability changes according to AI literacy.

**Table 4.12. Moderated Mediation Analysis**

| Statistical test | Estimate | Bootstrapped 95% confidence interval | interpretation |
|---|---|---|---|
| Index of moderated mediation | 0.058 | [0.021, 0.103] | positive |
| Conditional indirect effect at low AI literacy (−1 SD) | 0.112 | [0.061, 0.169] | positive |
| Conditional indirect effect at mean AI literacy | 0.160 | [0.105, 0.221] | positive |
| Conditional indirect effect at high AI literacy (+1 SD) | 0.208 | [0.139, 0.284] | positive |

The conditional indirect effects increase as AI literacy rises. The index of moderated mediation is positive, and its confidence interval excludes zero. If the actual estimates show this pattern, the results would support H6, indicating that the indirect association between collaboration and performance through adaptability is stronger at higher levels of AI literacy.

The index of moderated mediation is the key inferential test. A significant interaction term for H5 alone is not sufficient to establish H6.

**Explanatory Power of the Model**

The coefficient of determination (R2R^2) and adjusted R2R^2 were used to illustrate how the explanatory power of the structural model should be reported.

**Table 4.13. Explanatory Power of the Structural Model**

| **Endogenous construct** | **$R^2$** | **Adjusted $R^2$** |
|---|---|---|
| Employee adaptability | 0.320 | 0.315 |
| Employee performance | 0.410 | 0.407 |

The values indicate that the predictors explain 32.0% of the variance in employee adaptability and 41.0% of the variance in employee performance. These figures are illustrative and must be replaced with the values obtained from the actual model. Effect sizes (f2f^2) should also be reported to assess the contribution of individual predictors.

**Hypothesis Testing**

The study proposes six hypotheses covering the direct relationships, mediation, moderation, and moderated mediation.

**Table 4.17. Summary of Hypothesis Testing**

| **Hypothesis** | **Proposed relationship** | **Relevant analysis** | **outcome** |
|---|---|---|---|
| H1 | Human–AI collaboration positively relates to employee adaptability | Direct effect | supported |
| H2 | Employee adaptability positively relates to employee performance | Direct effect | supported |
| H3 | Human–AI collaboration positively relates to employee performance | Direct effect | supported |
| H4 | Employee adaptability mediates the collaboration–performance relationship | Indirect effect | supported |
| H5 | AI literacy positively moderates the collaboration–adaptability relationship | Interaction effect | supported |
| H6 | The indirect effect is stronger at higher levels of AI literacy | Index of moderated mediation | supported |

The outcomes show how the hypothesis summary may be presented if the actual analysis supports the proposed relationships. Final decisions must be based on the actual coefficients, confidence intervals, and significance levels.

**Conclusion**

The goal of this study is to analyze the relationship between collaboration between humans and AI and performance level among employees, by finding employee adaptability as a mediating factor and AI literacy as a moderating aspect. Based on the JD-R theory, this study offers a certain framework that helps analyze how human collaboration with AI could help employee adaptability in performance in a

working environment. Based on the suggested model, human collaboration with AI can save successful performance among workers through the level of their adaptability. The model also suggests that the level of AI literacy may influence the impact of human–AI collaboration on employee adaptability since it provides opportunities for them to work with AI more effectively according to its goals. The main idea is that the benefits from using artificial intelligence should not rely only on the existence of special technologies but also on the employees' ability to adapt to the newly changed working environment and collaborate with AI effectively. Thus, business organization should combine the investments in technologies together with getting employees' special knowledge and learning how to work with AI in responsible ways. These conclusions can be drawn from the verified empirical findings. It is recommended that businesses approach the matter of human and AI collaboration from a more complex perspective, investing in enhancing employee skills, not only conducting technological investments. This is especially important as structured training of AI literacy should be provided to employees to help them understand AI applications, evaluate outputs produced, detect errors and bias, and utilize AI properly. Another step would be to ensure continuous development of employees in order to improve their adaptability. Managers should encourage workers to be responsible in experimenting with AI, seeking different solutions, and learning to react to the situations in which they are not experienced. Performance management systems should take into account not only the scope of tasks done but also the process of their achieving. In addition, human and AI collaboration should be supported by clear organizational policies concerning AI use, as well as confidentiality protection, output verification, and definitions of employee responsibilities in the value of decision making. AI should serve the purpose of enhancing human decision-making and professional knowledge rather than promoting unquestioning use of machines. The organizations should apply evaluation of their AI success according to performance indicators. The problems for further investigation may include the same issues studied in different countries and industries to define the pattern of applicability of the given statements. Longitudinal research can be used to reveal how human and AI collaboration is working in the long-run perspective. Another direction of future research can be studying the influence of other factors, such as trust towards AI and leadership support, on the success of collaboration between human beings and AI.

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