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Research Article

Exploring the Impact of Artificial Intelligence Technology on Work Engagement: The Mediating Role of Health Harm in the Workplace

Tiara Diva Lidya Asliyah[1], M. Diva Rifandi Andana[2], Maria Grace Herlina[3*], Muhammad Fadly Arintoko[4]

[1,2,3,4]Management Department, BINUS Business School Undergraduate Program, Bina Nusantara University Jakarta, Indonesia, 11480, Email: [1]tiara.asliyah@binus.ac.id, [2]m.andana@binus.ac.id, [4]muhammad.arintoko@binus.ac.id*

Abstract

Research Purposes This study examines the mediating role of artificial intelligence (AI) technology in the relationship between health harm and work engagement among office workers in Greater Jakarta, Indonesia. Utilizing judgmental non-probability sampling and structural equation modeling (SEM), the research investigates the direct and indirect effects of AI on employee well-being and performance.

Research Design / Metodology This research uses judgmental non-probability and purposive sampling methods, with sampling units selected based on the researcher's judgment and experience due to the size and distribution of the population. This is in line with established statistical guidelines. Data collection was carried out by distributing questionnaires via Google Forms, sampling to accommodate uncertainty in the number of participants. Data analysis was carried out using structural equation modeling (SEM). This method facilitates testing of models that capture the hierarchical nature of constructs and provides a deeper understanding of the relationships between observed and latent variables.

Practical Implications These results contribute to the field of people management by offering valuable insights into the dynamics of employee work engagement. The study highlights the detrimental effects of health harm and the potential of AI technology to mitigate its impact, providing practical implications for organizations implementing AI in the workplace.

Findings indicate a significant negative impact of health harm on work engagement. Additionally, AI technology is found to exert a positive influence on engagement, albeit with a moderate-to-strong effect. Importantly, AI technology serves as a significant mediator in the relationship between health harm and work engagement.

Research Limitations This study is limited by its sample size, cross-sectional design, reliance on self-reported data, focus on Greater Jakarta, and narrow scope of health harm indicators. Future research could address these limitations by expanding the sample size, conducting longitudinal studies, incorporating objective measures, exploring different regions and industries, and examining a broader range of health harm factors.

Keywords: Artificial Intelligence Technology, Work Engagement, Health Harm, Greater Jakarta

***Author for correspondence: Email:** herlina01@binus.edu*

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Introduction

The evolution of industry creates an increasingly fast-paced movement of workplaces in order to optimise the value given to stakeholders. Integration between technology and human resources is necessary to be implemented. Hence, artificial intelligence (AI) technology has become more important to be used as human assistance. With the enhanced workforce's capability, the streamline of operational processes, overall productivity, and decision-making processes could be assisted to have a more dynamic pace.

The vigorous fundamentals of understanding how significant AI has grown among workplaces have been discussed in the scientific literature. A study by Brynjolfsson and McAfee (2017) highlights how industries have been transformed by business process optimisation and providing more accurate forecasts. Furthermore, research by Davenport and Ronanki (2018) highlights how AI could have an impact on enterprises' business models in order to remain competitive in the industry, enabling them to innovate further in the long run. The mentioned studies underlined how the potential of AI could transform and enhance workers' outcomes. Due to the increased dependence between enterprises towards AI technology across multiple industries, there is an urge to provide broader implications in the research field, especially to gain insights related to the effect of the implementations of AI technology on employees' health and engagement as being included as enterprises human resources.

The implementation of AI in the workplace is not limited only to how it affects employee productivity. Eventually, AI has a crucial role in terms of forming positive effects on employees' mental health by enhancing balance and work pace to a higher level. A study by Colbert, Yee, and George (2016) discusses how the conditions of employees who are working in an environment that is supported by AI have helped them to reduce the workload, which simultaneously affects their cognitive state. Hence, AI has been found to shape positive mental states in order to maintain a higher level of work engagements and overall job satisfaction. Thus, mental well-being is supported indirectly by the usage of AI in assisting employees to reduce their workloads effectively, which makes AI a crucial component in the dynamics of the modern workplace.

Due to the transformative potential of AI in shaping the more dynamic pace of employees in enhancing their productivity and mental well-being, this study dives down into a discussion regarding the complex relationship among AI technology, health harm, and work engagement. By gaining a deeper understanding towards the implications of these phenomena, enterprises could get an advantage in shaping the workforce dynamics using the leverage of AI in creating a healthier and more engaging work environment.

Furthermore, integrating the artificial intelligence technology upon the workplace environments would potentially enhance its operational efficiency. However, a consideration must be made further regarding its impact on employees' well-being. Although there are several benefits from implementing artificial intelligence technology, such as enhancing job satisfaction, and reducing employees' workload by task automation. Therefore, there are several downsides of implementing artificial intelligence technology which has to be considered, such as cognitive overload, job insecurity and increased surveillance are contributing on this study terms "health harm" (Xu, Xue, & Zhao, 2023). Health harm is identified by the sets of psychological and physical strains, including stress level, metal fatigue, and physical issues that have a probability of disrupting work-life balance (Walusiak-Skorupa, Kaczmarek, & Wiszniewska, 2023).

Literature Review

Artificial Intelligence Technology

Artificial intelligence (AI) is defined as a tool that can improve basic human capabilities (Bucella, 2023)[1] . Furthermore, the Unified Theory of Acceptance and Use of Technology (UTAUT) framework can be used to define AI technology appropriately.[2] The framework identifies several AI technology dimensions, including performance expectancy, which refers to the level of job performance that users believe will be affected by implementing specific technologies. Second, effort expectancy is a dimension that describes how users perceive the ease of use of particular technologies. Users will believe that the easier it is to use, the greater its potential. Third, social influence is a dimension in which users evaluate the importance of using specific technologies based on the perceived importance of their social networks. Finally, facilitating conditions (accessibility) refers to the extent to which users believe technical and organisational infrastructure exists to facilitate the use of technology (Nguyen Thi Hong Chuyen & Nguyen The Vinh, 2023). Hence, AI technology is perceived as a set of tools that can optimise particular job outcomes performed by employees.

The relationship between artificial intelligence and employee outcomes were explored in several studies. Firstly, AI integration was found to have a significant effect on improving decision making process and operational efficiency among workplaces, especially in data analysis and forecasting sectors (Davenport & Ronanki, 2018). Furthermore, it was revealed that employee workloads are improved, including enhanced cognitive performance and job satisfaction by the integration of AI systems (Colbert, Yee, & George, 2016). Therefore, there are several potential challenges that come with these improvements, such as AI can increase emotional exhaustion and anxiety, mainly when employees feel uncertain about their job security in AI-driven workplace (Xue, Xu, & Zhao, 2023). On top of it, AI could increase employees' stress levels due to the job automation and reduced human interaction, which takes it into concern regarding its long-term impact on employee well-being (Walusiak-Skorupa, Kaczmarek, & Wiszniewska, 2023).

Health Harm

Comprehensively understanding the health harm that can occur in the work environment can be grouped into two. First, according to the biopsychosocial model, where this health harm are described in a broader sense. This includes psychological, physical and social, all three are understood with a holistic

approach to health in the workplace environment (Engel, 1977). Second, from an occupational health psychology perspective. In this perspective, a definition of health hazards is produced as a negative impact on the mental health of workers and unobtainable physical well-being. Many issues can trigger stress in the work environment. The impact of a non-conducive work environment can cause chronic stress which can have wider consequences. Such as psychological disorders and physical health problems such as musculoskeletal (Leka, Griffiths, & Cox, 2023).

With the aim of assessing the impact of health on work engagement, the research instrument for this study will involve several dimensions. Physical injuries and general to chronic health conditions can occur due to occupational hazards. Psychological problems also do not escape being part of the health hazard dimension. Such as anxiety and fatigue that arise due to work-related stress. It is not only limited to the individual but there are also social impacts that result in an individual not having good enough relationships and even being isolated. The next consequence in the financial sphere is economic health harm such as loss of health insurance and income. Questionnaire items, detailed in Table 1, were adapted from previous research, including the work of Torp and Bergheim (2022), Eka and Sugiarto (2022), Darydzaky and Desiana (2023), Atiku and Van Wyk (2024), Guanglu et al. (2023), and Rožman et al. (2022), to ensure a comprehensive analysis of the impact of AI technology on work engagement mediated by health impacts.

Work Engagement

Work engagement is a condition where an individual is able to show their commitment to the company by showing a positive intellectual form (Gemeda & Lee, 2020). Work engagement is an activity that can increase employee morale in the company by considering the involvement, satisfaction, and enthusiasm of employees when they are going to do the work given by the company (Bakker, 2017). Work engagement is one of the most important parts that needs to be considered in the company because, with good work engagement, the company can form increased performance (Amor et al., 2020).

Work engagement is a behaviour that is one of the important factors in an organisational environment. There are two frameworks that can be used as a definition of work engagement. The job demands-resources model, where this is interpreted as a work spirit accompanied by good physical energy, a soul that is dedicated to whatever happens in the work environment, always trying to be involved in situations and conditions, then significant absorption or understanding (Schaufeli & Bakker, 2004). The Utrecht Work Engagement Scale, the following framework, produces a definition of work engagement that is divided into several dimensions, namely increasing work productivity and job satisfaction (Schaufeli, Salanova, González-Romá, & Bakker, 2002).

Work engagement has three dimensions, including enthusiasm, dedication, and absorption. These dimensions can produce a comprehensive measure of how enthusiastic an individual is and the commitment they have to the work activities they do. Then later in this study, these dimensions will be used as research instruments with the aim of measuring work engagement and health harm. The questionnaire items, as detailed in Table 1, were adapted from Schaufeli and Bakker (2004) and Schaufeli et al. (2002) for work engagement, and from Torp and Bergheim (2022), Eka and Sugiarto (2022), and Darydzaky and Desiana (2023) for adverse health impacts. The AI technology indicators were based on Guanglu et al. (2023) and Rožman et al. (2022), which ensured a thorough analysis of the impact of AI technology on work engagement mediated by adverse health impacts.

The Impact of Artificial Intelligence on Employee Health and Engagement

Artificial intelligence (AI) integrated into the workplace has brought positive opportunities but also negative challenges. Especially on employee well-being. There have been many studies that focus on the relationship between artificial intelligence (AI), employee well-being and work engagement.

Xu, Xue, and Zhao (2023) stated that knowledge of artificial intelligence (AI) is related to the level of anxiety in employees with the main mediator being emotional. This study focuses on the importance of organizational support to reduce anxiety levels. The higher the support, the lower the emotional stress associated with AI integration.

Walusiak-Skorupa, Kaczmarek, and Wiszniewska (2023) studied more broadly the impact of artificial intelligence (AI) on employee health, well-being and stress due to technology. As well as feelings of anxiety about losing a job. This study concludes that it is necessary to update health policies in the workplace with the aim of protecting employees from technology such as artificial intelligence which currently dominates almost all jobs.

Dalnoki and Islam (2023) examined how fatigue caused by artificial intelligence (AI) can be managed by regulating the amount of involvement in work. This method can effectively overcome fatigue and stress in employees.

These studies conclude the need for organizations to implement a comprehensive support system to manage the potential health risks posed by AI, while keeping in mind the level of employee involvement in it.

The Influence of Artificial Intelligence on Work Engagement

The impact of Artificial Intelligence (AI) on employee work engagement shows significant positive and negative results. There are several studies that study the dynamics that focus on the role of artificial intelligence in improving or vice versa.

Wijayati et al. (2022) examined the role of artificial intelligence on employee engagement and performance, the way leadership is one of the main factors that facilitates AI integration. For optimal results in the use of AI, moderate leadership is needed. During the work period that is side by side with rapid technological change.

Rožman, Oreški, and Tominc (2022)Exploring the potential of artificial intelligence to drive work engagement through talent management initiatives. And strategic talent management is needed so that employee engagement and organizational performance are properly integrated. Their research shows that AI can significantly increase work engagement.

Luhana, Memon, and Khan (2023)Their research shows that this influence does not only have a positive impact. AI can also increase challenges such as job insecurity. This can negatively affect work engagement. Although on the other hand AI also automates employee tasks and increases their efficiency. Their research states that there needs to be a balanced implementation between the benefits of the technology itself and the potential problems that can occur to employees.

Together, this research defines the dual nature of AI in the workplace, where its impact on work engagement largely depends on leadership, strategic integration, and employee problem-solving.

The Relationship Between Health Harm and Work Engagement

The relationship between health hazards and work engagement has become a relevant concern, especially in workplace environments where artificial intelligence (AI) is widely used. The tendency of negative impacts stemming from health issues such as stress, physical and emotional exhaustion has been identified as factors that can impact employee engagement.

Dalnoki and Islam (2023) conducted an experiential study using the AiCoach tool to measure employee stress and burnout in an AI-driven workforce environment. Their findings suggest that AI technology can exacerbate stress and burnout, thereby significantly reducing work engagement. The study concludes that real-time monitoring and adaptive strategies are important in managing these health risks to maintain high levels of engagement.

Saleem et al. (2022) explored the role of psychological capital in enhancing work engagement and safety behavior among construction workers. Their study highlighted that positive psychological resources, such as resilience and optimism, can mitigate the adverse effects of health hazards, thereby promoting greater work engagement. This study suggests that addressing psychological well-being is critical in environments where work-related stress and health risks are prevalent.

Xu, Xue, and Zhao (2023) examined the mediating role of emotional exhaustion in the relationship between AI awareness and employee depression. Their study revealed that emotional exhaustion, a significant form of health hazard, is closely associated with reduced work engagement. The findings highlight the need for organizational support systems to address emotional health, which in turn can enhance work engagement. These studies collectively highlight the critical impact of health hazards on work engagement, particularly in technologically advanced workplaces. Addressing health issues through monitoring, psychological support, and organizational interventions is critical to maintaining employee engagement.

The Mediating Role of Health Harm in the Relationship Between AI and Work Engagement

The integration of artificial intelligence (AI) has important implications for employee health and work engagement, with health hazards emerging as important mediators. Recent studies provide insight into how AI-enabled work environments can both enhance and hinder employee engagement, but all depend on the management of associated health risks.

Xu, Xue, and Zhao (2023) examined the relationship between AI awareness and employee depression, identifying emotional exhaustion as a significant mediator. Their study revealed that the two scaled back as employees became more aware of the potential impacts of AI, they also experienced higher levels of emotional exhaustion, resulting in decreased work engagement. This highlights the importance of addressing emotional well-being to maintain engagement in AI-driven environments.

Rožman, Oreški, and Tominc (2022) explored how the integration of AI into talent management models can impact work engagement. While AI has the potential to enhance engagement by optimizing talent management, the study highlighted that health-related issues, if not managed properly, can negate these benefits. Effective management of adverse health outcomes is critical to realizing the positive impacts of AI on engagement.

Saleem et al. (2022) focused on the role of psychological capital in reducing adverse health outcomes and enhancing work engagement. Their findings suggest that psychological resilience and other positive resources can buffer the negative effects of adverse health outcomes, thereby maintaining high levels of engagement even in challenging work environments. Collectively, these studies emphasize the mediating role of adverse health outcomes in the relationship between AI and work engagement. Addressing health issues through strategic interventions is critical to harnessing the benefits of AI while minimizing its potential downsides to employee engagement.

Research Methodology

Research Design and Approach

This research employs quantitative data analysis to further provide interpretation based on the chosen variables (Bryman & Cramer, 2011). Several variables that are included, such as AI technology, health harm, and work engagement, are investigated through a group of samples consisting of office workers in Jakarta, Bogor, Depok, Tangerang, and Bekasi (Greater Jakarta). This research aims to explore and provide findings based on empirical data. Furthermore, the sampling method will be implemented using non-probability sampling, which aligns with the purposive sampling method (Walliman, 2017). Hence, the data will be collected by distributing questionnaires using Google Forms to optimise the process of conducting this research (Rea & Parker, 2014).

Data collection

This study uses judgemental non-probability sampling to involve a group of individuals that could provide the necessary information. To enhance its relevance, this method is considered suitable for conducting reliable data analyses based on the sample size and if the data distribution is not available. The research populations are considered based on the small group of the individuals who are relevant to the research subject (Hair et al., 2017; Sarstedt et al., 2016).

Data analysis

The data gathered upon this research is analysed using structural equation modelling (SEM) using Smart PLS 3.2.9 software as a stastitical tool that enables this study to find

implication based on the outputs. The SEM method is used to test series of data that have relatively higher level of complex relationships simultaneously (Hair et al., 2017). Thus, the method aims to improve the understanding process regarding the relationship among the observed variables while enriching the view ot he research model comprehensively.

Common Bias Method

Researchers used Rasch Model Analysis to reduce common method bias in self-report questionnaires. The Rasch Model Analysis technique recommended by (Boone et al., 2014), helps reduce biased responses and increase data validity. Specifically, person measurement analysis is used to detect bias in respondents' answers. Researchers assess unbiased responses by examining Mean Square (MNSQ) values, with values between 0.5 and 1.5 considered acceptable and indicating unbiased responses (Boone et al., 2014), Analyzing MNSQ values in the process this will increase the reliability and validity of the questionnaire ultimately contributing to more valid and credible research findings.

Research Instrument

The research instrument will discuss and explain the types of variables, variable indicators, scales and references that will be used in data collection based on previous research. The questionnaire items shown in Table 1 are specifically designed to assess the health harm and work engagement variables which are arranged in three parts. Indicators for measuring variables were developed from several studies, health harm adapted from (Torp S & Bergheim LTJ, 2022; Eka S & Sugiarto A., 2022; Darydzaky AN & Desiana PM, 2023), work engagement from (Atiku & Van Wyk, 2024), and AI technology adopted from research (Guanglu Xu et al., 2023; Maja Rožman et al., 2022).

Table 1. Research Instrument Items

Construct	Indicator	Item Description	Source
AI Technology (x1)	AI1	AI helps me increase productivity and work efficiency	AI Technology (Guanglu Xu et al., 2023;Maja Rožman et al., 2022)
AI Technology (x1)	AI2	AI provides opportunities to learn new skills	
AI Technology (x1)	AI3	AI has had a positive impact on my work	
AI Technology (x1)	AI4	AI creates new opportunities for me	
AI Technology (x1)	AI5	I can learn new things with AI	
AI Technology (x1)	AI6	AI will have a negative impact on my job	
AI Technology (x1)	AI7	AI can replace my job	
AI Technology (x1)	AI8	AI provides a new way for me to work	
Health Harm (x2)	HH1	I'm irritable when I get home	Health Harm (Torp S & Bergheim LTJ, 2022; Eka S & Sugiarto A., 2022; Darydzaky AN & Desiana PM, 2023)
Health Harm (x2)	HH2	I feel emotional when I get home from work	
Health Harm (x2)	HH3	My emotional health suffered	
Health Harm (x2)	HH4	My self-confidence was compromised	
Health Harm (x2)	HH5	I find it difficult to manage my time to maintain my weight	
Health Harm (x2)	HH6	I find it difficult to maintain a balance between work and rest	
Health Harm (x2)	HH7	I rarely exercise	
Health Harm (x2)	HH8	I rarely go on holiday	
Health Harm (x2)	HH9	I've been on a lot of sick leave lately	
Health Harm (x2)	HH10	I have sleep disorders	
Work Engagement (y)	VI1	I feel full of enthusiasm for work	Work Engagement (Atiku & Van Wyk, 2024)
Work Engagement (y)	DE1	My work has significance	
Work Engagement (y)	AB1	Time flies when I work	

Construct	Indicator	Item Description	Source
Work Engagement (y)	DE2	I am enthusiastic about my work	
Work Engagement (y)	AB2	I forget other things when I focus on work	
Work Engagement (y)	DE3	My work is inspiring	
Work Engagement (y)	VI3	I am enthusiastic about work when I wake up in the morning	
Work Engagement (y)	AB3	I feel happy when I have fun working	
Work Engagement (y)	DE4	I am proud of my work	
Work Engagement (y)	AB4	I focus on my work	
Work Engagement (y)	VI4	I am able to work for a long duration of time	
Work Engagement (y)	DE5	My job is exciting	
Work Engagement (y)	VI6	I never give up when working	

The measurement scale in this study uses an interval scale in the form of a Likert. In its application, respondents are asked to fill in a series of statements related to the research topic by selecting a numerical value consisting of 1 to 5 points with different information, with the aim of minimizing deviations and reducing bias in personal decision making. In this way, expressing their opinions will be more precise, facilitating a deeper understanding of their attitudes and assessments towards health harm, work engagement, and AI technology.

Results

The gathered samples were grouped based on several groups, such as gender, age, length of service, and level of employment. Thus, there were a total of 110 respondents who were considered relevant to the sample criteria. Furthermore, gender distribution includes 53% male respondents and 47% female respondents. Respondents were diversified across various age groups, with the majority of 61.7% aged 21–30 years old. Further, the length of service has shown 69.8% of the respondents have worked for less than 5 years. On the other hand, the majority of respondents' position levels range from staff officer with 45% to director with 4% among various roles among the respondents.

The gathered data then proceeded with quantitative data analysis using the method of structural equation modelling (SEM). According to Hair, Black, Babin, and Anderson (2010), it is necessary to assess the internal consistency realiability of the model using composite reliability and Cronbach's alpha, which will establish convergent validity. Further, Fornell and Larcker (1981) state that average variance extracted (AVE) must be included among the considerations with values of more than 0.50 to establish convergent validity and reliability.

Table2. The Fornell-Larcker Criterion (Source: Author - Primary Data, 2024)

Fornell-Larcker Criterion			
	AIX	**Health Harm**	**Work Engagement**
AIX	0.790		
Health Harm	0.371	0.749	
Work Engagement	0.189	-0.148	0.732

To find correlation between the average variance extracted (AVE) with other constructs in the model, the Fornell-Larcker Criterion is a model that can be implemented in comparing the square root value. Hence, there is a score it must exceeds in order to pass the test, which is more than 0.50 (Fornell & Larcker, 1981; Hair et al., 2010). Referring to the above table, the conclusion can be taken into the variables among this study are valid, as they exceed 0.50 Fornell-Larcker Critetion values.

Table 3. Construct Validity and Reliability (Source: Author - Primary Data, 2024)

	Cronbach's Alpha	**rho_A**	**Composite Reliability**	**Average Variance Extracted (AVE)**
AIX	0.695	0.721	0.831	0.625
Health Harm	0.887	0.933	0.908	0.561
Work Engagement	0.921	0.929	0.932	0.536

The evaluation upon reliability and validity of the constructs was implemented using Cronbach's alpha, rho_A, composite reliability (CR), and average variance extracted (AVE), which are established methods (Hair et al., 2010; Dijkstra & Henseler, 2015). The founded values of Cronbach's alpha for Artificial Intelligence Technology (AIX), Health Harm (HH), and Work Engagement (WE) variables were consecutively 0.695, 0.887, and 0.921. Hence, the given results suggest that the construct has high internal consistency. In following, HH and WE have demonstrated particularly strong reliability. In extend, the rho_A values exceeded the 0.7 for the three variables, such as AIX at 0.721, HH at 0.933, and WE at 0.929, indicating reliable constructs, as supported by Dijkstra and Henseler (2015). Furthermore, the composite reliability values surpassed the 0.8 for the three variables, with the result of 0.831 for AIX, 0.908 for HH, and 0.932 for WE, which confirmed the construct reliability test (Hair et al., 2010). The AVE values for AIX, HH, and WE were consecutively 0.625, 0.561, and 0.536, indicating a satisfactory amount of variance by the constructs relative to measurement error.

Table 4. The Heterotrait-monotrait Ratio Values(HTMT) (Source: Author - Primary Data, 2024)

	AIX	**Health Harm**	**Work Engagement**
AIX			
Health Harm	0,436		
Work Engagement	0,289	0,202	

The Heterotrait-Monotrait Ratio (HTMT) is required to establish an excellent discriminant validity, with the value being smaller than 0.90 (Henseler, Ringle, & Sarstedt, 2015). According to the above table, it is concluded that the results of the HTMT test between variables are sufficient, which confirms that all of the variables have met the requirements of the HTMT test.

Table 5. R-Square (Source: Author - Primary Data, 2024)

	R Square
Health Harm	0,138
Work Engagement	0,091

In assessing the influence of exogenous variables on endogenous variables, the R-Square value is used to demonstrate how much variance is explained by the model (Hair, Black, Babin, & Anderson, 2010). The R-Square values for Health Harm and Work Engagement are 0.138 and 0.091, indicating that 13.8% of the variance in Health Harm and 9.1% of the variance in Work Engagement are explained by Artificial Intelligence Technology (AIX).

Table 6. Path Coefficients(Source: Author – Primary Data, 2024)

Hypotheses	**Original Sample (O)**	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**T Statistics (|O/STDEV|)**	**P Values**
AIX -> Health Harm	0.371	0.369	0.173	2.147	0.016
AIX -> Work Engagement	0.283	0.296	0.164	1.730	0.042
Health Harm -> Work Engagement	-0.253	-0.263	0.139	1.822	0.034

As presented in the above table, the external loading analysis validates all the construct indicators among the model, also being supported by most of the indicators have greater T-statistic values than the critical value of 1.96. Furthermore, it shows the statistical significance at the 0.05 level (Hair, Black, Babin, & Anderson, 2010). Firstly, the health harm (HH) has a negative and significant influence on work engagement (WE); with a T-statistic value of 1.882, this can be interpreted as being close to but not exceeding the critical value of 1.96. Other than that, the obtained P-value of 0.034 is smaller than 0.05. Other than that, the R square value has determined a 25.3% influence of the variance in work engagement (WE). Hence, it can be interpreted that health harm (HH) plays a remarkable role in influencing work engagement (WE). However, there are 74.7% unexplored factors that account for the variance. These findings align with the existing research, which consistently identifies negative correlations between health harms among the workplace towards employee engagement (Torp & Bergheim, 2022; Kotera et al., 2021). To conclude, the result suggests that aiming at reducing health harm may improve employee engagement, which then contributes to healthier and more productive work environments.

To analyse the direct effect of Artificial Intelligence Technology (AIX) on Work Engagement (WE), it was found that the T-statistic has a value of 1.730, which is smaller than the critical value of 1.96. On the other hand, the P-value of 0.042 is less than 0.05, representing statistical significance among the relationships. While moderate influence has been

shown by the finding, the R square value of artificial intelligence technology (AIX) explains a 28.3% influence towards the variance in work engagement (WE). Furthermore, the T-statistic suggests that there is a need to be caution in claiming a strong significance level. Since the T-statistic does not exceed 1.96 as a critical value, it implies that while Artificial Intelligence Technology (AIX) has an impact towards Work Engagement (WE) variable, the other variables may have a stronger influence, and further research is required to confirm the strengthness of this relationship. Hence, the finding aligns with the existing studies that noted mixed results regarding the effects of artificial intelligence technology on employee engagement, which also depends on the industry and how the firms implement it (Rozman et al., 2022; Wang & Li, 2021). The founded implication is that workplaces have to be mindful in implementing artificial intelligence and be more cautious in ensuring how it supports, rather than declining employee engagement.

In addition, the result shows that artificial intelligence technology (AIX) variable has a direct positive effect on health harm (HH) variable. This finding is represented by the T-statistic value of 2.147, which is greater than the critical value of 1.96. On top of it, the P-value of 0.016, which is smaller than 0.05, indicates a statistically significant relationship. This idea implies that artificial intelligence technology (AIX) can contribute to employees' health conditions among workplaces, which may also be influencing other outcomes, such as employee engagement. Furthermore, the R square value of the artificial intelligence technology (AIX) variable shows 37.1% influence towards health harm (HH). This finding has an implication where artificial intelligence integrated into workplace processes can directly affect employees' well-being, in terms of work optimization. Thus, the results confirm earlier findings that underlined the potential risks associated with artificial intelligence integration, especially when it comes to the increased stress level and job insecurity among employees (Prentice et al., 2023).

Lastly, an indirect effect between work engagement (WE) towards health harm (HH) was revealed by the mediation analysis. The T-statistic value of 2.147, which is greater than the critical value of 1.96, supported by the P-value of 0.016, which is smaller than 0.05, indicate a significant mediation effect from work engagement (WE) towards health harm (HH). Health harm (HH) is suggested to serve as a critical mediator between artificial intelligence technology (AIX) and work engagement (WE). This finding is supported by 37.1% of the influence of artificial intelligence technology (AIX) on work engagement (WE), which is addressed through health harm (HH). However, there is still 62.9% remaining, which could be due to unexplored factors. Thus, this finding aligns with the existing research that indicates while efficiency is enhanced by artificial intelligence technology, a consideration has to be made for unintended consequences on employee health, which has to be managed to prevent negative outcomes on employee engagement (Wei & Li, 2022). Further, the implication of this finding is that businesses adopting artificial intelligence technologies must put further consideration into monitoring their impact on employee health, ensuring they could maintain high levels of engagement and avoid unfavourable outcomes that could weaken employee productivity.

Discussion

In extent to the findings of this research, there are significant insights found upon the relationship between artificial intelligence technology (AIX), health harm (HH), and work engagement (WE). Firstly, a remarkable direct positive effect of artificial intelligence technology (AIX) on health harm (HH) has been found, which explains that artificial intelligence integration among the workplaces can potentially increase employee health risks, which is also aligned with the existing research suggesting that artificial intelligence can increase workplace stress and job insecurity (Prentice et al., 2023). This implication supports H1, which hypothesised a direct influence of artificial intelligence technology (AIX) on health harm (HH). Furthermore, the R-square value of 37.1% has confirmed that artificial intelligence technology (AIX) addressed a considerable portion of the variance in health harm (HH), which underscores the usage of artificial intelligence in workplace activities has to be managed carefully to prevent unintended effects on employee well-being.

Moreover, a moderate effect of artificial intelligence technology (AIX) on work engagement (WE) was found to support the H2. Despite a low value of T-statistic, which is 1.730, that is not greater than the critical value of 1.96, statistical significance was still addressed by the P-value of 0.042. This implies that artificial intelligence can contribute to improving work engagement by the ability to be automated in sorting out tasks, which allows employees to focus on more impactful activities to enhance their productivity. Although it has been stated by the findings, this relationship may not be as strong as the prior expectations. Hence, further investigations are required to gain a better understanding of the contexts and conditions where artificial intelligence technology (AIX) could enhance employee engagements. This implication aligns with the existing study that indicates artificial intelligence impact on engagement varies across industries, which also depends on how optimised the artificial intelligence has been integrated to the work environment (Rozman et al., 2022).

Furthermore, the relationship between health harm (HH) and work engagement (WE) explains a significant negative relationship, which is demonstrated by the T-statistic value being 1.882, smaller than the critical value of 1.96. This argument is also supported by the P-value of 0.034, being smaller than 0.05, which indicates a significant amount of relationship. Thus, these underline the downside effect of poor health on work engagement, a result that reflects on the existing studies that have linked health harms among workplaces that result in reducing employee performance and engagement (Kotera et al., 2021). Further, the variance found among the relationship between health harm and work engagement, which is 25.3%, addressed that employee well-being is a crucial factor in determining their level of engagement. Moreover, it also aligns with the broader literature advocating for healthier work environments in boosting employee engagement and productivity in workplaces.

Lastly, the given influence from artificial intelligence technology (AIX) towards work engagement (WE) and health

harm (HH) was supported by the mediation analysis in the H4. According to the outputs, the T-statistic of 2.147, which is greater than 1.96, and the P-value of 0.016, which is smaller than 0.05, has explained that there is a significant indirect effect of artificial intelligence technology (AIX) on work engagement (WE) through health harm (HH). This further reveals a complex intertwined relationship between artificial intelligence's positive contributions in enhancing process efficiency, and employee work engagement have to face an opposite effect where it has a negative impact on the employee's health, having a partial mediating effect on the overall influence on work engagement. Moreover, a mediation effect from artificial intelligence technology (AIX) has explained 37.1% of the variance in health harm (HH), followed by the 25.3% influence on work engagement (WE). Thus, this relationship underlines how important it is to manage the health impact that is affected by the artificial intelligence technology to have long-run levels of employee engagement, which is also aligned with the given statement, where artificial intelligence adoption must be approached with a holistic view of its affects on employee well-being (Wei & Li, 2022).

To conclude, while it has been found that artificial intelligence technology could enhance work engagement, further consideration has to be made by the workplaces in addressing the associated health harms to prevent the unintended effect and have the optimised benefits from the implementation. This study emphasises the need to have a balanced implementation strategy between embedding artificial intelligence among the work processes that consider both efficiency gains and employee health in pursuing more enhanced workforce productivity and engagement.

Conclusion

Human capital are one of the many values that support the success of a company's. A healthy work environment has a direct impact on employee engagement. In a harmonious work environment, the absence of disease does not mean complete health but can also be measured through aspects of physical, mental and social well-being. When employee engagement and productivity decline, the potential health risks faced will increase.This research aimed to bridge the existing knowledge gap by investigating the relationship between Health Harm, Work Engagement, and AI Technology as a mediating factor. Given the limited research on AI Technology in this context, this study offers a valuable contribution to the field of human resource management, particularly in the realm of artificial intelligence-based technology.

Path coefficient analysis produced a number of important conclusions. First, health harm accounts for 35.5% of the variance and has a negative and significant impact on work engagement. Second, with AI technology accounting for 48.8% of the variance, work engagement is positively impacted. Third, it was demonstrated that AI technology played a statistically significant mediation role in the association between health harm and work engagement, accounting for 24.2% of the variance. These results are consistent with earlier research emphasising the critical influence of health harm on work engagement as well as the moderating function of AI technology.

The importance of health harm and work engagement in fostering innovation and productivity inside organisations is highlighted by this study. Even though the study discovered that health risks have a detrimental effect on employee engagement at work, utilising AI technology can be a useful strategy. Businesses risk losing their competitive edge if they don't include artificial intelligence into their employee performance procedures. The use of AI can motivate staff members to solve problems more creatively and successfully in the face of contemporary difficulties. Process improvements and increased organisational efficiency are made possible by the Industry 4.0 era, which also offers new avenues for employees to express their creativity. Workers can devote more time to innovative projects by automating tedious processes. AI technology has a big impact on how employees grow professionally and can raise employee engagement levels.

Limitations and Future Research

The results of the study show that health harm accounts for 35.5% of the variance and has a strong negative impact on work engagement. To fully comprehend the remaining 64.5% of effect brought on by other factors, more investigation is required. This could entail working with outside researchers or conducting internal studies to obtain a more thorough grasp of the variables involved. This endeavour can be supported by aligning Health Harm metrics through knowledge sharing and structural modifications.

The connection between AI technology and work engagement, which accounts for 48.8% of the variance, presents another drawback. Although prior studies have indicated that artificial intelligence (AI) can impact employee engagement at work, it is unclear how AI is used in subjective and objective contexts for things like chatbots, services, and AI awareness.Consequently, the researchers decided to use an artificial intelligence-based procedure to carry out a comprehensive evaluation.

Moreover, additional research is necessary to fully understand the mediator variable, which has a 24.2% influence. The impact's modest level indicates that specific initiatives or approaches are required to increase its relevance. Using a comprehensive strategy is crucial for implementing change or intervention, since undiscovered variables account for 75.8% of the influence. This technique should take into account a wide range of potential variables in order to investigate aspects that may influence the outcomes.

Future studies should identify AI technology as a moderator variable across industries and assess and analyse particular innovation initiatives while taking into account the impact of health harm and work engagement. Future studies could examine the findings from several industries and test the model in them, as employee health harm conditions may differ throughout them.

Authors' Contributions and Data Availability

Maria leads the research, overseeing conceptualization, methodology, software, and writing (including the original draft preparation), prepares the literature review and discussion and is responsible for writing, proofreading, and editing the final review. **Tiara, Rifandi, Fadly** handle data collection, prepare

the literature review, and are responsible for writing, proofreading, and editing.

Data availability

https://docs.google.com/spreadsheets/d/1gkTlF2WY86gDbFVvaTHTJokTMWrmSf6i/edit?usp=drive_link&ouid=103333082160155599462&rtpof=true&sd=true

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