

# NAVIGATING AI INTEGRATION: THE ROLE OF LITERACY AND ANXIETY IN SHAPING EMPLOYEE ENGAGEMENT THROUGH MODERATED MEDIATION APPROACH

Pradip Kumar Nanda

*Bharat Heavy Electricals Limited, India, kulabir1@gmail.com*

## Abstract

Despite extensive research in employee engagement, little is known about how AI literacy and AI anxiety interact with trust in AI to shape employee engagement in exponential technology environments. This study explores how trust in AI, perceived fairness, AI literacy, and AI anxiety influence employee engagement in AI-driven workplaces. Using a three-wave mixed-method design, data were gathered from 252 employees in Indian firms employing AI technologies. The results indicate that trust in AI significantly enhances employee engagement, where perceived fairness in AI is a mediator. Higher AI literacy amplifies the positive impact of trust and fairness in employee engagement, while AI anxiety weakens these relationships. The moderated mediation effect demonstrates that AI literacy and anxiety buffer the relationship between trust in AI and engagement. Our results highlight the importance of fostering trust and fairness in AI systems and enhancing AI literacy through targeted training while mitigating anxiety. Transparent and ethical AI strategies improve engagement by alleviating fears and creating supportive work environments. These approaches boost employee satisfaction and performance in AI-integrated settings. We suggest future research to examine these dynamics across diverse cultural contexts and longitudinal design to understand evolving human-AI interactions.

**Keywords:** *Artificial Intelligence, Employee Engagement, Trust in AI, Perceived Fairness in AI, AI Literacy and AI Anxiety*

## 1. Introduction

The advent of artificial intelligence (AI) has radically altered the organizational dynamics at our workplaces. In this context, the widespread adoption of AI raises critical concerns about trust and fairness in AI, attributable to AI-driven decision-making. Recent studies highlight that nearly 70 percent of employees feel uneasy about AI's role in HR practices, fearing biased, opaque, or impersonal decisions (Bankins et al., 2022; Chadha, 2024). These concerns are particularly pronounced in emerging economies like India, where AI adoption is accelerating, but employee perceptions, organizational readiness, and ethical safeguards remain challenged and underexplored (Narayanan et al., 2023).

AI integration into workplaces redefines how employees interact with organizational systems. Employees' engagement is a critical factor in leveraging AI to realize its full potential for organizational success. Employees evaluate AI-driven decisions based on trust and perceived fairness, shaping their willingness to engage with AI. However, AI anxiety, stemming from concerns over job displacement, algorithmic bias, and lack of transparency, can reduce employee engagement (Dutta & Mishra, 2024). Conversely, AI literacy, or an employee's understanding of AI, may enhance trust and acceptance of AI (Li & Bitterly, 2024). These psychological and cognitive factors influence whether AI becomes a source of engagement or disengagement. Addressing these dynamics is critical for creating AI-driven workplaces that are both technologically efficient and human-centric.

Current literature highlights the pivotal role of trust in AI in fostering employee engagement and organizational performance. Lower employee trust in AI results in stress, disengagement, and diminished commitment. Existing research has examined these elements in isolation, often overlooking their interdependent effects on employee engagement (Nanda & Nagasubramanian, 2023). Without a comprehensive framework, organizations risk AI-induced disengagement, resistance, and ethical dilemmas, threatening both employee well-being and business outcomes.

We build on three key frameworks to examine the above problem statement. In the context of the Job Demands-Resources (JD-R) Model (Bakker & Demerouti, 2007, 2017), we observe that AI can function as both a job resource (reducing workload, enhancing efficiency) and a job demand (creating uncertainty and stress). Trust and fairness perceptions in AI determine whether AI engages or alienates employees. From the Social Exchange Theory (SET) (Blau, 1964) perspective, we assume that employees reciprocate with fair and transparent AI-driven processes with higher engagement but may disengage when AI decisions lack perceived fairness or accountability (Chadha, 2024). With references to the Fairness Theory, we argue that the perceived justice of AI-driven decisions mediates the relationship between trust and engagement, shaping whether employees embrace AI as a support system or resist it as a threat (Cropanzano et al., 2001).

While prior studies have examined the technical and operational aspects of AI (Hughes et al., 2019; Rožman et al., 2022; Malik et al., 2023), AI's psychological and relational dimensions remain under-examined, particularly in emerging economies. The critical gaps in understanding AI's psychological and relational impacts on employee engagement remain void without integrating trust in AI, perceived fairness in AI, AI literacy, and AI anxiety into a cohesive framework. Our study provides insights into these behavioral dynamics in the transformational potential of AI, grounding our study in the JD-R model, SET, and Fairness Theory. Our study addresses this critical gap by examining:

1. How does trust in AI influence employee engagement directly and through the perception of fairness in AI?
2. The moderating effect of AI literacy in building the trust-fairness relationship.
3. The moderating role of employee anxiety on AI, on the fairness-engagement link.
4. The combined influence of AI anxiety and AI literacy on fairness perceptions and engagement.

We employed a three-wave mixed-method design, combining qualitative focus group discussions with quantitative surveys of 252 employees from Indian organizations adopting AI technologies. We tested the mediation and moderation effects through Structural Equation Modeling.

We offer three key theoretical contributions. First, we demonstrated that trust in AI and perceived fairness in AI are vital job resources; AI literacy and anxiety are the boundary conditions necessary for enhancing employee engagement and extending the JD-R model. Second, we demonstrated how trust in AI, perceived fairness in AI, and employee engagement function as reciprocal exchange, refining the Social Exchange Theory (SET). Additionally, incorporating AI literacy and anxiety as contextual moderators, we broaden the SET's scope to include AI-specific interaction dynamics. Third, we advance the Fairness Theory by stressing the mediating role of fairness in AI, in the trust in AI-employee engagement link.

## ***1.1 Theoretical Framework and Hypotheses Development***

### ***1.1.1 Trust in AI and Employee Engagement***

Trust in AI plays a crucial role in fostering employee engagement (Kulkarni et al., 2024). Trust in AI is rooted in the characteristics and actions of AI systems. It alleviates uncertainties, enhances psychological safety, and promotes cognitive and motivational processes (Gkinko & Elbanna, 2023). Trust in AI strengthens emotional connections to work (Rožman et al., 2022). While trust is multidimensional, comprising competence, reliability, and integrity, it establishes itself as a valuable tool in workplaces integrating advanced technologies (Hoffman et al., 2023).

When employees perceive AI systems as accurate and efficient in performing tasks, competence-based trust emerges (Lorentsa & Elbanna, 2023). Employees' trust enhances their decision-making abilities, streamlines workflows, and improves their efficiency (Park & Jung, 2021). Improved trust lets employees concentrate on strategic efforts, boosting their engagement (Dutta & Mishra, 2024). Reliability-based trust is essential for achieving organizational goals stemming from AI's consistency and dependability. Explainable AI and bias detection processes promote inclusivity and fairness, essential for employees' trust and their engagement (Kurup & Gupta, 2022; Rodgers et al., 2023).

AI adoption is facilitated by a high level of employee trust by mitigating employees' apprehensions about automation and reducing resistance to change for seamless technology integration into job roles (Hoffman et al., 2000). Conversely, low employee trust may lead to heightened stress and disengagement (Westover, 2024). Prioritizing participatory AI design, transparent AI decision-making, and fairness audits builds positive perceptions of AI and employee trust in AI. Hence, trust through its multidimensional characteristics, is critical for aligning human-AI collaboration with organizational goals and enhancing employee engagement.

### ***1.1.2 The Link between Trust in AI, Perception of Fairness in AI, and Employee Engagement***

We deduce from the Fairness Theory that perceived fairness in AI mediates the relationship between trust in AI and employee engagement. The theory posits that trust in AI enhances perceptions of fairness by ensuring ethical AI usage and transparency. This perception, in turn, reinforces employees' feelings of inclusion and justice, raising engagement through motivational pathways (JD-R theory). Thus, perceived fairness enables enhanced employee engagement through trust in AI.

When employees trust AI, they are likely to perceive AI's processes and decisions as fair and unbiased. This trust is shaped by AI's alignment with ethical standards, transparency, and consistency (Cheong, 2024). Fairness in AI helps create a more favorable work environment by upholding ethical norms and organizational principles (Goyal et al., 2024). Therefore, prioritization of fairness in AI decision-making to increase employee engagement and overall organizational success is essential (Dries et al., 2024). Fair AI systems improve work satisfaction while promoting inclusivity and productivity by addressing distributive and procedural justice.

Unfair or biased AI can lead to damaging outcomes like frustration and disengagement (Park & Jung, 2021; Malik, 2024). Firms must preserve employee value systems, as perceived unfairness can undermine organizational goals. Distributive justice assesses the fairness of AI decision outcomes, whereas procedural justice addresses the impartiality of AI processes (Rožman et al., 2022; Rick et al., 2022). If AI judgments are perceived as fair, engagement and commitment increase; if unfair, employees may feel frustrated, disengaged, or hostile toward the technology.

From the above analysis, we summarize that perceptions of fairness in AI mediate the relationship between trust and engagement. When employees have credence in AI, they are more inclined to perceive that AI makes fair decisions, leading to higher engagement. Conversely, perceived unfairness can result in negative emotions and reduced engagement. Thus, we propose:

***H1: Perception of Fairness in AI mediates the relationship between Trust in AI and Employee Engagement.***

### ***1.1.3 Boundary Condition: AI Literacy, Trust in AI, and Perception of Fairness in AI***

We advocate that AI literacy moderates the relationship between trust in AI and perceived fairness in AI, drawing on the JD-R theory. Personnel with high AI literacy better understand AI systems, enhancing perceptions of transparency and fairness (Nong et al., 2024). Conversely, insufficient AI literacy may hinder comprehension and reduce feelings of justice, even when trust exists (Gkinko & Elbanna, 2023). Thus, the positive relationship between trust in AI and perceived fairness in AI is strengthened by AI literacy.

Employees' AI literacy significantly impacts their trust building. Higher literacy encourages employees to probe and comprehend AI's prospects and constraints, improving engagement and interaction with AI technologies (Budhwar et al., 2022). Employees are more likely to relate to and learn about AI systems when they consider these systems capable, trustworthy,

and morally sound (Kurup & Gupta 2022; Lorentsa et al., 2023). Increased AI literacy reduces misunderstandings of employees about bias or mistakes enabling them to recognize ethical and transparency issues in AI (Park & Jung, 2021; Malik et al., 2023). Informed employees can critically evaluate AI decision-making processes (Rodgers et al., 2023; Shulner-Tal et al., 2023).

Employees' perception of fairness diminishes when they interpret AI-driven biases or mistakes as purposeful or malicious (Wijayati et al., 2022). Higher AI literacy improves comprehension of AI's strengths and weaknesses, enabling reasoned evaluation of AI judgments and procedures (Nong et al., 2024). As a result, the relationship between trust in AI and perceived fairness in AI is significantly moderated by AI literacy.

When employees have an informed perspective, the link between perceived fairness and trust in AI is strengthened, enabling them to view AI as a tool for fairness rather than prejudice (Bankins et al., 2022). Demystifying mistrust through AI literacy removes fears and misconceptions. AI literacy is crucial for successful AI integration, as distributive and procedural justice promotes belongingness and productivity (Duff et al., 2024). Through open communication and ethical considerations, informed employees appreciate AI's fairness (Budhwar et al., 2022; Floridi, 2024). Without AI literacy, employees may misinterpret AI processes, breeding mistrust.

From these findings, we argue that higher AI literacy strengthens the positive association between trust in AI and perceptions of fairness. Therefore, we hypothesize:

*H2: The relationship between Trust in AI and Perception of Fairness in AI is stronger when AI Literacy is high (compared to low).*

#### ***1.1.4 Boundary Condition: AI Anxiety, Perception of Fairness in AI, and Employee Engagement***

Under JD-R theory, we suggest that the relationship between perceived fairness in AI and employee engagement is moderated by AI anxiety. High anxiety amplifies psychological demands associated with AI, weakening fairness's motivational benefits. Conversely, low anxiety allows employees to appreciate fairness and translate it into engagement. Therefore, AI anxiety diminishes the positive effect of perceived fairness on engagement.

AI anxiety arises from job replacement fears, the absence of transparent AI decision-making, and ethical concerns (Li & Huang, 2020; Apostu, 2023). As AI integrates into processes, anxiety about job loss, powerlessness, or unethical AI behavior can hinder perceptions of fairness and reliability (Stahl & Wright, 2018). As anxious workers may avoid or mistrust AI, anxiety lowers their engagement, decreasing productivity (Dutta & Mishra, 2024).

Employee anxiety may prompt employee avoidance behaviors, further weakening the fairness–engagement link (Goyal et al., 2024). Employees with high AI anxiety are less likely to adopt AI due to perceived risks or biases. High AI anxiety may reduce interaction and trust in AI's objectivity. Fear of technology can create feelings of inadequacy, diminishing AI's perceived benefits (Myers, 2024). Reducing AI anxiety is crucial to creating productive, AI-enabled workplaces where fairness fosters engagement. Hence, understanding AI anxiety's

moderating effect is thus essential. This inverse effect underscores the intricate relationship between anxiety, fairness, and engagement. From these insights, we hypothesize:

*H3: The relationship between Perceived Fairness in AI and Employee Engagement is stronger when AI Anxiety is low (compared to high).*

We also argue that, through perceived fairness in AI, AI anxiety can strengthen the indirect relationship between trust in AI and engagement. Fairness in AI buffers anxiety by addressing bias and ensuring transparency, enabling employees to view AI as an ally (Robert, 2020; Narayanan et al., 2023; Shulner-Tal et al., 2023). These dynamics influence the trust-engagement link. Hence we propose:

*H4: The positive indirect relationship between trust in AI and Employee Engagement through Perceived Fairness in AI is stronger when AI Anxiety is low (compared to high).*

### **1.1.5 Moderated Mediation: AI Literacy and AI Anxiety**

Based on JD-R and Fairness Theory, we contemplate that AI literacy and anxiety guide the mediated relationship between trust in AI, perceived fairness, and engagement. High literacy combined with low anxiety strengthens fairness perceptions, enhancing mediation. Conversely, low literacy and high anxiety weaken fairness perceptions, disrupting mediation. From an SET perspective, such interaction shapes employees' ability to engage in positive exchanges, reinforcing or eroding the trust-fairness-engagement linkage.

Informed employees likely believe AI is open and fair, fostering trust and engagement (Park & Jung, 2021; Hoffman et al., 2023; Malik, 2024). AI anxiety's negative effects on satisfaction, engagement, and stress are well documented (Hoffman et al., 2023; Rick et al., 2024). Providing skills to navigate AI effectively lessens anxiety's effects (Stănescu & Romaşcanu, 2024). Scholars also argue that AI literacy empowers perceptions of fairness even under anxiety, leading to engagement (Wijayati et al., 2022). High literacy without fairness improvements may worsen anxiety by highlighting systemic faults (Gemalmaz & Yin, 2022). Environmental contexts further shape these interactions (Kurup & Gupta, 2022). Thus we hypothesize that:

*H5: The interaction between AI Literacy and AI Anxiety moderates the relationship between Perceptions of Fairness in AI and Employee Engagement, such that higher AI Literacy reduces the negative impact of AI Anxiety on Employee Engagement.*

The conceptual model theorizing these relationships is depicted in **Figure .**

## **2. Methods**

We adopted a pragmatic research paradigm with a deductive approach to examine the hypothesized relationships among our study constructs acknowledging the revolutionary potential of AI in business situations. The key objective was to explore the nuanced relationships between trust in AI, employee engagement, and AI- fairness perceptions while assessing the moderating roles of AI anxiety and AI literacy. We integrated qualitative focus

group discussions and quantitative surveys using a three-wave data collection and analysis approach to address our research questions comprehensively.

## **2.1 Research Design**

To capture temporal separation and a broad understanding of the interactions among our study variables, we employed a three-wave mixed-method design. The three-wave approach was essential to examine how attitudes and behaviors change as employees gain more exposure to AI technologies (Wolf & Maier, 2024).

In our first phase of data collection and analysis, a qualitative focus group discussion was carried out before the quantitative survey. The qualitative phase was designed to understand contextual relevance and develop the constructs through employees' opinions and perceptions. This approach enabled us to examine new insights, like anxiety, justice, and trust, in the dynamic technological and economic landscape of the Indian workplace. The three-wave survey provided the quantitative foundation for testing the hypotheses at a later stage. We wished to leverage the synergetic strengths of qualitative and quantitative data approaches to gain meaningful insights (Takona, 2024). While the qualitative phase provided intuitions on employees' experiences with AI integration and associated issues, the quantitative phase ensured the breadth and generalizability of our results. Scholars highly recommend the mixed-method approach to understand complex and dynamic phenomena like AI adoption in workplaces, especially in the Indian region.

## **2.2 Sample and Participant Recruitment**

Our study population consisted of employees of Indian firms actively using AI technologies in their daily operations. Indian companies across industries, including manufacturing, IT, and services. It served as the ideal population relevant to the study's context. Given AI's transformational potential in Indian firms, this context offers a unique intersection of traditional workplace dynamics and advanced technological integration. The population is fertile ground for examining trust, fairness, and engagement in AI-related challenges.

Before the main study, the survey instrument underwent pilot testing with 30 professionals from LinkedIn, including HR practitioners and AI experts. Of these, 24 participants provided valuable feedback, leading to refinements in the survey to ensure clarity and contextual fit.

Our three-wave study used a stratified random sampling strategy to enable diverse representation. Inclusion criteria required at least five years of organizational tenure, ensuring respondents were exposed to AI-related practices. Employees were stratified by job roles (technical, managerial, operational) and industry sectors (IT, manufacturing, services). An initial sample size of 275 employees was targeted, accounting for attrition across three waves. G\*Power calculated the sample size based on our five constructs, moderated mediation analyses, and desired statistical power of 0.85 using structural equation modeling. By the second wave, 256 participants remained (93% retention). In the third wave, 252 participants responded (98% retention).

Drop-out analysis showed no significant differences between participants and non-participants on AI literacy ( $t(275)=0.01$ ,  $p=.4286$ ), trust in AI ( $t(275)=-1.02$ ,  $p=.10$ ), or gender

( $t(275)=-1.01, p=.12$ ). Of the 252 final participants, 55.63% were men ( $N=140$ ). The average age was 38.65 years ( $SD=3.82$ ), and the average organizational tenure was 14.12 years ( $SD=8.25$ ). Role distribution was 36.5% technical, 33.7% managerial, and 29.8% operational. Sector distribution was 42.9% IT, 29.4% manufacturing, and 27.7% services.

## 2.3 Measures

### 2.3.1 Qualitative Measures

We employed qualitative measures in focus group discussions to gain an exhaustive understanding of employees' perceptions of AI integration. We used open-ended questions to inspire respondents to reflect on their job experiences and feelings about AI. Discussions were audio-recorded and transliterated verbatim to confirm accuracy. We then conducted the thematic analysis to identify repetitive patterns and themes, focusing on trust, perceived fairness, AI literacy, and anxiety.

### 2.3.2 Quantitative Measures

Insights from focus groups informed the refinement of constructs and items. A structured survey was employed for quantitative data collection to ascertain validity and reliability. Each construct was measured with six items adapted from validated scales, founded on literature and focus group intuitions. Responses were rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree), ensuring comprehensive coverage while maintaining respondent engagement. Survey instruments included:

**Trust in AI:** We used all the eight items from the 8-item scale by Hoffman et al. (2023) measuring on dimensions like predictability, reliability, efficiency, and believability. Sample items: "I trust the AI system to make accurate decisions," "I trust the AI system to make accurate decisions," "I trust AI decision-making to be unbiased." Cronbach's  $\alpha = .91$  (Hoffman et al., 2023).

**Employee Engagement:** UWES-9 (Schaufeli et al., 2006), comprising dedication, vigor, and absorption. Sample items: "At my work, I feel bursting with energy," "I feel happy when I am working intensely." Cronbach's  $\alpha = .93$  (Dutta & Mishra, 2024).

**Perception of Fairness in AI:** Adapted seven items from the 12-item AI Fairness Scale (Duff et al., 2024), measuring fairness in four life domains i.e. Interpersonal, Occupational, Community, and Societal. Sample Items included: "AI makes decisions fairly and transparently," "AI decisions align with my values". Cronbach's  $\alpha = .91$  (Shulner-Tal et al., 2023).

**AI Literacy:** Adapted six items from the AI Literacy Scale (Nong et al., 2024) that measure five dimensions comprising application ability, cognitive ability, morality, critical thinking, and self-efficacy with 15 indicators. Sample items include: "I understand how AI systems work," "I am confident in using AI tools in my daily work". Cronbach's  $\alpha = .83$  (Wang et al., 2023).

**AI Anxiety:** Adapted eight items from the 21-item AI Anxiety Scale (Wang & Wang, 2022) covering job replacement fears, AI configuration, sociotechnical blindness (e.g., "I feel anxious about AI making important decisions," "I worry about AI replacing human jobs," "I feel uncomfortable with AI systems monitoring my work"). Cronbach's  $\alpha = .93$  (Götz et al., 2024).

Cronbach's alpha values for each wave were calculated and compared to the original scales to ensure consistency and reliability. All constructs exceeded the acceptable threshold of  $\alpha = .70$ , confirming internal consistency.

#### **2.4 Data Collection**

Three focus groups of eight members each were conducted to gather qualitative insights. Participants represented diverse industries and job roles, ensuring a range of perspectives. Semi-structured discussions were guided by prompts such as "How do you perceive AI decisions in your workplace?" and "What factors influence your trust in AI systems?" Sessions were conducted via Zoom, recorded with consent, and transcribed for thematic analysis. Key themes, including trust, fairness perceptions, and anxiety emerged, shaping final survey items (e.g., the significance of transparency led to items on perceived fairness).

Surveys were administered at eight-week intervals (T1, T2, T3) to capture temporal changes in perceptions and behaviors. At T1, we collected baseline data on trust in AI and AI literacy. At T2, we collected follow-up data on perceived fairness in AI and AI anxiety. At T3, we captured data on moderated mediation effects and long-term dynamics on engagement. Google Forms were distributed via a dedicated LinkedIn group, ensuring accessibility and convenience.

#### **2.5 Data Analysis Strategies**

We conducted a two-step data analysis using SEM with SPSS 28 and AMOS 28. First, using maximum likelihood estimation, we examined the measurement model via Confirmatory Factor Analysis (CFA) to assess common method bias, discriminant validity, and reliability, given adapted items.

We compared the proposed five-factor model (trust in AI, employee engagement, fairness, literacy, anxiety) with three nested models **Error! Reference source not found.** : a four-factor model (combining trust and literacy), a three-factor model (grouping T1, T2, and T3 measures), and a single-factor model (all constructs) (Gürbüz et al., 2024). The four-factor model tested the distinction between literacy and anxiety; the three-factor model assessed temporal conflation; the single-factor model evaluated common method bias (Podsakoff et al., 2024). Fit indices showed the five-factor model was superior, supporting discriminant validity.

We used the PROCESS macro (Hayes, 2022) for regression-based path modeling to test hypotheses. PROCESS Model 4 (5000 bootstrap resamples) tested mediation (H1). Indirect effects were deemed significant if 95% CIs did not include zero. PROCESS Model 1 tested simple moderation (H2, H3). PROCESS Models 14 and 7 tested moderated mediation (H4, H5). Explanatory and moderator variables were mean-centered before moderation analyses.

Procedural and statistical safeguards minimized bias and errors. We employed Full Information Maximum Likelihood (FIML) to handle missing data, ensuring unbiased use of available information. Multi-item scales increased measurement reliability and reduced random error. SEM tested complex relationships and model fit, ensuring robust results.

#### **2.6 Ethical Considerations**

We complied with ethical standards by informing respondents about study purposes, voluntariness, and confidentiality. Informed consent was obtained from all respondents, who confirmed that their responses would be used solely for research.

### 3. Results

Participants emphasized the significance of AI producing trustworthy and consistent outputs for crucial jobs, with the subthemes of accuracy, consistency, and reliability being stressed under the theme of trust in AI. Openness is vital for building trust, particularly when arriving at important decisions, and participants rated AI systems that could clearly explain their conclusions reasonably. Regarding AI literacy, employees expressed that being aware of how AI functions reduces their anxiety and promotes engagement while utilizing AI technologies in the workplace. Participants articulated their worries that AI would take over their jobs, particularly in repetitive activities connected to AI anxiety. Participants' varied perspectives on AI are reflected in the table, highlighting both the advantages and difficulties they see with AI applications in their workplaces.

**Table 3** depicts the descriptive statistics of our work's key variables, including means, correlation coefficients, and standard deviations (SD) of the responses. It shows moderate positive correlations between variables like Trust in AI (TAI), AI Literacy (AIL), and perceived fairness in AI (PFAI), with correlations reaching significance at the  $p < 0.01$  level. Employee Engagement (EE) is positively correlated with Trust in AI, AI Literacy, and Perceived Fairness in AI. Gender and age are included as control variables, with age showing significant correlations with AI Anxiety and AI Literacy.

**Table 4** depicts the findings of the regression analyses that tested the hypotheses regarding mediation, moderation, and moderated mediation pathways between the key variables of trust

in AI, perceived fairness in AI, AI anxiety, AI literacy, and employee engagement. The results strongly support the proposed hypotheses, with significant effects observed in the mediation and moderation models.

The outcomes of PROCESS Model 4 for the mediation analysis revealed a significant indirect effect of trust in AI on employee engagement via perceived fairness in AI. The indirect effect was significant ( $b = 0.22$ ,  $p < 0.001$ ). The effect of perceived fairness in AI on employee engagement, was also significant ( $b = 0.40$ ,  $p < 0.001$ ). Moreover, the direct effect of trust in AI on employee engagement (path c') remained significant ( $b = 0.28$ ,  $p < 0.001$ ), confirming that trust in AI positively influences employee engagement both directly and indirectly through perceived fairness in AI. The significant indirect effect ( $b = 0.22$ ,  $p < 0.001$ ) further substantiates the mediation hypothesis, highlighting the central role of perceived fairness in fostering employee engagement through trust in AI.

The moderation results from PROCESS Model 1 supported the hypothesis that AI literacy moderates the relationship between trust in AI and perceived fairness in AI. The interaction term (trust in AI \* AI literacy) was significant ( $b = 0.22$ ,  $p < 0.01$ ), indicating that the effect of trust in AI on perceived fairness in AI is more substantial for employees with higher AI

literacy. This outcome supports Hypothesis 2, proposing that AI literacy boosts the perception of fairness in AI, amplifying its positive impact.

Hypothesis 3 posited that AI anxiety moderates the relationship between employee engagement and perceived fairness in AI. The interaction term (perceived fairness in AI \* AI anxiety) was significant ( $b = 0.24, p < 0.01$ ), displaying that higher AI anxiety weakens the positive effect of fairness on engagement. The output confirms the moderating role of AI anxiety and supports Hypothesis 3.

The moderated mediation analyses (PROCESS Models 14 and 7) tested the combined influence of AI anxiety and AI literacy on the mediated relationship between trust in AI, perceived fairness in AI, and employee Engagement. For both hypotheses, the results demonstrated significant indices of moderated mediation. In Hypothesis 4, the index of moderated mediation ( $b = 0.20, p < 0.001$ ) was significant, representing that AI anxiety moderates the indirect effect of trust in AI on employee engagement via perceived fairness in AI. For individuals with high AI anxiety, the mediated effect was weaker ( $b = 0.08, p < 0.05$ ) compared to those with low anxiety ( $b = 0.18, p < 0.01$ ). Similarly, Hypothesis 5 was supported, with a significant moderated mediation index ( $b = 0.25, p < 0.001$ ). The SEM path diagram is shown in **Figure 1**. The result illustrates that AI literacy moderates the mediated relationship between trust in AI, perceived fairness in AI, and employee engagement, with higher literacy strengthening the indirect effect.

Significant interaction effects were illustrated with plots (**Figure 2**- AI Literacy & **Figure 3**- AI Anxiety) to enhance our understanding of the effects of the moderators at various levels on employee engagement.

Overall, the results from **Table 4** confirm the hypotheses, demonstrating that both AI anxiety and AI literacy significantly influence the relationships between trust in AI, perceived fairness in AI, and employee engagement. The findings highlight these factors' complex, interacting roles in shaping employee attitudes and behaviors in AI-driven environments.

## 4. Discussion

### 4.1 Overview of Findings

The qualitative insights from our focused group discussion emphasized themes that highlighted anxiety (concerns about job security), fairness (transparency, clarity), trust (accuracy, dependability, consistency), and literacy (easy, demystification). Quantitative analyses confirmed significant correlations among key variables, aligning with theoretical expectations.

The findings validated the hypothesized relationships. Trust in AI significantly impacts employee engagement directly and through perceived fairness, supporting its mediating role (H1). AI literacy moderates the trust-fairness relationship, with higher literacy strengthening positive fairness perceptions in AI (H2). Conversely, AI anxiety weakens the fairness-engagement relationship, moderating its influence (H3). Moderated mediation results reveal

that AI anxiety reduces the mediating effect of fairness on trust-engagement pathways (H4), while AI literacy strengthens it (H5).

The results underscored the significance of trust in AI as a pivotal resource in fostering employee engagement. Drawing on JD-R theory, trust in AI is a job resource that mitigates uncertainties, enhancing psychological safety and motivation. Aligning with Fairness Theory, our result established that perceived fairness in AI, influenced by trust, amplifies employees' sense of justice, fostering engagement, where transparency and ethical practices are critical elements of the observed phenomenon.

In line with SET assumptions, the results indicated that AI literacy becomes a crucial moderator. High literacy workers have a better understanding of AI procedures, which strengthens feelings of justice and trust. Besides, despite high levels of trust, insufficient literacy may lead to misunderstandings and reduce perceived justice in AI-driven decisions. Our results highlighted how AI literacy functions as a mutually beneficial resource in the trust, fairness, and engagement triangle. AI anxiety interferes with motivational pathways and raises psychological demands, as envisaged in the JD-R's health impairment route. The undesirable effect of anxiety is reflected in the adoption of AI, as anxiety in AI makes it challenging to convert their awareness of justice into participation in AI-integrated workflows. Our results from the moderated mediation test confirmed anxiety and literacy influence the perception of fairness in AI. While high literacy lessens anxiety's harmful impacts, poor literacy exacerbates them, highlighting the importance of improving employees' AI literacy and alleviating their fears.

Our findings align with and extend prior research on AI's role in organizational behavior studies. Trust in AI as a resource aligns with the conceptualization of trust fostering positive Individual and organizational outcomes (Gkinko & Elbanna, 2024; Kulkarni et al., 2024). Our study validates prior studies through themes like accuracy, reliability, and consistency, emphasizing trust in AI's multidimensionality for improved fairness perception and employee engagement (Klimchak et al., 2020; Lorentsa et al., 2023; Nong et al., 2024). The mediating role of perceived fairness aligns with justice taxonomy (Greenberg, 1987), highlighting procedural and distributive justice's role in shaping engagement through employee trust in AI (Hughes et al., 2019; Narayanan et al., 2023). Our study found that transparent and unbiased AI enhances employees' fairness perceptions leading to enhanced employees' engagement, complementing earlier findings (D'souza et al., 2023; Goyal et al., 2024; Chadha, 2024). While the perception of fairness in AI was identified as critical for engagement in previous studies (Gürbüz et al., 2024; Maromenon et al., 2024), our study adds nuance by demonstrating its mediating role within the trust-engagement pathway (Duff et al., 2024). AI literacy's moderating role converges with extant literature, highlighting AI literacy's significance in enhancing fairness perceptions. Our findings echoed AI literacy's role in fostering engagement through fairness (Nong et al., 2024). The findings of our study explain that Employees' AI literacy and anxiety buffer the trust-fairness-employee engagement link offering fresh insights.

Our findings diverge from recent studies that treat fairness as a direct predictor of trust or engagement, rather than a mediator (Zhou et al., 2021). While we show AI literacy moderates trust-fairness-engagement links, prior research questions its sufficiency without broader

organizational support (Li & Kim, 2024). Peng et al. (2022) suggest trust in AI may not consistently enhance engagement, contrasting our model. Others highlight AI's unintended effects on well-being and fairness or emphasize leadership over fairness as the engagement driver (Divya et al., 2024), offering a distinct perspective from our findings.

Our study offers an alternative explanation for AI's impact on engagement by highlighting the mediating role of fairness and the moderating effects of AI literacy and anxiety. This contrasts prior studies that treated these variables as direct predictors, overlooking their interactive influence within trust-based mechanisms in AI-integrated organizational settings.

#### **4.2 Theoretical Contributions**

Our study contributes to theoretical understandings by advancing “the Job Demands-Resources (JD-R) model, Social Exchange Theory (SET), and Fairness Theory” in comprehending the interaction of trust in AI, perceptions of fairness in AI, and employee engagement.

According to the JD-R perspective, trust in AI is an important job resource that reduces psychological demands and improves motivational pathways. Additionally, we explained perceived fairness as a resource that induces and boosts engagement by incorporating justice and inclusiveness in our approach. By including moderators like AI anxiety and AI literacy in our model, our study expands the JD-R framework to meet the challenges of using responsible AI in the workplace. High levels of literacy lower cognitive demands, enabling workers to use AI systems efficiently, but anxiety increases psychological demands and impairs engagement. Our findings within the JD-R framework address AI-specific issues and provide valuable insights into technologically advanced work settings.

Our study emphasized the reciprocal nature of trust and fairness in AI systems through SET. Trust in AI reflects a social exchange where employees rely on the organization to deploy reliable and ethical AI systems. Perceptions of fairness reciprocate this trust, strengthening employees' emotional dedication to their jobs. AI literacy enhances these exchanges by empowering employees with the information necessary to evaluate AI systems critically. AI anxiety, on the other hand, disrupts this mutual exchange, underscoring the fragility of trust-fairness relations in high-tech environments.

Our study extends the Fairness Theory by demonstrating the mediating role of perceived fairness in the relationship between trust in AI and employee engagement. Open and objective AI procedures enhance employee views of justice, which promotes a favorable work environment. The results demonstrated the significance of procedural and distributive justice in influencing perceptions of fairness in AI. It explains the contribution of ethical practices and AI transparency in promoting employee engagement. Furthermore, by demonstrating how contextual factors affect perceptions of fairness in AI by including AI literacy and anxiety as moderators, we expand the boundaries of the Fairness Theory.

Our study integrated JD-R, SET, and Fairness Theory to understand how AI-specific factors shape employee engagement comprehensively. It extends these theories by incorporating AI-related variables, offering novel insights into managing human-AI interactions in organizational contexts.

### ***4.3 Practical Implications***

We offer notable practical implications for policymakers, managers, and society by blending the interplay of trust in AI, perceived fairness in AI, AI literacy, and AI anxiety in shaping employee engagement.

Policymakers are crucial in standardizing policies to ensure ethical AI integration across organizations. First, policymakers should advise top management to implement AI literacy programs a routine process. If AI literacy training, resources, and frameworks are effectively designed and implemented, employees in diverse industrial contexts can successfully adjust to AI-driven processes. Second, while leveraging AI, the decision-making procedures should be transparent across organizations. Explicit norms for explainability and accountability in AI systems will enhance employee views on trust and fairness in AI. Third, we recommend policymakers address AI anxiety challenges to diminish the perception of employees in losing control over their jobs and job security. Initiatives like transparent communication on the ethical use of AI and reskilling programs will have far-reaching outcomes regarding employee engagement and performance. Finally, participative AI design should be encouraged to address problem ownership, change resistance management, and address the diverse needs of employees. Policymakers can ensure that AI systems are developed with consideration for employees' anxiety, fairness, and ethical standards, building an inclusive workplace where employees work.

We suggest that managers' top priority must be to build trust in AI through strategic interventions. Investing, designing, and executing training programs for AI literacy is a crucial first step. These programs would enhance employees' comprehension of how AI systems operate, alleviating their anxieties and preparing them to use AI technologies efficiently. Practitioners should regularly perform fairness audits to assess AI systems' transparency, bias, ethics, and alignment. Employee trust in AI-driven decision-making will grow through these strategies, constructively shaping employees' views on distributive and procedural justice. Employee participation in AI integration should also be encouraged by adopting participatory decision-making practices. In addition to allaying their worries, this approach would promote pride and confidence in AI systems. By aligning these initiatives with organizational goals, managers can create an inclusive and supportive work environment, augmenting employee engagement and performance.

By emphasizing ethical AI practices, literacy development, and anxiety reduction, organizations can harness AI's potential to enhance engagement and foster positive individual, organizational, and societal outcomes while contributing to broader human-AI-centric interactions.

### ***4.4 Implications for Sustainable Practices***

Managers can leverage these findings to foster sustainable AI integration by prioritizing transparent, fair AI systems that build lasting employee trust. Investing in continuous AI literacy programs reduces anxiety and empowers employees, ensuring long-term adaptability and engagement. Regular fairness audits and participatory AI design promote ethical, inclusive workplaces, mitigating resistance and turnover. By addressing AI anxiety through reskilling and open communication, organizations sustain a motivated, resilient workforce.

These practices align AI adoption with human-centric values, enhancing productivity, well-being, and organizational stability—key pillars of sustainable business in technology-driven environments.

#### **4.5 Limitations**

We acknowledge the limitations of our study. First, the sample is restricted to Indian organizations, limiting the findings' generalizability to other organizational and cultural contexts. Second, even though the three-wave design helps us to reduce common method bias, it is limited to capturing temporal shifts in employee attitudes and behaviors toward AI adoption at workplaces. Longitudinal research may comprehensively understand AI's long-term effects on worker engagement. Third, while the self-reported data from respondents may provide valuable insights, it may introduce the social desirability bias, limiting our findings.

#### **4.6 Future Research**

Future research should expand samples across cultural and geographic contexts to understand global differences in how AI influences engagement. Comparing cultures may uncover unique aspects of anxiety, fairness, and trust. Scholars should also examine long-term effects of AI adoption on employee behaviors through longitudinal studies, revealing how fairness and trust perceptions evolve over time. Additionally, incorporating objective data, such as usage patterns and employee performance measures, can reduce reliance on self-reporting data and can strengthen current understanding.

#### **4.7 Conclusion**

Our study explored how trust in AI, perceived fairness in AI, AI anxiety, and AI literacy impact employee engagement in AI-driven workplaces. Our findings revealed that when employees trust AI, their engagement levels rise, especially when they perceive the AI systems as fair. Understanding AI through literacy programs helps employees interact better with these systems, reducing their fears. On the other hand, anxiety about AI can lead to skepticism and reduce engagement. Our findings underline the significance of building trust and ensuring fairness in AI design and implementations. Organizations should invest in AI literacy training and address employee concerns to foster a collaborative environment between humans and AI for better organizational productivity and social benefits. Organizations can boost employee engagement by addressing these factors, improving performance and job satisfaction in AI-integrated work environments. Future research should consider long-term studies across cultures to understand how human-AI interactions evolve.

#### **Data Availability Statement**

Data in support of the study may be shared on a reasonable request as the data may compromise the strategic interests of the surveyed organizations.

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## List of Tables

**Table 1:** The output of analytical models from Confirmatory Factor Analysis (CFA)

Models	$\chi^2$	df	CFI	SRMR	RMSEA	$\Delta X^2$	$\Delta df$
1. Single-factor model	2350.12***	392	0.58	0.13	0.15	1590.70**	10
2. Three-factor model	1760.90***	384	0.68	0.12	0.13	589.22**	8
3. Four-factor model	1440.20***	380	0.74	0.09	0.11	320.70*	4
4. Five-factor model	1190.08***	378	0.81	0.05	0.04	250.12*	-

Note: N = 252. Degrees of freedom (df); Comparative fit index (CFI); Root-mean-squared error of approximation (RMSEA); Standardized root mean squared residual (SRMR); aThe suggested five-factor model (Trust in AI, AI literacy, perceived fairness in AI, AI anxiety, and employee engagement). bTrust in AI and AI literacy combined. cone factor pooled T1 measures, including Trust in AI and AI Literacy; the other factor pooled T2 measures, including perceived fairness in AI and AI anxiety; and another factor included T3 employee engagement. dall items were combined. \*\*\*p < 0.001, \*\*p < 0.01, and \*p < 0.05.

**Table 2:** Thematic analysis results from focus group discussions

Theme	Subtheme	Illustrative Quote
Trust in AI	Reliability	"AI decisions are consistent over time, which builds trust."
	Accuracy and Dependability	"When AI provides accurate results repeatedly, it becomes a dependable tool."
	Consistency	"Consistency in AI outputs helps me rely on it for critical tasks."
Perceived Fairness in AI	Clarity	"If AI decisions are explained clearly, it feels fair even when the outcome isn't in my favor."
	Rationality	"The rationale behind AI systems outputs is valued by us."
	Transparency	"Especially when decisions are high-stakes, AI transparency helps me trust the system."
AI Literacy	Concern	"Employees are less anxious who know how AI works."
	Easiness	"We became more comfortable using AI at work, when I learnt how AI makes decisions."
	Demystification	"AI algorithms reduce the mystery and fear surrounding its use through better understanding."

**Table 2: Thematic analysis results from focus group discussions**

Theme	Subtheme	Illustrative Quote
AI Anxiety	Job Replacement	" AI might eventually take over my role, I worry about."
	Threat Perception	" Especially when my role depends on repetitive tasks automation perceived like a threat."
	Job Insecurity	" As AI advances, we question the long-term security of my job."

Source: Author

**Table 3: Descriptive statistics for means, SD, and correlation coefficients**

Variables	Mean	SD	1	2	3	4	5	6
1. T1 TAI	3.42	0.64						
2. T1 AIL	3.38	0.56	0.29**					
3. T2 PFAI	3.56	0.61	0.36**	0.37**				
4. T2 AIA	3.62	0.58	0.48**	0.08	0.35**			
5. T3 EE	3.68	0.46	0.32**	0.40**	0.30**	0.27**		
6. Gender (1 = males)	–	–	-0.11	-0.12	0.02	-0.21**	-0.06	
7. Age	38.65	3.82	0.04	0.10**	0.15**	0.09	-0.05	-0.07

(two-tailed). SD: standard deviation; TAI- trust in AI, AIL- AI literacy, PFAI- perceived fairness in AI, AIA- AI anxiety, EE-employee engagement \* $p < 0.05$ ; \*\* $p < 0.01$ .

**Table 4:** The mediation, moderation, and moderated mediation outcomes from regression analyses

Paths	<i>b</i>	<i>SE</i>	95 % <i>CI</i>
<b>Hypothesis 1</b> Mediation ( <i>PROCESS Model 4</i> )			
Path <i>a</i> : Trust in AI→ perceived fairness in AI	0.52***	0.05	[0.30, 0.55]
Path <i>b</i> : Perceived fairness in AI→ employee engagement	0.40***	0.03	[0.18, 0.39]
Path <i>c</i> : Trust in AI→ employee engagement	0.36***	0.04	[0.21, 0.42]
Path <i>c'</i> ( <i>direct effect</i> ): Trust in AI→ employee engagement	0.28***	0.06	[0.16, 0.26]
Indirect effect: Trust in AI→ perceived fairness in AI→ employee engagement	0.22***	0.04	[0.15, 0.26]
<b>Hypothesis 2</b> Moderation ( <i>PROCESS Model 1</i> )			
Interaction: Trust in AI* AI literacy→ perceived fairness in AI	0.22**	0.05	[0.16, 0.38]
High AI literacy(1 SD above the mean)	0.54***	0.06	[0.35, 0.65]
Medium AI literacy (mean = 0)	0.27***	0.04	[0.22, 0.47]
Low AI literacy (1 SD below the mean)	0.15**	0.06	[0.08, 0.20]
<b>Hypotheses 3</b> Moderation ( <i>PROCESS Model 1</i> )			
Interaction: Perceived fairness in AI* AI anxiety→ employee engagement	0.24**	0.07	[0.15, 0.38]
High AI anxiety (1 SD above the mean)	0.20***	0.02	[0.15, 0.25]
Medium AI anxiety (mean = 0)	0.28***	0.03	[0.13, 0.32]
Low AI anxiety (1 SD below the mean)	0.25***	0.04	[0.08, 0.30]
<b>Hypotheses 4</b> Moderated mediation ( <i>PROCESS Model 14</i> )			
Interaction: Perceived fairness in AI* AI anxiety→ Trust in AI→ perceived fairness in AI → employee engagement			
Moderated mediation Index	0.20	0.04	[0.10, 0.16]
High AI anxiety (1 SD above the mean)	0.08	0.05	[0.04, 0.15]
Medium AI anxiety (Mean = 0)	0.15	0.04	[0.05, 0.21]
Low AI anxiety (1 SD lower the mean) High AI anxiety (1 SD above the mean)	0.18	0.03	[0.10, 0.25]

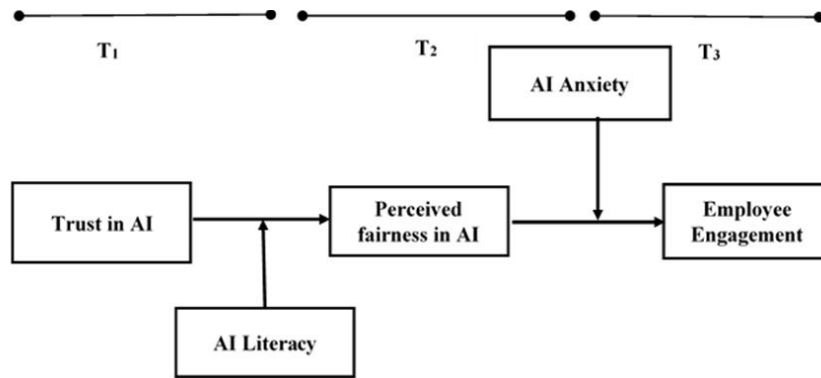
**Hypotheses 5** Moderated mediation (*PROCESS Model 7*)

Interaction: Trust in AI\* AI literacy → Trust in AI → perceived fairness in AI → employee engagement

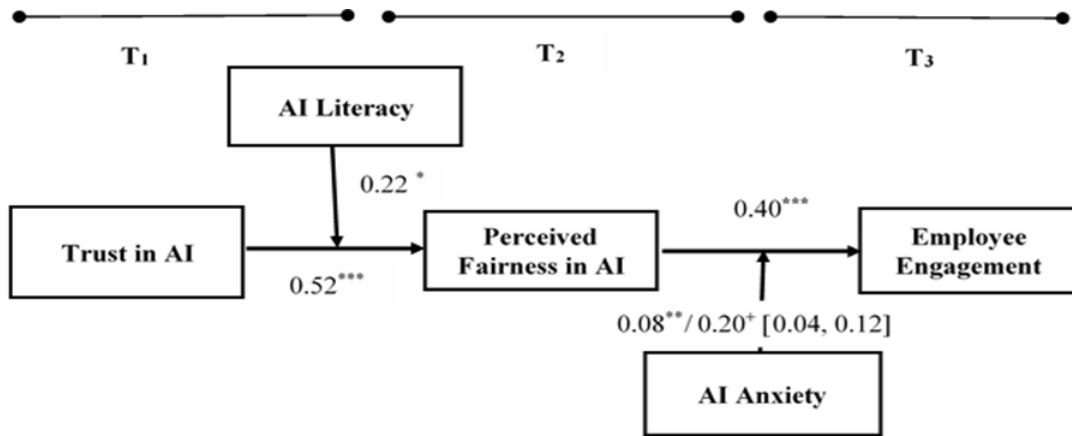
Index of moderated mediation	0.25	0.04	[0.10, 0.28]
High AI literacy (1 SD above the mean)	0.18	0.03	[0.05, 0.26]
Medium AI literacy (Mean = 0)	0.15	0.04	[0.07, 0.22]
Low AI literacy (1 SD below the mean)	0.07	0.03	[0.03, 0.10]

*Note:* *b*: unstandardized coefficient, Standard deviation-SD; Standard error- SE; Lower and upper confidence intervals-CI. Gender and age are controlled but not stated for ease. \*\*\**p* < 0.001; \*\**p* < 0.01; \**p* < 0.05; Bootstrap resampling = 5000.

**List of Figures**



*Figure 1: The Conceptual Model*



Indirect Effect= Trust in AI=>Perceived Fairness in AI=>Employee engagement= 0.12, CI [0.05,0.21]

\* p < .05; \*\* p < .01; \*\*\* p < .001.

+: Index of moderated mediation; T: Time; CI: confidence intervals. unstandardized estimates are reported. only hypothesized and significant associations are reported for simplicity. age and gender are controlled for.

Figure 1: Result of the proposed model of Trust in AI and Employee Engagement

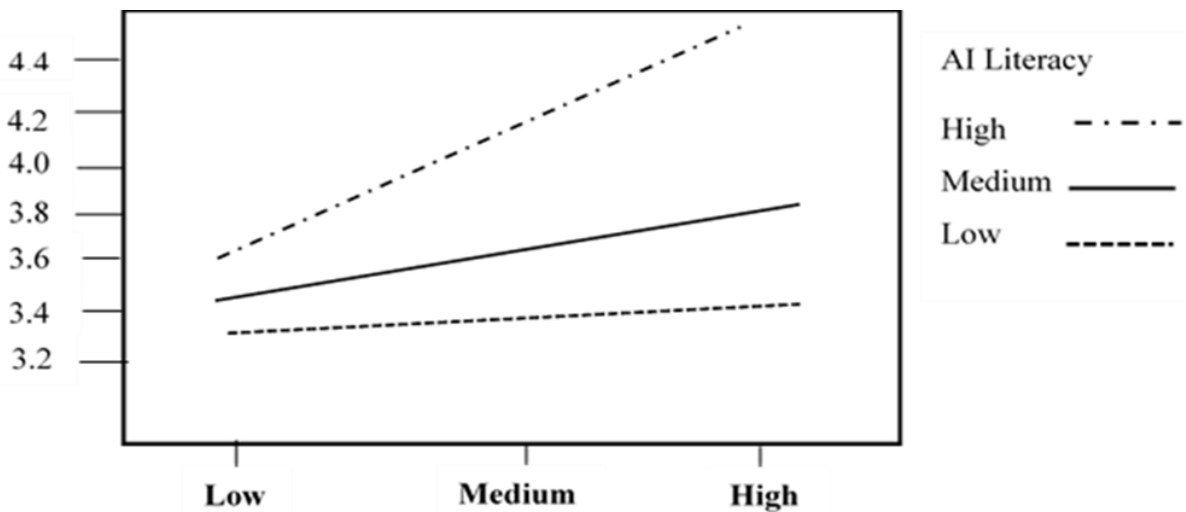
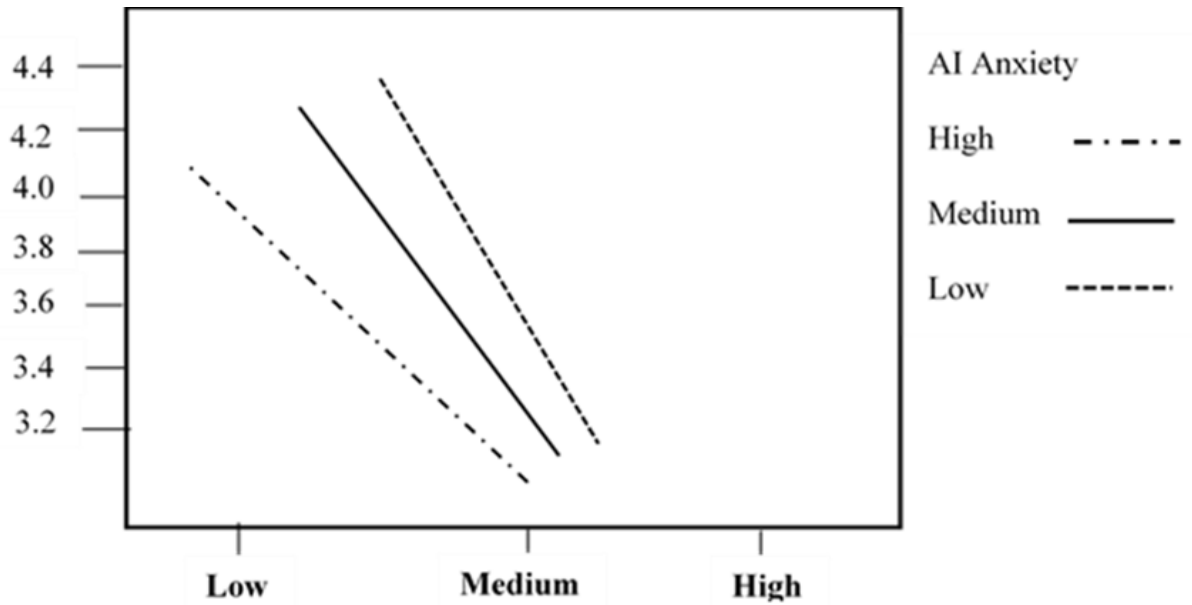


Figure 2: Plot for interaction between Trust in AI and AI Literacy on Perceived Fairness on AI



*Figure 3: Plot for interaction between Perceived Fairness in AI and AI Anxiety on Employee Engagement*

## CORRESPONDING AUTHOR

Pradip Kumar Nanda can be contacted at: [kulabir1@gmail.com](mailto:kulabir1@gmail.com)

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