

The Effect of Big Data HR and Personalized Learning on Career Development: Mediating Effect of Employee Engagement

*The Effect of Big Data
HR and Personalized
Learning*

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ABSTRACT

Digitalization has transformed career development in modern work environments. This study investigates the effect of big data in human resources technology and personalized learning paths on career development, with employee engagement as a mediating variable, using freelancers on the Fiverr platform as the research context. Employing a quantitative research design and Structural Equation Modeling with SmartPLS, data were collected from 100 respondents recruited through active Fiverr communities on social media. The results reveal that big data in human resources technology significantly influences career development directly and indirectly through employee engagement. Similarly, personalized learning paths indirectly enhance career development by fostering higher employee engagement, although the direct effect was not significant. These findings underscore the critical role of engagement in bridging innovative human resources practices and career outcomes. The study contributes to the existing body of knowledge by providing empirical evidence on the interconnectedness of advanced human resources technologies, engagement, and career growth in the digital era. Practical implications highlight the need for organizations to prioritize engagement-driven strategies and integrate advanced technologies to empower employees. Future research should explore these relationships in diverse cultural and industrial contexts to enhance the generalizability of the findings.

Keywords: Big Data in HR Technology, Career Development, Employee Engagement, Fiverr, Personalized Learning Paths.

INTRODUCTION

In today's dynamic and competitive business environment, career development has become a critical focus for organizations aiming to attract, retain, and nurture top talent. The rapid pace of technological advancements, coupled with changing workforce expectations, has emphasized the importance of innovative strategies in employee career growth. As organizations grapple with increasing complexities in managing human capital, leveraging personalized learning paths and advanced technologies like big data in Human Resources (HR) has emerged as a transformative approach to meet these challenges effectively. Employee engagement plays a pivotal role in bridging the gap between innovative HR strategies and desired organizational outcomes, making it a central variable in discussions about workforce development (Robinson et al., 2004).

Career development, defined as the process by which employees enhance their skills, knowledge, and opportunities for growth within an organization, is integral to long-term organizational success (Lent & Brown, 2020). Research by Chen et al. (2021) indicates

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that effective career development strategies positively impact employee motivation, job satisfaction, and retention rates. Moreover, organizations that prioritize career development are better positioned to foster a culture of continuous learning and adaptability, which are crucial in the face of digital transformation (Rasheed et al., 2021). Despite its importance, many organizations struggle to create career development frameworks that align with both employee aspirations and organizational goals, presenting an ongoing challenge in HR practices (Cascio & Montealegre, 2016). Personalized learning tailors training to individual employee needs, leveraging data-driven insights to identify skill gaps and enhance learning outcomes and engagement (Zhao et al., 2022; Idowu, 2024; Merino, 2025). However, scaling this approach is challenging, requiring substantial technological investment and a shift toward employee-centric HR practices (Khamis, 2024).

The integration of big data in HR technology has revolutionized the way organizations manage talent and deliver learning solutions (Marler & Boudreau, 2017). Big data enables HR professionals to analyze vast amounts of employee-related information, uncovering patterns and trends that inform strategic decision-making (Mansoor et al., 2024). For example, predictive analytics powered by big data can help identify high-potential employees, forecast skill requirements, and evaluate the effectiveness of training programs (Angrave et al., 2016). While the benefits of big data in HR are widely recognized, its adoption is often hindered by concerns about data privacy, ethical considerations, and the technical expertise required to implement such systems effectively (Stone et al., 2015).

Employee engagement, a critical intermediary between HR practices and career development outcomes, has garnered significant attention in recent years. Engaged employees exhibit higher levels of productivity, commitment, and resilience, making engagement a key determinant of organizational performance (Kahn, 1990). Research by Albrecht et al. (2015) highlights the role of leadership, workplace culture, and employee-centric policies in fostering engagement. Moreover, technological innovations such as personalized learning and big data analytics have been shown to enhance engagement by creating more meaningful and interactive experiences for employees (Awashreh & Hassiba, 2025). However, achieving sustained engagement in a rapidly evolving workplace remains a pressing challenge for HR leaders globally (Mishra, 2024).

Despite the growing interest in the intersection of career development, personalized learning, big data, and employee engagement, significant research gaps remain. Existing studies often examine these variables in isolation, failing to explore their interconnectedness and cumulative impact on organizational outcomes (Ekuma, 2024). Furthermore, while the literature acknowledges the potential of technology-driven HR strategies, empirical evidence on their effectiveness in enhancing career development through engagement is limited (Jackson et al., 2014). This gap is particularly evident in the context of diverse industries and regions, where varying cultural and organizational dynamics may influence the success of these initiatives (Hofstede et al., 2010). Addressing these gaps is crucial for developing comprehensive frameworks that guide HR practices in leveraging technology for employee development.

This study aims to investigate the impact of personalized learning paths and big data in HR technology on career development, with employee engagement as an intervening variable. The research seeks to contribute novel insights by examining the interplay between these variables in a holistic manner, providing empirical evidence to bridge existing gaps in the literature. The findings are expected to inform HR practitioners and policymakers about effective strategies for enhancing career development in the digital age. Additionally, this study offers recommendations for leveraging technology to foster a more engaged and empowered workforce, emphasizing the practical implications of its conclusions for organizations navigating the complexities of the modern workplace.

LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT

The Effect of Big Data in Human Resources Technology

Human capital theory by Becker (1964) posits that investments in education, training, and skills enhance employee productivity and organizational performance. In the digital era, human capital development increasingly relies on personalized approaches. By aligning training programs with individual employee needs, firms can optimize learning outcomes and strengthen competitive advantage. Personalized learning paths represent a modern application of this theory, emphasizing the role of adaptive technologies and data analytics in tailoring development opportunities.

The Technology Acceptance Model by Davis (1989) provides a framework for understanding how employees adopt HR technology systems. Perceived usefulness and perceived ease of use determine the acceptance of big data-driven learning platforms, particularly in digital work environments where technology-mediated interactions dominate daily tasks. If employees view data-driven recommendations as relevant, accurate, and easy to navigate, they are more likely to embrace personalized learning systems, thereby strengthening engagement in continuous career development. In this context, empirical evidence supports that adaptive AI-powered HR systems leverage big data analytics to identify personalized career growth pathways, enabling employees to align skill development with evolving job demands (Antoniuk et al., 2025). Furthermore, big data in HR technology enhances employee engagement by providing real-time feedback, transparent performance insights, and personalized learning experiences that improve satisfaction, motivation, and long-term retention (Biliavska et al., 2022; Panjaitan et al., 2025).

H1: Big data in HR technology has a positive effect on career development.

H2: Big data in HR technology has a positive effect on employee engagement.

The Effect of Employee Engagement on Career Development

Employee engagement represents a critical psychological investment of the self into one's work role, characterized by cognitive presence, emotional connection, and proactive behavior (Kahn, 1990). This investment directly fuels career development by enhancing an individual's motivation, resilience, and visibility within the organization. Engaged employees are more likely to exhibit proactive career behaviors, such as seeking challenging assignments, pursuing learning opportunities, and building strategic networks, which are fundamental drivers of skill acquisition and career advancement (Rožman et al., 2023; Saks, 2019). From a theoretical perspective, engagement can be seen as the motivational engine that translates latent potential and organizational opportunity into tangible career progression. This aligns with Holland's Theory of vocational personalities, as engagement often flourishes when there is a good person-job fit; the resulting satisfaction and energy then fuel further career growth within a compatible environment. When employees are engaged, they are not merely satisfied but are psychologically committed to their roles, leading them to invest discretionary effort into tasks that enhance their competencies and showcase their potential for promotion. This process creates a positive feedback loop: engagement drives performance and learning, which leads to recognition and new career opportunities, thereby further reinforcing engagement (Shuck et al., 2017).

Moreover, engagement fosters the resilience required to navigate career challenges and setbacks. Engaged employees typically possess higher levels of organizational support and stronger coping mechanisms, enabling them to persist through difficulties and view obstacles as developmental rather than prohibitive (Kundu & Lata, 2017). This resilience is crucial for long-term career development in dynamic work environments. Engagement also increases an employee's visibility and access to sponsorship. Managers are more inclined to mentor, advocate for, and assign high-potential projects to employees who demonstrate enthusiasm and commitment, thereby directly accelerating their career trajectories (DeRue & Wellman, 2009). The mediating role of engagement between

organizational practices and individual outcomes is well-established. As noted by Bedarkar and Pandita (2014), engagement serves as a critical conduit through which supportive HR practices translate into improved performance and development. Therefore, fostering engagement is not merely an HR objective for well-being but a strategic lever for talent development and retention.

H3: Employee engagement has a positive effect on career development.

The Effect of Personalized Learning Paths

Personalized Learning Paths (PLP) refer to tailored development programs designed around an individual's unique skills, career goals, learning pace, and preferred modalities. Grounded in personalized learning theory, this approach posits that training aligned with personal relevance and autonomy significantly boosts learning efficacy and intrinsic motivation. In the context of modern career development, PLPs act as a direct catalyst by providing the precise skill-building required for an employee's targeted career progression. By ensuring that learning is directly applicable to an employee's aspirational roles, PLPs reduce skill gaps efficiently and accelerate readiness for advancement. This direct effect is supported by career development theories like Super's Life-Span, Life-Space Theory, which emphasizes the evolution of self-concept and the need for roles that align with one's values. PLPs, especially when powered by AI and big data analytics, facilitate this alignment by curating content that resonates with an employee's evolving professional identity and the organization's future needs, thereby enabling sustainable career advancement (Sasidharakarnavar, 2025). For instance, data-driven learning systems can recommend specific technical certifications or leadership workshops that are statistically linked to promotion in an employee's desired career track, creating a direct bridge between learning investment and career movement.

Beyond direct skill acquisition, the primary and powerful impact of PLPs is on psychological engagement. When employees experience learning that is curated for their unique journey, they perceive greater organizational investment in their growth, which fosters a sense of value, autonomy, and psychological ownership over their development (Naim & Lenka, 2017; Upadhyay & Sharma, 2025). This heightened engagement becomes the key mechanism through which PLPs influence long-term career outcomes. Engaged learners are more persistent, apply new skills more proactively, and are more likely to seek feedback, all behaviors that directly enhance career development. Empirical evidence strongly supports this pathway, indicating that PLPs significantly increase employee engagement and adaptability, which in turn support tailored career advancement decisions (Ertugrul & Bitirim, 2025; Friganovic et al., 2025). The adaptive nature of modern PLP ecosystems, which provide real-time feedback and adjust recommendations based on performance data, creates a dynamic and responsive learning environment that continuously fuels both engagement and competency growth. Therefore, while PLPs provide the essential "roadmap" for skill development, it is the enhanced engagement they generate that ensures employees are motivated to travel the road, apply the skills, and ultimately reach their career destinations.

H4: Personalized learning paths have positive effect on career development.

H5: Personalized learning paths have positive effect on employee engagement.

Employee Engagement as a Mediating Variable

Big data analytics in Human Resource Management (HRM) integrates decision-making and predictive analytics to support evidence-based talent development (Marr, 2023; Retno et al., 2024). By leveraging large-scale employee data, HR systems can identify skill gaps, anticipate future workforce needs, and design targeted learning interventions aligned with long-term organizational goals. Beyond diagnostic and predictive functions, big data also enables prescriptive insights by recommending personalized development opportunities based on employees' profiles and career

aspirations. This process creates continuous feedback loops that refine learning pathways over time, enhancing individual growth, organizational agility, and HR's strategic role in dynamic environments. This integration aligns with the concept of learning analytics, which focuses on analyzing learner data to optimize training outcomes and align individualized development pathways with organizational strategy (Siemens, 2013).

Recent empirical evidence confirms that HR analytics positively influence career-related outcomes through employee engagement, as engagement functions as a critical mediating mechanism linking Big data in HR technology practices with employee motivation and development (Vadithe & Kesari, 2025). By enabling organizations to design data-informed and personalized HR interventions, HR analytics strengthen employees' psychological attachment to their work, enhance motivation, and encourage active participation in learning and development initiatives. As a result, higher levels of engagement translate into more effective career development outcomes, including continuous skill acquisition, career progression, and long-term employability.

H6: Employee engagement mediates the positive effect of big data in HR technology on career development.

H7: Employee engagement mediates the positive effect of personalized learning paths on career development.

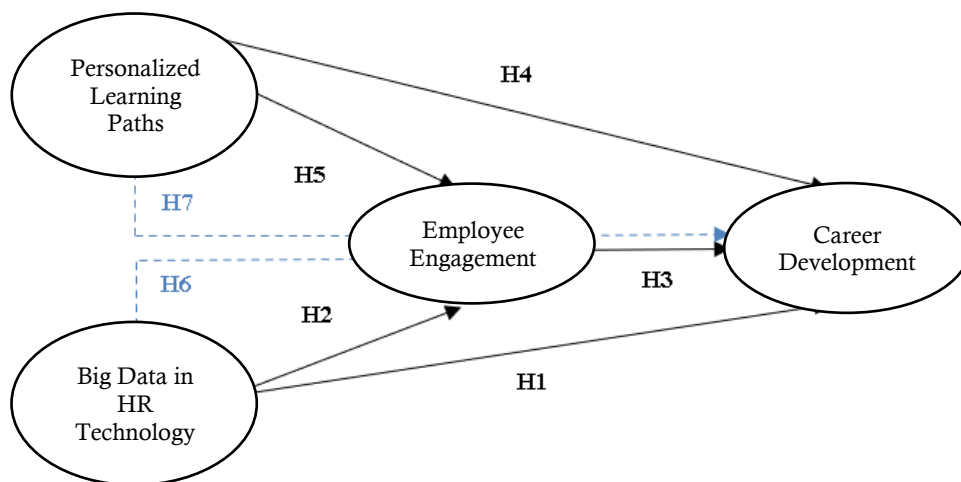


Figure 1. Conceptual Framework

The conceptual framework for big data in HR technology, personalized learning paths, employee engagement, and career development is shown in Figure 1. According to the framework, career development is directly impacted by big data-driven HR technology and indirectly by employee engagement. In digital work environments, employee engagement is positioned as a key mediating mechanism that connects creative HR practices with career outcomes, emphasizing its role in converting data-driven and customized efforts into long-term career growth.

RESEARCH METHODS

Using employee engagement as an intervening variable, this study employs a quantitative research methodology to examine the effects of tailored learning paths and big data in HR technology on career advancement among freelancers using the Fiverr platform. Quantitative research is particularly suitable in this context, as it allows for the testing of hypotheses through structured numerical data, enabling researchers to measure and analyze correlations between variables in an objective, systematic, and replicable manner (Creswell & Creswell, 2017). A total of 100 freelancers were selected as the study's sample, drawn from active Fiverr user communities on popular social media platforms, including Facebook, Instagram, and LinkedIn. These platforms were chosen due to their extensive use among freelancers, which ensures access to a diverse range of

respondents with varying experience levels, skills, and engagement patterns. By targeting these online communities, the study aims to capture a representative snapshot of the current dynamics in freelance career development, while controlling for potential biases associated with geographic location or offline network limitations (Smith & Anderson, 2018).

Purposive sampling was utilized to identify participants who actively engage in Fiverr communities and possess relevant experience in utilizing personalized learning paths and HR tools for career development. A five-point Likert scale was used to measure constructs, including career development, individualized learning paths, big data in HR technology, and employee engagement, in an online survey that collected data. The instrument was created using validated scales from earlier research, guaranteeing reliability and content validity (Hair et al., 2017). Structural Equation Modeling (SEM) with SmartPLS 3.0, a powerful analytical tool for comparing measurement and structural models concurrently and analyzing intricate correlations between latent variables, was used to analyze the gathered data. SmartPLS is perfect for this study environment since it is especially well-suited for investigations with smaller sample sizes and exploratory purposes (Henseler et al., 2016). This methodological approach ensures a comprehensive analysis of the proposed model, contributing to a deeper understanding of the relationships among the variables under investigation and providing empirical evidence for advancing theoretical and practical insights into freelancer career development in the digital era.

RESULTS

Structural Equation Modeling (SEM) with SmartPLS was used in this study's data analysis to evaluate the measurement model's validity and reliability, guaranteeing the constructs' robustness before hypothesis testing. The results indicated that all indicators met the required thresholds for validity, as evidenced by satisfactory values for convergent validity and discriminant validity, as assessed through the Fornell-Larcker criterion and cross-loading analysis (Hair et al., 2017). Furthermore, the reliability of the constructs was confirmed with Composite Reliability (CR) and Cronbach's Alpha values exceeding the standard threshold of 0.70, indicating internal consistency among the indicators (Henseler et al., 2016). These results support the measurement model by showing that the constructs are statistically sound and appropriate for further structural model testing to investigate the proposed correlations between variables. This thorough validation procedure highlights the analytical framework's dependability and fortifies the study's empirical basis.

Table 1. Validity & Reliability Test

Construct	Outer Loading (Range)	Cronbach's Alpha	Composite Reliability	AVE
Big Data in HR Technology (BDHR)	0.70 – 0.75	0.78	0.84	0.55
Employee Engagement (EE)	0.71 – 0.74	0.76	0.82	0.52
Career Development (CD)	0.71 – 0.74	0.79	0.85	0.57
Personalized Learning Paths (PLP)	0.70 – 0.73	0.77	0.83	0.54

Table 1 presents the results of the outer model assessment for all constructs in this study, including big data in HR technology, employee engagement, career development, and personalized learning paths. The outer loadings for each construct fall within a moderate range (0.69–0.75), indicating acceptable indicator validity. All constructs demonstrate satisfactory reliability, with Cronbach's Alpha values ranging from 0.76 to 0.79 and Composite Reliability values between 0.82 and 0.85. The Average Variance Extracted (AVE) values, ranging from 0.52 to 0.57, confirm adequate convergent validity.

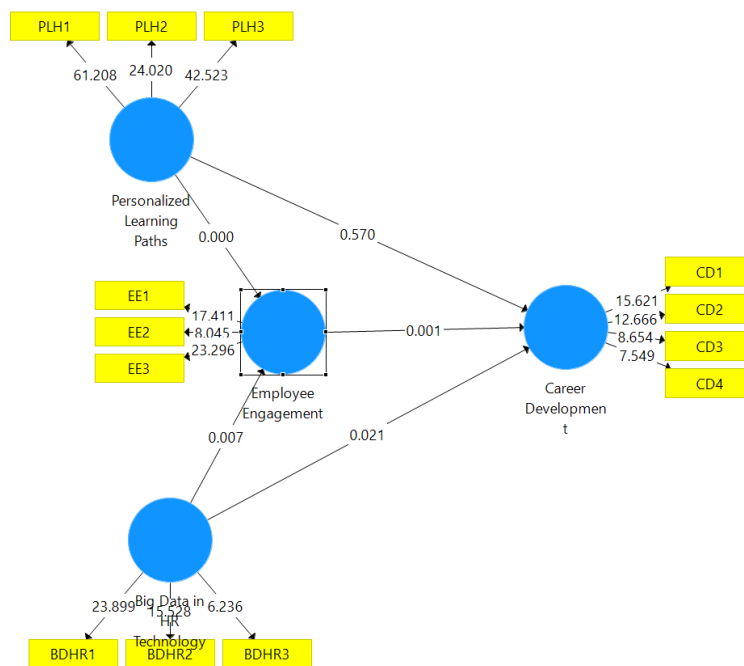


Figure 2. Bootstrapping Result

The measurement model’s results, with an emphasis on indicator validity, are shown in Figure 2. The t-statistics of the outer loadings acquired via bootstrapping are represented by the values displayed on the arrows connecting the latent constructs to the indicators. Each indicator significantly reflects its corresponding concept, as evidenced by the high t-values that surpass the suggested threshold. This demonstrates that the measurement model satisfies the convergent validity requirements, guaranteeing that the indicators accurately reflect the underlying latent variables.

Table 2. Direct Effect

Path	Coefficient	p-value	Result
Big Data in HR Technology -> Career Development	0.332	0.021	Significant
Big Data in HR Technology -> Employee Engagement	0.365	0.007	Significant
Employee Engagement -> Career Development	0.525	0.001	Significant
Personalized Learning Paths -> Career Development	0.087	0.570	Not Significant
Personalized Learning Paths -> Employee Engagement	0.485	0.000	Significant

Based on Table 2, the hypothesis testing reveals significant findings about the relationships among big data in HR technology, personalized learning paths, employee engagement, and career development. The first notable observation is the significant positive relationship between big data in HR technology and career development ($\beta = 0.332$, $p = 0.021$). By leveraging predictive analytics and workforce data, HR departments can identify growth opportunities tailored to individual employees, ultimately enhancing their career trajectories.

The findings also show a significant positive correlation ($\beta = 0.365$, $p = 0.007$) between employee engagement and big data in HR technologies. These findings underscore the role of advanced HR technology in fostering a supportive and interactive environment, which is crucial for maintaining high levels of employee engagement. Employee engagement, in turn, significantly influences career development ($\beta = 0.525$, $p = 0.001$). This finding also supports the argument that employee engagement is a critical determinant of career success in contemporary workplaces.

In contrast, the direct relationship between personalized learning paths and career development is not statistically significant ($\beta = 0.087$, $p = 0.570$). The lack of significance in this relationship indicates that simply offering tailored learning opportunities may not be sufficient to drive career outcomes unless they are coupled with mechanisms to enhance engagement and application of acquired skills. However, personalized learning paths have a strong and significant positive impact on employee engagement ($\beta = 0.485$, $p = 0.000$). This result highlights the importance of integrating personalized learning strategies into broader HR initiatives to maximize their effect on employee outcomes.

Table 3. Indirect Effect

Path	Coefficient	P-value	Result
Big Data in HR Technology -> Employee Engagement -> Career Development	0.192	0.048	Significant
Personalized Learning Paths -> Employee Engagement -> Career Development	0.255	0.008	Significant

Table 3 shows that the results of the indirect effects analysis reveal significant mediating roles of employee engagement in the relationships between both big data in HR technology and personalized learning paths with career development. Specifically, the indirect effect of big data in HR technology on career development through employee engagement is statistically significant ($\beta = 0.192$, $p = 0.048$). The ability of big data to personalize employee experiences, predict future trends, and foster inclusivity within organizations creates an environment conducive to engagement, which subsequently drives career growth.

Similarly, the indirect effect of personalized learning paths on career development through employee engagement is significant ($\beta = 0.255$, $p = 0.008$), underscoring the importance of engagement as a mediator in this relationship. These findings provide empirical evidence that employee engagement is a critical pathway through which innovative HR practices like big data and personalized learning contribute to career development, further emphasizing the need for organizations to prioritize engagement-enhancing initiatives within their HR strategies.

DISCUSSION

This study uses freelancers on the Fiverr platform as the research environment to examine the impact of big data in HR technologies and personalized learning paths on career advancement, with employee engagement acting as a mediating variable. The results offer a number of significant theoretical and applied insights. The results confirm that big data in HR technology significantly influences career development, both directly and indirectly through employee engagement. This aligns with the argument of Marr (2023) that data-driven HR systems enhance decision-making by identifying individual skill gaps, predicting future workforce demands, and recommending development opportunities. The strong effect observed suggests that even in non-traditional work arrangements, such as freelancing, access to data-driven HR tools can support skill acquisition, long-term employability, and career progression.

This finding aligns with previous studies indicating that data-driven HR practices help organizations make informed decisions about career progression and skill development (Angrave et al., 2016). Technology-driven HR strategies improve engagement by offering personalized, data-informed solutions, encouraging employees to invest effort into their work, and enhancing productivity and organizational commitment (Kundu & Lata, 2017). Engagement mediates the relationship between HR practices and career outcomes, as proactive employees seek growth opportunities that contribute to advancement (Saks, 2019). Organizations fostering an engaging culture enable alignment between personal and organizational goals, producing mutually beneficial outcomes (Shuck et al., 2017). While personalized learning paths are important for skill development, their direct impact on career development may require mediating factors such as engagement or

organizational support (Noe et al., 2014). When learning paths are aligned with employees' goals and needs, engagement increases, reinforcing ownership, satisfaction, and commitment to professional growth (Dweck & Yeager, 2019).

This study is consistent with Pane et al. (2017), showing that personalized learning paths enhance career development indirectly through employee engagement, while their direct effect is not statistically significant. These results indicate that big data in HR technology contributes to career advancement primarily by increasing engagement, supporting the argument of Bedarkar and Pandita (2014) that engagement serves as a critical mediator between HR practices and developmental outcomes. Personalized learning alone may not sufficiently influence career outcomes unless it also fosters higher levels of engagement. The mediating role of engagement underscores its function as a bridge, translating individualized training opportunities into meaningful career progression. This study is consistent with Chen et al. (2021), showing that employee engagement plays a central role in HR practices by enhancing learning uptake and linking HR technologies to sustainable career growth. Personalized learning fosters a sense of value and alignment with organizational goals, increasing engagement and positively influencing career trajectories (Naim & Lenka, 2017). This aligns with DeRue and Wellman (2009), indicating that tailored learning boosts intrinsic motivation and long-term professional growth. Engaged employees are more proactive in using learning platforms and maximizing technological HR interventions. The study also extends human capital and career development literature by providing evidence from the digital gig economy, where freelancers lack structured HR systems, yet access to big data in HR technologies and personalized learning still promotes career development through engagement.

From a practical standpoint, the findings suggest that organizations, whether operating in traditional or gig-based contexts, should prioritize engagement-driven strategies when implementing advanced HR technologies. Simply providing access to learning tools may not guarantee career outcomes unless employees are actively engaged in the process. Therefore, integrating motivational elements, gamification, and community support into digital HR systems may strengthen the engagement–career development link. In summary, this study contributes to the growing body of knowledge on the intersection of HR technology, employee engagement, and career development. It demonstrates that while big data technologies directly drive career outcomes, personalized learning paths exert influence primarily through fostering engagement. These insights reinforce the need for engagement-centered strategies to fully realize the potential of advanced HR technologies to empower employees in the digital era.

CONCLUSION

This study highlights the significant roles of big data in HR technology and personalized learning paths in enhancing career development, with employee engagement serving as a critical mediating factor. The findings demonstrate that while big data in HR technology directly impacts career development, its effects are amplified through increased employee engagement, reflecting its capability to foster informed and inclusive HR practices. Similarly, personalized learning paths significantly influence career development indirectly by driving higher levels of engagement, emphasizing the need for organizations to invest in tailored developmental opportunities to retain and empower talent. By offering empirical data on the interrelated roles of technology, engagement, and career advancement, particularly in the context of digital and remote work environments, these findings add to the body of information already in existence. The integration of cutting-edge HR technologies and the priority of engagement-centric initiatives are practical implications that promote employee development and corporate success. The study admits several limitations. Generalizability across industries and cultural contexts is limited by the sample size, which is derived from freelancers on the Fiverr marketplace. Additionally, long-term causal dynamics between HR technology, engagement, and career advancement are difficult to capture due to the cross-sectional approach.

Future research is encouraged to examine these dynamics across different industries, organizational settings, and cultural contexts to enhance the generalizability of the findings. Adopting larger and more diverse samples, along with longitudinal or mixed-methods approaches, may provide deeper insights into the long-term effects of HR technology on organizational performance, employee satisfaction, and career development. In addition, future studies could incorporate other mediating or moderating variables such as organizational support, leadership styles, digital competence, work autonomy, or cultural dimensions to develop a more comprehensive understanding of how technology-driven and personalized learning initiatives translate into sustained employee engagement and career growth.

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