ENTREPRENEURSHIP AND INNOVATION REVIEW
Volume 3, Issue 1, June 2025 | pp. 22-40
https://doi.org/10.54518/eir.3.1.2025.1306

Human Capital in the Age of Artificial Intelligence: Challenges and Opportunities

Sinta Annisa[1] ✉, Yehezkiel Kharis Haryono[1], Intan Ratna Wati[1]

Universitas Diponegoro, Semarang, Indonesia[1]

ABSTRACT

The paradigm shift that has occurred in the workplace due to the massive use of Artificial Intelligence (AI) requires a comprehensive and structured understanding of its impact on human capital. This research is a systematic literature study that aims to integrate and analyze empirical findings from scientific journals. The analysis identified four main challenges: (1) skill gaps and the incompatibility of the competencies possessed by the current workforce in the AI era; (2) jobs that widen income inequality; (3) ethical risks such as in the recruitment process, performance evaluation, and employee data privacy; and (4) a decline in critical thinking skills. Not only challenges have emerged, but there are also positive opportunities arising from the use of AI. The positive aspects are the creation of collaboration between humans and AI that can increase productivity, the creation of new jobs, and the encouragement of human creativity and innovation. This study examines the importance of balance between humans and AI to build an adaptive and fair human resource ecosystem in an era of rapid technological development.

Keywords: *Artificial Intelligence, Human-AI Collaboration, Human Capital, Skills Gap.*

CORRESPONDING AUTHOR:
Sinta Annisa
Diponegoro University, Semarang, Indonesia
contact: *annisasinta19@gmail.com*

ARTICLE HISTORY
Received : April 16, 2025
Final Revised : May 28, 2025
Accepted : June 06, 2025
Published : June, 30 2025

1. | INTRODUCTION

The massive implementation of Artificial Intelligence has changed the structure and dynamics of the global workforce, triggering a paradigm shift in human capital management (Caputo, 2024). The latest report from (The 2025 AI Index Report | Stanford HAI, 2025) shows that in one year, the use of AI by organizations has increased sharply from 55% to 78%, indicating that AI technology is becoming an increasingly important part of business strategies and operations around the world. This surge in AI usage marks an evolution from the focus on automation in the industry 4.0 era to human-machine collaboration championed in Industry 5.0 (Fernandez et al., 2025). AI is no longer viewed solely as an automation tool but also as a means to augment human capabilities, thereby enhancing productivity (Wiethof et al., 2022).

Despite its potential for efficiency, the widespread application of AI has triggered a major shift in the structure of employment and presented new challenges that need to be critically examined. This era of rapid digital transformation has widened the skill gap in various industrial sectors, requiring an increase in workforce capacity to remain relevant amid technological acceleration (Salminen et al., 2024). This disruption also creates economic inequality due to the shift from routine, middle-income jobs to professions requiring high skills (Cheng et al., 2024; Kaur et al., 2023). In addition, the widespread use of AI in the workplace raises ethical dilemmas such as algorithmic bias in recruitment systems (Sony et al., 2025), AIbased surveillance that threatens employee data privacy and erodes work autonomy (Carter, 2025), and excessive dependence that risks eroding critical thinking skills and independent decision-making capacity, which are fundamental aspects of human capital (Shah & Asad, 2024).

AI also serves as a powerful tool for enhancing human capabilities and creating new economic value that contributes to the revitalization of human capital. Collaboration between humans and AI has been proven to increase productivity by up to 57% (Sowa et al., 2021), while also opening new job opportunities (Rismani & Moon, 2023). Through the automation of routine tasks, AI frees humans to focus on strategic and creative work, while transforming HR functions to be more data-driven and predictive (Hourani, 2025; Kadirov et al., 2024).

However, a review of the literature reveals that research on the impact of AI on human capital is still incomplete. Many studies tend to be polarized into either pessimistic or optimistic approaches. A number of researchers focus only on the challenges by examining the risks of algorithmic bias in recruitment and threats to employee data privacy (Carter, 2025; Sony et al., 2025). On the other hand, different studies are dominated by discussions of opportunities that explore human augmentation through collaboration between humans and AI and increased productivity (Sowa et al., 2021; Wiethof et al., 2022). As a result of these differing perspectives, understanding of the impact of AI is incomplete, requiring a comprehensive synthesis that integrates both perspectives in a balanced manner.

Based on the research gap identified, this study presents a systematic literature review to comprehensively combine various findings on the challenges and opportunities of AI for human capital. This approach aims to identify key issues, including skill gaps, income inequality, ethical and data privacy risks, and a decline in critical thinking skills, while also exploring strategic opportunities, such as human-AI collaboration, increased productivity and efficiency, the creation of new jobs, and a boost to innovation and creativity. The synthesis

results are expected to form the basis for creating a balance between humans and AI in building an adaptive, equitable, and sustainable human resource ecosystem.

2. | LITERATURE REVIEW

Human Capital Theory

Human capital plays a direct role in the production process, serves to increase productivity, and reflects the capacity and ability of individuals to adapt, solve problems, and deal with changing conditions in order to improve the quality of work (Becker, 1975; Schultz, 1961). The role of human capital in the era of artificial intelligence (AI) has shifted the value of human capital from routine technical skills to more complex cognitive and social abilities, such as creativity, problem solving, and collaboration (Caputo, 2024; Kadirov et al., 2024).

AI not only reduces the traditional role of labor but also drives transformation toward more strategic, analytical, and creative functions (Hourani, 2025). Automating routine tasks allows humans to focus on work that requires critical thinking and innovation (Soumpenioti & Panagopoulos, 2023), while optimizing HR functions through predictive analytics, increased engagement, and the development of technical and soft skills to address the skills gap in the digital age (Salminen et al., 2024). The Human-in-the-Loop concept emphasizes that the future of work will focus on collaboration between humans and AI, rather than the complete replacement of human roles (Sowa et al., 2021; Wiethof et al., 2022).

The human capital theory remains relevant by transforming its perspective: from merely accumulating individual assets to forming adaptive partnerships between humans and AI. Human capital is no longer about "what is known," but rather about "how adaptable and collaborative" one is with technology to create value in an ever-changing work landscape (Tian & Zhang, 2025).

Artificial Intelligence in the Workplace

Definition of AI and its Application in the Workplacez. According to research by Gandía, de Lucas Ancillo, and del Val Núñez (2025), Artificial Intelligence (AI) is defined as a computational system designed to mimic human intelligence through automatic learning processes, pattern analysis, and databased decision making. In the context of the modern workplace, the study emphasizes that AI is no longer seen as a technical support tool, but as a strategic element capable of transforming organizational structures, work behaviors, and management systems.

The study also shows that the application of AI in the workplace is developing through various technologies such as machine learning, natural language processing, and sensor-based monitoring systems. These technologies are used to accelerate data analysis, predict risks, identify work patterns, and support real-time managerial decision-making. It can be concluded that AI plays an important role in improving organizational efficiency because it is capable of processing information with speed and accuracy that exceeds human capacity (Gandía et al., 2025).

Affected HR Fields. Gandía et al. (2025) explain that one of the sectors most affected by the penetration of AI is Human Resource Management. Although the article uses the perspective of employee behavior as its main focus, the explanation covers key HR functions that have changed due to the adoption of AI.

First, research shows that AI influences the recruitment process through the use of automated screening algorithms that assess candidate suitability based on historical data and

specific competency indicators. This makes the recruitment process faster and more systematic.

Second, the study describes that performance evaluations are increasingly dependent on digital monitoring, where AI can observe work activity patterns, productivity rhythms, and employee communication dynamics. This data is then used to assess performance objectively.

Third, Gandía et al. (2025) emphasize that AI strengthens people analytics practices. Through large-scale data analysis, AI enables HR to predict burnout risks, assess engagement levels, and design more targeted intervention strategies.

Fourth, the study shows that AI also plays a role in supporting internal HR services through chatbots and adaptive learning systems. This technology promotes improved service quality while reducing administrative burdens.

Positive Impact on the Workforce. According to the findings of Gandía et al. (2025), the use of AI has a number of significant positive impacts on the workforce. The most dominant impact is increased efficiency. AI is able to take over repetitive tasks so that employees can allocate their time to strategic activities that require creativity and high-level decision making.

The study also confirms that AI supports improved accuracy in organizational decision-making, particularly through its analytical capabilities to process data consistently. In addition, AI-based monitoring technology helps detect occupational safety risks more quickly, thereby creating a safer work environment.

Gandía et al. (2025) also show that AI helps strengthen competency development processes through automated learning systems that tailor training materials to individual needs. Thus, AI not only increases productivity but also supports the improvement of human resource quality.

Negative Impact on the Workforce. In addition to its benefits, the Gandía et al. (2025) study also identified a number of negative impacts of AI on the workforce. One of the most prominent issues is job insecurity. The study shows that increasing automation has created fear among employees that their roles will be replaced by technology, which can ultimately reduce motivation and psychological well-being.

Privacy issues are another concern. The article explains that the intensive use of AI-based monitoring systems can create a feeling of being overly watched, threatening employees' psychological comfort and reducing trust in the organization.

In addition, Gandía et al. (2025) emphasize the risk of algorithmic bias that can arise if AI training data is unbalanced. This can lead to unfair decisions, whether in the context of recruitment, promotion, or performance evaluation. The study also shows that the use of AI to replace human interaction has the potential to weaken social relationships between workers and reduce the quality of interpersonal communication.

Challenges of Human Capital in the AI Era

The development of artificial intelligence has brought about major changes in the structure of the modern labor market. In a study by Acemoglu & Restrepo (2019), the increasingly widespread use of AI poses various challenges that directly affect the quality, distribution, and capacity of human resources. Their research shows that the direction of AI development, which is too focused on automation, actually puts great pressure on workers in terms of skills, income, ethics, and critical thinking abilities (Acemoglu & Restrepo, 2020). The four main challenges are explained in depth below.

Skill Gap. Acemoglu and Restrepo emphasize that much of today's AI technology is designed with the primary goal of replacing human tasks. As machines take over these roles, the job market for workers with low and medium skills is shrinking. This technology makes it difficult for workers with limited abilities to adapt, as the demand for new competencies such as data analysis, programming, or smart system operation is increasing rapidly.

In this situation, highly skilled workers gain more opportunities, while those with low competencies fall further behind. Companies are increasingly seeking talent capable of managing or assisting with AI technology, leading to a decline in demand for jobs that do not require specialized skills. This shift is creating a widening skills gap, where some workers successfully adapt and move into higher-skilled jobs, while others are ultimately pushed out of the labor market.

The next challenge identified by the authors is increasing income inequality. When companies replace humans with machines, the economic value generated by the production process flows more to capital and technology owners than to labor. Workers, especially those in low-skill categories, receive an increasingly smaller share of the total value generated by the industry.

Research by Acemoglu & Restrepo shows that the impact of this decline in income is most felt by workers in the lower income groups. They experience a decline in employment opportunities, lower wages, and increased career uncertainty. Meanwhile, highly skilled workers are enjoying greater demand and increased income due to their abilities being in line with the needs of a technology-based economy.

In addition to the economic impact, Acemoglu & Restrepo also highlight the ethical risks arising from the application of AI. AI technology enables companies to collect, analyze, and monitor worker data at a very high level of detail. While this can improve efficiency, it also opens up opportunities for data misuse and excessive surveillance.

The author explains that AI not only replaces human tasks, but can also be used to control worker behavior. When technology is used to monitor performance or activities in a non-transparent manner, worker privacy is threatened. Workers may not know how their data is collected, processed, or used for decision-making related to their work.

This situation also raises concerns about the concentration of power in the hands of those who have access to data and technology. Organizations can use AI capabilities to determine workflows, regulate productivity, or even shape worker behavior without providing a space for fair dialogue. In this context, AI has the potential to shift healthy working relationships into ones that are fraught with information inequality and unilateral control.

Declining Critical Thinking Skills

Another challenge is the decline in critical thinking skills due to over-reliance on automated systems. Acemoglu & Restrepo explain that when too many work functions are transferred to machines, including those that require human judgment, consideration, or analysis, people lose the opportunity to practice and sharpen these skills.

This phenomenon is known as deskilling, a condition where workers' skills decline because they are no longer used in daily activities. If algorithms always take over the decision-making process, humans will eventually become mere executors of instructions. They will no longer be accustomed to evaluating situations, analyzing data independently, or questioning the results of AI systems.

In the long term, this can weaken human capacity to deal with complex problems. Workers become more passive, less reflective, and less capable of making strategic decisions. This decline in critical thinking skills is one of the greatest threats to the development of AI, as it weakens the quality of human resources that should be the center of creativity and innovation.

Opportunities of Human Capital in the AI Era

Based on research entitled Artificial Intelligence in Innovation Research: A Systematic Review, Conceptual Framework, and Future Research Directions conducted by Mariani, Machado, Magrelli, and Dwivedi (2022), the application of artificial intelligence (AI) has brought about major changes in work systems, innovation, and human resource management. This study confirms that AI not only serves as an automation tool but also as a system that expands human capabilities in thinking, analyzing, and creating innovative value within organizations.

The adoption of AI is influenced by three main factors, namely economic, technological, and social factors, all of which are closely related to the role of humans in the workplace. From an economic perspective, AI increases efficiency and productivity; from a technological perspective, AI accelerates the innovation process; and from a social perspective, AI shapes new patterns of collaboration between humans and machines (Mariani et al., 2023).

Thus, the results of this study show that the era of artificial intelligence does not diminish the role of humans, but rather opens up great opportunities for strengthening human resource capacity. These opportunities cover four main aspects, namely human–AI collaboration, increased productivity and efficiency, the creation of new jobs, and the encouragement of innovation and creativity.

Research by Mariani et al. (2022) shows that the application of artificial intelligence does not lead to the replacement of humans by machines, but rather to the formation of collaborative work patterns between humans and intelligent systems. AI functions as a partner that strengthens human capacity to think, analyze, and make decisions more quickly and accurately. In modern organizational systems, human–AI collaboration brings about the integration of human cognitive abilities and the analytical power of technology.

Through this collaborative approach, humans remain the main controllers of organizational processes, while AI performs analytical, predictive, and large-scale data processing functions. This can be seen from the results of a bibliometric study conducted by Mariani et al. (2022), in which many studies place AI as a tool that helps humans optimize innovation, increase productivity, and support data-driven decision making.

AI helps humans understand customer behavior patterns, manage supply chains, and create product innovations with greater accuracy. However, artificial intelligence does not possess human intuition, ethical values, and social considerations. Therefore, the collaboration between the two results in a balanced form of work, where humans are tasked with providing direction, interpretation, and final decisions on the results of the AI system's work.

In this context, the ability of humans to understand, operate, and supervise AI becomes an important factor. This collaboration requires human resources with digital skills, analytical abilities, and high work ethics so that the human-AI relationship runs harmoniously and productively.

One of the main findings of Mariani et al.'s (2022) research is that the application of AI has a direct impact on increasing productivity and efficiency within organizations. In the conceptual framework developed, economic factors are one of the main drivers of AI adoption

in companies. The use of AI enables organizations to reduce production costs, accelerate operational processes, and improve the quality of work without increasing the number of employees.

AI is capable of processing large amounts of data at speeds far beyond human capabilities, thereby accelerating the analysis and decision-making processes. As a result, various fields such as manufacturing, logistics, and public services have experienced increased efficiency through work system automation and predictive analysis.

Furthermore, this study also highlights that efficiency improvements occur not only at the technical level, but also at the managerial level. With the help of AI, the strategic planning process becomes more focused because decisions are based on measurable data and trends. Mariani et al. (2022) state that AI plays a role in "reducing human error" and "improving the overall effectiveness of organizations."

However, increased productivity and efficiency can only be achieved if the workforce is able to adapt to the technology being used. Therefore, this study emphasizes the importance of training and developing digital competencies for employees so that they can operate AI systems optimally.

The research by Mariani et al. (2022) refutes the view that artificial intelligence will eliminate human jobs on a large scale. On the contrary, their findings show that the application of AI actually creates new forms of work that did not previously exist. This is explained through the category of organizational outcomes in the research framework, where the use of smart technology drives organizational structure transformation and expands the role of the workforce.

In modern organizations, various new positions related to the management, monitoring, and development of AI systems have emerged, such as data managers, algorithm analysts, digital innovation system developers, and artificial intelligence ethics controllers. These changes indicate that the role of humans is shifting from routine operational activities to more strategic, analytical, and creative work.

Mariani et al. (2022) also emphasize that the need for human resources with digital skills and adaptive thinking abilities will increase. AI is changing manual work patterns to ones based on supervision, evaluation, and system improvement. Thus, the presence of AI encourages humans to continue learning and adjusting their abilities in order to play an active role in an increasingly intelligent work ecosystem.

This transformation also has implications for the formation of organizational and educational policies that place greater emphasis on technological literacy, digital ethics, and critical thinking skills. In this way, the human workforce will not only be able to survive in the AI era, but also become the main driver in optimizing this technology.

The aspect of innovation is the main focus of the research by Mariani et al. (2022). Based on the results of their systematic review of 1,448 articles, it was found that AI plays an important role in strengthening an organization's ability to innovate. AI assists in complex data analysis, market opportunity detection, and the development of new ideas based on empirical evidence.

Through the use of technologies such as machine learning, data mining, and the Internet of Things (IoT), organizations can create product and service innovations that are faster, more efficient, and tailored to market needs. Mariani et al. argue that AI is a key factor in

strengthening an organization's "dynamic capabilities," which is the ability to adapt and transform in an ever-changing environment

In addition to innovation, the presence of AI also encourages increased human creativity. AI systems are capable of providing data, simulations, and alternative solutions that enrich the human creative thinking process. However, human creativity remains at the core of the innovation process because only humans are capable of giving meaning, value, and social context to the results of technological innovation.

Thus, AI serves as an enabler of human creativity, not a replacement. The combination of artificial intelligence and human creative thinking creates a faster, more measurable, and sustainability-oriented innovation process.

Integrating Human–AI Systems

Augmented Intelligence is a concept described as a form of integration of Artificial Intelligence into the human capital ecosystem, where AI is not intended to replace the role of humans, but to complement and enhance human capabilities so as to realize effective collaboration to increase productivity (Singh & Pandey, 2025). Based on this paradigm, AI serves as a tool that strengthens human analytical and operational capabilities, resulting in collective intelligence in the workplace (Chowdhury et al., 2023).

A human-in-the-loop approach is necessary for effective collaboration between humans and AI, with humans continuing to play an important role in the final decision-making process (Watson et al., 2021). Aspects that require human empathy and emotion must be maintained, as they cannot be fully understood by AI. The synergy between human empathy and the speed of AI analysis creates more effective and equitable results (Singh & Pandey, 2025).

The socio-technical systems theory emphasizes the importance of balance between technological aspects (AI) and social aspects (humans, culture, and organizational structure) (Tenakwah & Watson, 2024). Without considering the social dynamics of the organization, the application of AI that only focuses on efficiency risks creating an unwillingness to accept change, thereby reducing employee engagement and reinforcing existing biases (Sony et al., 2025).

From a human capital strategy perspective, collaboration between humans and AI opens up opportunities to create an adaptive hybrid workforce (Chowdhury et al., 2023). Repetitive analytical and administrative tasks can be taken over by AI, freeing humans to concentrate on tasks that require creativity, intuition, empathy, and strategic consideration (Sowa et al., 2021; Watson et al., 2021). A study by Benabou & Touhami (2025) found that the most effective decision-making weighting is 70% by humans and 30% by AI, reflecting the ideal collaboration model between the two in decision-making.

3. | RESEARCH METHOD

This research is a systematic literature review that aims to identify, evaluate, integrate, and analyze empirical and conceptual findings related to human capital challenges and opportunities in the era of Artificial Intelligence. SLR was chosen because it provides a comprehensive and structured mapping of the latest literature developments and identifies research gaps that need to be explored in the future.

Search Strategy and Data Sources

The literature search was conducted in November 2025 using leading academic databases, namely Scopus, ScienceDirect, Emerald Insight, and IEEE. The search strategy was developed

using a combination of Boolean keywords to ensure broad and relevant coverage. The main keywords used included:

("human capital" OR "workforce" OR "human resource"), AND ("Artificial Intelligence" OR "AI" OR "machine learning"), AND ("challenge" OR "opportunity" OR "impact" OR "future of work"), AND ("skill gap" OR "ethics" OR "collaboration" OR "productivity")

The search was limited to articles published between 2019 and 2025 to ensure that the findings reflect the most recent developments in AI.

Inclusion and Exclusion Criteria

The article selection process was carried out in stages, carefully considering the inclusion and exclusion criteria. The selected articles included empirical and conceptual research in English that discussed the impact of artificial intelligence on various aspects of human capital, such as skills, productivity, ethics, or employment, and were published in peer-reviewed journals or reputable conference proceedings. Conversely, publications in the form of books, theses, or non-scientific articles, as well as studies that do not clearly highlight the relationship between AI and human capital or do not have complete manuscripts, are not included in the analysis.

Data Selection and Extraction Procedures

The selection procedure follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework. Articles are screened based on their titles and abstracts, after which they are exported into a reference management tool (such as Zotero or Mendeley). This process is carried out independently by two researchers to minimize bias, with differences resolved through discussion until a mutual decision is reached. Selected articles were then extracted into a standardized matrix, including information such as authors, year, objectives, main findings (challenges and opportunities), and research context.

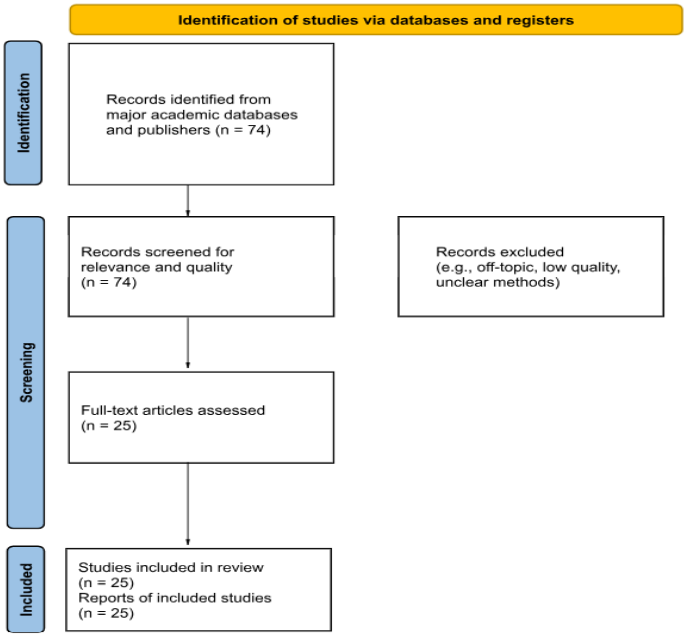

Figure 1. Summary of the Selection Process Using the PRISMA Framework

The literature selection process in this study followed the PRISMA 2020 framework to ensure that only relevant and high-quality studies were included. A total of 74 articles were identified from various leading databases, then through a rigorous screening process based on topic, quality, and methodology criteria, 49 articles were excluded, leaving 25 articles to

proceed to full-text assessment. Ultimately, 25 articles that met all requirements were deemed suitable for synthesis and further analysis to answer the research question regarding the impact of artificial intelligence on human capital.

Data Analysis Techniques

The extracted data were analyzed using thematic analysis. The analysis stages included: Familiarization by reading repeatedly to understand the depth of the findings; Generating initial codes to identify important points; Searching for themes by grouping codes into potential themes; Reviewing themes to ensure their coherence and relevance to the research questions; Defining and naming themes to produce a comprehensive classification of challengesand opportunities. This analysis aims to present a structured and in-depth synthesis of the existing literature.

4. | RESULTS

Characteristics of the Studies Reviewed

This study analyzes 25 international scientific articles published in the last five years. The articles were selected based on inclusion and exclusion criteria that focused on the relationship between Artificial Intelligence (AI) and Human Capital development, particularly in the context of improving employee efficiency, organizational innovation, and workforce transformation in the digital era. Classification based on key characteristics, namely publisher and research method, was carried out to understand the scope and focus of the studies analyzed.

Table 1. Characteristics based on publisher

Publisher	Frequency
Scopus	18
Emerald	4
Elsevier	1
Springer	1
IEEE	1
Total	**25**

Most of the articles analyzed came from Scopus-indexed journals and proceedings, totaling 18 articles. This indicates that the data sources used are highly credible and have undergone a rigorous peer review process. In addition, Emerald contributed four articles, followed by Elsevier, Springer, and IEEE with one article each. The dominance of publications from Scopus illustrates that topics related to Artificial Intelligence and Human Capital have become a broad concern in various scientific fields. This also confirms the growing academic interest in research discussing the influence of AI on performance efficiency and human resource management on a global scale.

Table 2. Distribution of Articles Based on Research Methods

Metode Penelitian	Frequency
Quantitative	10
Qualitative	7
Literature Review	5
Mix Methods	3
Total	25

Based on the research methods used, most studies applied a quantitative approach (10 articles). This approach emphasizes the use of empirical data to explain the relationship between the application of Artificial Intelligence and increased employee performance efficiency through statistical analysis and mathematical models. Furthermore, seven articles use a qualitative approach, such as case studies, in-depth interviews, and conceptual analysis to understand the phenomenon of AI implementation in an organizational context more deeply. In addition, there are five articles that use literature reviews to identify research trends, theoretical gaps, and future research directions. Meanwhile, three other articles use a mixed methods approach that combines quantitative and qualitative analysis to produce a more comprehensive understanding.

Synthesis of AI Challenges and Opportunities for Human Capital

Based on a thematic analysis of the 25 articles reviewed, the impact of Artificial Intelligence (AI) on human capital was found to have consistent thematic patterns across various organizational contexts and industrial sectors. The analysis results show four main challenges and four strategic opportunities that are interrelated, reflecting the dynamics of the relationship between technology and human capacity development. The results of the analysis are summarized in Tables 3 and 4 below.

Table 3. Challenges of AI Toward Human Capital

Challenge	Supporting Studies	Key Findings
Skill Gap	Maria et al.; Salminen et al.; Acemoglu & Restrepo; Tian & Zhang; Watson et al.	AI technology is replacing human tasks, narrowing the job market for low- and medium-skilled workers. New competency requirements such as data analysis and programming are increasing very rapidly
Income Inequality	Acemoglu & Restrepo; Cheng et al.; Kaur et al.;	Economic value flows more to capital and technology owners. Low-skilled workers experience a decline in job opportunities and wages, while high-skilled workers enjoy an increase in income.
Ethical and Data Privacy Risks	Sony et al.; Carter; Acemoglu & Restrepo; Gandía et al.; Benabou & Touhami.	The use of AI allows for detailed monitoring of employee data, but risks threatening privacy. Excessive surveillance and bias in recruitment systems can lead to information inequality and unfairness for workers.
Declining Critical Thinking Skills	Acemoglu & Restrepo; Shah & Asad.	Dependence on automated systems leads to deskilling, where workers lose the

	opportunity to practice independent judgment and analysis.

The analysis identified four main challenges faced by the workforce in the era of artificial intelligence. First, many jobs that can be replaced by AI have led to a skills gap, with routine jobs being replaced by AI, thereby narrowing job opportunities for those who rely solely on low and medium skills. Meanwhile, there is a drastic increase in demand for new skills such as data analysis (Acemoglu & Restrepo, 2020; Mariani et al., 2023; Salminen et al., 2024; Tian & Zhang, 2025; Watson et al., 2021).

The widening income gap is the second, albeit less critical, challenge. This indicates that economic gains are being enjoyed more by capital and technology owners, while low-skilled workers are experiencing wage declines and reduced job opportunities. Conversely, highly skilled workers are seeing an increase in income, widening the economic gap between the two groups (Acemoglu & Restrepo, 2020; Cheng et al., 2024; Kaur et al., 2023).

Third, ethical and data privacy issues have also emerged as equally worrying challenges. AI's ability to monitor and analyze employee data in detail does increase efficiency, but it also has the potential to threaten their privacy. In addition, excessive surveillance and bias in AI-based recruitment systems can lead to injustice and information inequality in the workplace. (Acemoglu & Restrepo, 2020; Benabou & Touhami, 2025; Carter, 2025; Gandía et al., 2025; Sony et al., 2025).

Finally, the fourth challenge that arises is that over-reliance on automation systems has the potential to reduce human critical thinking skills. When AI takes over the analysis and decision-making processes, employees gradually lose the opportunity to practice their independent judgment skills. The phenomenon of deskilling in the long term can weaken critical thinking skills, which are precisely what is needed to solve complex problems in the world of work (Acemoglu & Restrepo, 2020; Shah & Asad, 2024).

Table 4. Opportunities of AI Toward Human Capital

Opportunities	Supporting Studies	Key Findings
Human–AI Collaboration	Chowdhury et al; Mariani et al.; Sowa et al.; Benabou & Touhami; Singh & Pandey; Tenakwah & Watson; Watson et al.; Wiethof et al.	AI acts as a partner that enhances human capabilities through the human-in-the-loop concept, which increases productivity by up to 57% by combining human intelligence and technological analysis for faster and more accurate decisionfaster and more accurate decision-making
Productivity and Efficiency Improvements	Mariani et al.; Gandía et al.; Benabou & Touhami; Hourani; Kadirov et al.	AI-based automation improves operational efficiency and accuracy by accelerating the processing and analysis of large amounts of data, thereby supporting faster decision-making, reducing production costs,

	Soumpenioti & Panagopoulos; Wiethof et al.	and improving the quality of work results.
Creation of New Jobs	Mariani et al.; Rismani & Moon; Soumpenioti & Panagopoulos	AI is creating new types of jobs such as data managers, algorithm analysts, and AI ethics controllers. Human roles are shifting from routine operational work to more strategic and analytical work . more strategic and analytical.
Driving Innovation and Creativity	Benabou & Touhami; Mariani et al.; Singh & Pandey;Watson et al.	AI assists with complex data analysis, market opportunity detection, and new idea development. AI systems provide data and simulations that enrich the human creative thought process.

The presence of Artificial Intelligence also brings a breath of fresh air amid various challenges in the form of transformative opportunities for human capital development. The synthesis of various studies identified four strategic opportunities that can be exploited. First, collaboration between humans and AI can create highly effective synergies. AI plays an optimal role when positioned as a partner that strengthens human capabilities through the human-in-the-loop concept. This collaboration has been proven to increase productivity by up to 57% by combining human intelligence in terms of intuition and empathy with the speed of technology for faster and more accurate decision making (Chowdhury et al., 2023; Mariani et al., 2023; Singh & Pandey, 2025; Sowa et al., 2021; Tenakwah & Watson, 2024).

Second, increased productivity and efficiency are the most direct impacts of AI adoption. AI-based automation can improve operational efficiency and accuracy by accelerating the processing and analysis of large amounts of data. This not only supports faster decision-making, but also significantly reduces production costs and improves the quality of work (Benabou & Touhami, 2025; Gandía et al., 2025; Hourani, 2025; Kadirov et al., 2024; Mariani et al., 2023).

Third, contrary to the concerns of many people, AI actually creates new jobs that were previously unimaginable. AI has given rise to new professions such as data managers, algorithm analysts, and AI ethics controllers. This transformation has led to a shift in the role of humans from routine operational work to more strategic, analytical, and creative work, which is actually more valuable (Mariani et al., 2023; Rismani & Moon, 2023; Soumpenioti & Panagopoulos, 2023).

Fourth, AI has proven capable of driving human innovation and creativity to higher levels. AI assists in complex data analysis, market opportunity detection, and new idea development. AI systems provide data and simulations that enrich the human creative thinking process, functioning as enablers that accelerate the innovation cycle while still placing human creativity

at the core of the entire innovation process. (Benabou & Touhami, 2025; Mariani et al., 2023; Singh & Pandey, 2025; Watson et al., 2021).

These opportunities indicate that the future relationship between humans and AI will not only focus on efficiency, but also on creating greater added value through innovation and the development of new strategic roles in an increasingly adaptive and effective work ecosystem

5. | DISCUSSION

This study confirms that the presence of artificial intelligence in the context of human capital has created complex dynamics that continue to evolve alongside technological advances. The study's findings not only reveal a series of significant challenges but also transformative opportunities that could lead to the development of a more adaptive, fair, and effective human capital ecosystem. This discussion aims to explain the findings in a broader context, relate them to previous research, and highlight important theoretical and practical implications.

A paradigm shift in human capital theory is one of the main implications of these findings. The concept of human capital, which originally focused on the accumulation of knowledge and technical skills (Becker, 1975), has now shifted to the ability to adapt, collaborate with technology, and apply knowledge in constantly changing situations (Caputo, 2024; Tian & Zhang, 2025). AI is not only seen as a substitute for humans, but also as a partner that strengthens human cognitive and analytical capacities through the concept of augmented intelligence (Chowdhury et al., 2023; Singh & Pandey, 2025). These findings are in line with the research by Mariani et al. (2022) which emphasizes that AI functions as an enabler of innovation and creativity, not as a replacement.

The research results also confirm the emergence of challenges such as a widening skills gap (Acemoglu & Restrepo, 2020; Salminen et al., 2024). AI is shifting labor demand from routine tasks to high-level skills such as data analysis, complex problem solving, and creativity. This has the potential to marginalize workers with low and medium skills, while exacerbating income inequality (Cheng et al., 2024; Kaur et al., 2023). This phenomenon reflects what is known as job polarization, where middle-class jobs are shrinking, while demand for highly skilled and low-skilled workers remains, but with a widening wage disparity.

Ethical and privacy risks also reinforce these concerns. The use of AI in recruitment and performance monitoring has the potential to perpetuate algorithmic bias if not managed transparently and accountably (Carter, 2025; Sony et al., 2025). Over-reliance on automated systems can lead to deskilling or a decline in critical thinking skills (Acemoglu & Restrepo, 2020; Shah & Asad, 2024). As a result, organizations not only need to ensure that the AI systems they use are free from bias, but they must also maintain a balance between automation and human decision-making.

Beyond challenges, this research also identifies strategic opportunities that can serve as a foundation for human capital transformation. Human-AI collaboration has been shown to increase productivity by up to 57% and also create new strategic and analytical jobs (Mariani et al., 2023; Rismani & Moon, 2023; Sowa et al., 2021). These findings are consistent with the human-in-the-loop framework, which emphasizes that humans continue to play a central role in final decision-making (Tenakwah & Watson, 2024; Watson et al., 2021).

The socio-technical systems approach and AI capability framework offer guidance for harmonious AI integration (Chowdhury et al., 2023; Tenakwah & Watson, 2024).

Organizations need to build an environment that supports collaboration, invest in upskilling and reskilling programs, and ensure that AI implementation is aligned with organizational values and work ethics. Governments and educational institutions are also required to play an active role in developing policies that support digital literacy and continuous learning.

Overall, these findings reinforce the view that the future of human capital in the AI era is not about competition between humans and machines, but rather about balanced synergy. The success of this transformation depends on the ability of individuals, organizations, and governments to adapt, learn, and work together to build an inclusive, ethical, and sustainable work environment.

6. | CONCLUSION

Based on a systematic literature review, it is concluded that the impact of artificial intelligence on human capital is dualistic, presenting both disruptive challenges and transformative opportunities. The main challenges lie in the skills gap, income inequality, ethical risks, and a decline in critical thinking skills. Meanwhile, strategic opportunities arise through collaboration between humans and AI, which has been proven to increase productivity, create new jobs, and drive innovation. Success lies in changing perspectives towards mutually beneficial cooperation, where the concepts of augmented intelligence and socio-technical approaches are key to building an adaptive and equitable human resource ecosystem.

As a literature study, this research has limitations, namely its dependence on the scope and quality of available literature, as well as its inability to produce new empirical data. Therefore, future research is needed to empirically test these findings, either through quantitative or qualitative approaches, particularly in the context of human capital. A more in-depth exploration of the impact of AI on specific workforce groups and the development of inclusive AI governance models are also crucial research agendas.

Ultimately, the transition to a more human-centered AI era requires a shared commitment. Individuals need to have a mindset of continuous learning, organizations must invest in skills enhancement and the ethical use of AI, while governments need to create policies that support inclusive change. With these steps, AI can truly empower human capital while minimizing its challenges in a fair and effective manner.

Acknowledgment

We gratefully acknowledge the contributions of individuals who supported the completion of this article.

Funding Information

This research did not receive any funding.

Conflict of Interest Statement

The authors declare that there is no conflict of interest.

Ethical Approval and Originality Statement

Ethical approval was obtained for this study. The manuscript represents original work and has not been previously published, nor is it under consideration by another journal.

Data Disclosure Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

Acemoglu, D., & Restrepo, P. (2020). The wrong kind of AI? Artificial intelligence and the future of labour demand. *Cambridge Journal of Regions, Economy and Society*, *13*(1), 25–35. https://doi.org/10.1093/cjres/rsz022 .

Becker, G. S. (1975). *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. University of Chicago Press.

Benabou, A., & Touhami, F. (2025). Empowering human resource management through artificial intelligence: A systematic literature review and bibliometric analysis. *International Journal of Production Management and Engineering*, *13*(1), 59–76. https://doi.org/10.4995/ijpme.2025.21900.

Caputo, F. (2024). Human–artificial intellectual capital…beyond a fragmented perspective. *Journal of Intellectual Capital*, *25*(5–6), 1026–1041. https://doi.org/10.1108/JIC-06-2024-0195.

Carter, C. (2025). AI surveillance: Reclaiming privacy through informational control. *European Labour Law Journal*, *16*(2), 245–258. https://doi.org/10.1177/20319525241306327.

Cheng, C., Luo, J., Zhu, C., & Zhang, S. (2024). Artificial intelligence and the skill premium: A numerical analysis of theoretical models. *Technological Forecasting and Social Change*, *200*, 123140. https://doi.org/10.1016/j.techfore.2023.123140.

Chowdhury, S., Dey, P., Joel-Edgar, S., Bhattacharya, S., Rodriguez-Espindola, O., Abadie, A., & Truong, L. (2023). Unlocking the value of artificial intelligence in human resource management through AI capability framework. *Human Resource Management Review*, *33*(1), 100899. https://doi.org/10.1016/j.hrmr.2022.100899.

Fernandez, G., de Assis Dornelles, J., & Ayala, N. F. (2025). How Industry 4.0 Technologies Are Evolving to Industry 5.0—A Systematic Literature Review. *IFIP Advances in Information and Communication Technology*, *764 IFIPAICT*, 48–61. https://doi.org/10.1007/978-3-032-03515-8_4.

Gandía, J. A. G., Ancillo, A. D. L., & Del Val Núñez, M. T. (2025). Knowledge and artificial intelligence on employee behaviour advancing safe and respectful workplace. *Journal of Innovation & Knowledge*, *10*(4), 100750. https://doi.org/10.1016/j.jik.2025.100750.

Hourani, N. (2025). A Proposed Vision for Using Artificial Intelligence in Enhancing Strategic Value of Human Resources. *International Journal of Industrial Engineering and Production Research*, *36*(2), 39–51. https://doi.org/10.22068/ijiepr.36.2.2302.

Kadirov, A., Shakirova, Y., Ismoilova, G., & Makhmudova, N. (2024). AI in Human Resource Management: Reimagining Talent Acquisition, Development, and Retention. *Int. Conf. Knowl. Eng. Commun. Syst., ICKECS*. 2024 International Conference on Knowledge Engineering and Communication Systems, ICKECS 2024. https://doi.org/10.1109/ICKECS61492.2024.10617231.

Kaur, M., Kaur, J., & Kaur, R. K. (2023). Adapting to Technological Disruption: Challenges and Opportunities for Employment. *Proc. - IEEE Int. Conf. Comput., Commun., Intell. Syst., ICCCIS*, 347–352. https://doi.org/10.1109/ICCCIS60361.2023.10425266.

Mariani, M. M., Machado, I., Magrelli, V., & Dwivedi, Y. K. (2023). Artificial intelligence in innovation research: A systematic review, conceptual framework, and future research

directions. *Technovation*, *122*, 102623. https://doi.org/10.1016/j.technovation.2022.102623.

Rismani, S., & Moon, Aj. (2023). What does it mean to be a responsible AI practitioner: An ontology of roles and skills. *AIES - Proc. AAAI/ACM Conf. AI, Ethics, Soc.*, 584–595. https://doi.org/10.1145/3600211.3604702.

Salminen, K., Hautamaki, P., & Jahi, M. (2024). Aligning Industry Needs and Education: Unlocking the Potential of AI via Skills. *PICMET - Portland Int. Conf. Manag. Eng. Technol.: Technol. Manag. Artif. Intell. Era, Proc.* PICMET 2024 - 2024 Portland International Conference on Management of Engineering and Technology: Technology Management in the Artificial Intelligence Era, Proceedings. https://doi.org/10.23919/PICMET64035.2024.10653328.

Schultz, T. W. (1961). Investment in Human Capital. *The American Economic Review*, *51*(1), 1–17.

Shah, S. S., & Asad, M. M. (2024). Impact of Critical Thinking Approach on Learners' Dependence on Innovative Transformation Through Artificial Intelligence. In M. D. Lytras, A. Alkhaldi, S. Malik, A. C. Serban, & T. Aldosemani (Eds.), *The Evolution of Artificial Intelligence in Higher Education: Challenges, Risks, and Ethical Considerations* (p. 0). Emerald Publishing Limited. https://doi.org/10.1108/978-1-83549-486-820241010.

Singh, A., & Pandey, J. (2025). Artificial intelligence applications in human resource management: It is a mixed bag! *International Journal of Productivity and Performance Management*, 1–20. https://doi.org/10.1108/IJPPM-09-2024-0599.

Sony, M. M. A. A. M., Amin, M. B., Ashraf, A., Islam, K. M. A., Debnath, N. C., & Debnath, G. C. (2025). Bias in AI-driven HRM systems: Investigating discrimination risks embedded in AI recruitment tools and HR analytics. *Social Sciences & Humanities Open*, *12*, 102082. https://doi.org/10.1016/j.ssaho.2025.102082.

Soumpenioti, V., & Panagopoulos, A. (2023). AI Technology in the Field of Logistics. *Int. Workshop Semant. Soc. Media Adapt. Personal., SMAP*. 2023 18th International Workshop on Semantic and Social Media Adaptation and Personalization, SMAP 2023. https://doi.org/10.1109/SMAP59435.2023.10255203.

Sowa, K., Przegalinska, A., & Ciechanowski, L. (2021). Cobots in knowledge work: Human – AI collaboration in managerial professions. *Journal of Business Research*, *125*, 135–142. https://doi.org/10.1016/j.jbusres.2020.11.038.

Tenakwah, E. S., & Watson, C. (2024). Embracing the AI/automation age: Preparing your workforce for humans and machines working together. *Strategy & Leadership*, *53*(1), 32–48. https://doi.org/10.1108/SL-05-2024-0040.

The 2025 AI Index Report | Stanford HAI. (2025). https://hai.stanford.edu/ai-index/2025-ai-index-report

Tian, J., & Zhang, Y. (2025). Does artificial intelligence help in improving human capital based educational development? Evidence from 29 countries. *Technology in Society*, *83*, 103004. https://doi.org/10.1016/j.techsoc.2025.103004.

Watson, G. J., Desouza, K. C., Ribiere, V. M., & Lindič, J. (2021). Will AI ever sit at the C-suite table? The future of senior leadership. *Business Horizons*, *64*(4), 465–474. https://doi.org/10.1016/j.bushor.2021.02.011.

Wiethof, C., Roocks, T., & Bittner, E. A. C. (2022). Gamifying the Human-in-the-Loop: Toward Increased Motivation for Training AI in Customer Service. *Lect. Notes Comput. Sci.*, *13336 LNAI*, 100–117. https://doi.org/10.1007/978-3-031-05643-7_7.