

Research Article

Features and functional components in the use of artificial intelligence in human capital development (higher education as a model)

Abaker Abdelbanant Adam Ibrahim^{1,2,*}, 

¹ Former Vice chancellor of the University of the Holy Quran and Taseel of Sciences – Sudan.

² Vice President of the International Union of Universities – Sudan.

ARTICLE INFO

Article History

Received 1 Oct 2023

Revised: 20 Nov 2023

Accepted 20 Des 2023

Published 7 Jan 2024

Keywords

Intellectual Capital,

Human Resource
Management,

Artificial Intelligence
(AI),

Talent Management,

Higher Education
Development.



ABSTRACT

The study addressed the role of artificial intelligence applications in enhancing educational and learning strategies in higher education, by improving administrative functions; raising the efficiency of scientific and cognitive capabilities, and developing scientific research, in an improved educational environment, in addition to revealing the potential obstacles that accompany the process of using electronic machines. The study concluded that artificial intelligence has an effective role in enhancing and improving the performance of higher education institutions, which made the learning process more efficient, so there is an urgent need to raise awareness among stakeholders in education about the importance of using artificial intelligence applications in teaching and learning strategies, and not to make challenges an obstacle in employing human resources. The study relied on the descriptive analytical method to reveal the role of artificial intelligence and its applications in developing human capital in higher education institutions.

1. INTRODUCTION

The world is witnessing tremendous developments in information and communication technology, which has become the focus of attention for educators in higher education institutions[1]. AI is a simulation of human intelligence through the use of electronic machines and computers[2]. It involves many applications that are widely used by both educators and students[3]. Therefore, employing AI applications in higher education has become a fundamental objective in developing both intellectual and cultural human capital[4]. This study explores the concept of AI, its characteristics, and the reasons for interest in it, in addition to interacting with the positive impacts of AI on higher education institutions and addressing the challenges faced in improving productivity efficiency[5]. Despite the progress made by some higher education institutions in enhancing human capital efficiency, many countries face significant challenges in using AI[6]. This study aims to exploit the positive aspects of optimal machine intelligence use in developing the scientific and cognitive skills of higher education affiliates. The study seeks to promote and encourage educational institutions to effectively and safely use AI technology in higher education, ensuring the desired quality of higher education[7]. It aims to provide a platform for discussion and interaction among experts and specialists in AI and higher education, highlighting a range of challenges and contemporary transformations as AI fields witness massive and rapid advancements[8]. These advancements, particularly in health, administration, and education, can be leveraged to align with general strategies for human resource development in light of the digital age's demands and the community's needs for sustainable development[9][10]. The study aims to achieve the following objectives:

1. Increase awareness of the importance of AI technology and ensure the quality of higher education.
2. Identify challenges and problems hindering the use of AI technology in higher education and find possible solutions.
3. Enhance collaboration between higher education institutions in developing AI technology.
4. Highlight opportunities, challenges, and ethics encountered by AI technology users in improving higher education quality.

*Corresponding author email: abakerabdelbanat@gmail.com

DOI: <https://doi.org/10.70470/ESTIDAMAA/2024/001>

5. Encourage scientific research, foster technological development, and promote innovation in AI by developing human capital and improving productivity efficiency.

2. RELATED WORK

The term "Artificial Intelligence" refers to a collection of systems or devices that mimic human intelligence to perform specific tasks, which in turn help improve themselves based on the information they gather. AI emerged during the 20th century, and it has been defined by many scholars in various ways. Some define it as the science of computer engineering that uses specific algorithms[11]. The first person to coin the term "artificial intelligence" was the American scientist John McCarthy in 1956. He defined it as the science of engineering intelligent machines, specifically computer programs, that simulate the way the human brain works, deciding, and acting like humans[12]. The Italian philosopher Niccolò Machiavelli mentions that there are three types of artificial intelligence: the first understands things on its own, which he considers excellent; the second appreciates what others know, which he classifies as good; and the third fails to understand things on its own, which he deems useless. Some scientists believe that AI surpasses human intelligence in some areas, as it can solve complex problems in a short time that might take humans years to resolve[13]. Based on this, artificial intelligence is essentially a system that simulates human thinking in its actions and sometimes even surpasses it. However, not all software that operates based on a specific algorithm and performs predefined tasks can be considered AI. Artificial intelligence is attributed to computer systems that can learn, gather, analyze data, and make decisions based on this analysis, mimicking human thinking. Thus, modern developments in AI herald a new era for many other technologies. For example, AI can improve cloud technology, just as cloud technology contributes to AI development. The combination of the two can change how data is stored and processed. AI also plays a role in biotechnology, where machine learning offers a significant opportunity to make drug discovery cheaper and faster[14]. AI can provide solutions to some of the most pressing issues facing modern society, from clean energy to cancer and diseases. AI manifests in various forms, such as:

- AI robots are used to understand scientific problems more quickly, providing more efficient answers.
- AI analysts use it to process significant amounts of textual data to improve the quality of educational services.
- Recommendation engines can offer personalized program suggestions based on user preferences.
- AI's strength lies in its ability to think at a superior level, analyzing data rather than being tied to a specific form or function.

Although AI may present images of high-quality human-like robots, its goal is not to replace humans entirely but to enhance human capacities and contributions more efficiently. Given these insights, AI has become a broad term encompassing application that performs complex tasks that previously required human intervention, such as online customer interaction. Often, this term is used interchangeably with its subfields, which include open electronic education[15]. To derive full value from AI, many interdisciplinary higher education institutions are investing in data or information using scientific and research methods to extract scientific value from the data collected[16]. AI is frequently used to perform various tasks carried out by users. Hence, it is crucial to be fully proficient in computing, statistics, and data analysis to develop applications that help achieve the user's goals. The fundamental principle for anyone wishing to use AI is the ability to interact with electronic computing tools and handle various properties to collect information and reach results in a way that mimics creative and innovative thinking in making strategic decisions[17]. Thus, the goal of AI systems is to develop systems capable of solving complex problems in ways like logical reasoning and inference in humans. Some scientists believe that the initial concept of AI emerged in the 1940s, reaching its current state due to the convergence of the following factors:

1. The availability of large amounts of data and their sources, allowing the flow of information faster than humans can process.
2. Cloud computing technology has helped reduce production costs and increase productivity by speeding up the handling of large amounts of data through AI-enhanced systems with parallel processing.
3. The rise of social media platforms has fostered open-source communities, providing many advantages, which have helped boost cognitive knowledge.
4. The abundance of open-source programs and data has driven many to adopt AI.

These factors demonstrate that AI can add significant value to work by:

1. Providing a more comprehensive understanding of data handling.
2. Relying on predictions to uncover cognitive complexities.
3. Enhancing institutional performance through AI technology.
4. Understanding data on a scale unattainable by humans.
5. Using language and terminology recognition to analyze, interpret, and evaluate texts.

AI is a type of development that encompasses a set of technologies, including machine learning. AI has the potential to bring about an informational revolution that helps improve the management and employment of human capital, while also enhancing cooperation and communication among users[18]. One of AI's main advantages in higher education is its ability to adapt to individual and group learning styles, using platforms that help build creative and innovative capacities. AI enables users to perform their administrative and educational tasks through multi-purpose servers. AI technology employs big data for analysis and forecasting, handling human tasks across various intelligent applications in different fields. This has played

a significant role in digital transformation[19]. It is a combination of physical, digital, and biological sciences that seeks more efficient and faster ways to accomplish required tasks. AI and machine learning are becoming essential parts of our daily lives. For instance, scientists in the healthcare sector predict that AI can detect heart attacks before they occur and even perform complex surgeries. Additionally, AI can distinguish between life-saving and ineffective drugs. In the automotive industry, scientists foresee smart, driverless cars that will map out their 3D environment and drive themselves. There are many other fields where AI is entering, such as scientific search engines, voice command applications, weather forecasting, ATMs, and graphic design applications. Therefore, AI technology in higher education is one of the greatest developments in the field. Experts and scientists have placed their hopes on AI to access information as quickly as possible by using applications and algorithms to verify the information's accuracy[20]. Moreover, this process has significantly advanced human development. AI has many advantages, including:

- Lack of emotions: AI systems are entirely emotionless, unlike humans, whose emotions and moods can negatively impact their performance and decision-making. These systems operate with logical thinking, making decisions objectively and quickly.
- Continuous operation: Electronic machines can work non-stop, with high productivity regardless of environmental or geographical conditions, unlike humans, who are significantly affected by them.
- Easing daily life: AI has provided several essential applications that have made our lives easier in various scientific, experimental, economic, and other fields. The smartphone is the best example of this.
- Repetitive tasks: AI systems are used in repetitive tasks.
- Health care: AI systems have made significant contributions to human healthcare through simulation devices that help detect neurological disorders and radiation surgery applications that assist in removing tumors without harming surrounding healthy tissue.
- Data processing: AI systems can process, analyze, and store massive amounts of data with high accuracy.
- Reducing errors: AI provides high precision, reducing the margin of error during task execution.
- Speed in offering guidance: Some AI applications provide advice and consultation to their users quickly.

There are three key factors that confirm the importance of AI in our daily lives:

- AI's superior ability to compute and analyze texts, data, and information.
- AI's rapid response to scientific predictions thanks to advanced automated tools that classify data, enabling institutions to easily collect, store, and process data. Some institutions can even create AI algorithms to use in training and qualification with greater accuracy, thereby reducing reliance on human labor in many cases.
- AI provides high-tech applications that help make decisions better and faster.

The Impact of Artificial Intelligence on Human Development:

The concept of development is one of the most important contemporary global concepts in human life. It emerged primarily after World War II, referring to the process of bringing about fundamental changes in human societies. Development signifies the advancement of society and the transition from a static state to a higher and better position, utilizing latent potentials. The United Nations defines development as "a set of processes by which the efforts of both local communities and governments are directed to improve the economic, social, and cultural conditions of communities to help them integrate into the life of nations and contribute to their progress as much as possible[21]."

As for human development, it is defined as "the continuous growth of humans beyond other creatures according to natural laws and cosmic principles, quantitatively and qualitatively, leading to elevation toward building human civilizations." Human happiness can only be guaranteed through a firm belief and psychological conviction subject to mental growth and development. Thus, development should create a conducive environment for work and practice, both individually and collectively, aiming to develop complete cognitive capabilities and provide opportunities for leading a productive life that meets their needs and interests. Consequently, human development focuses on developing human capacities through training, education, and improving health or cognitive skills[22].

Human development is defined as "the development of individuals, or the utilization of strengths to improve social and economic life in terms of motivating people and providing qualitative and quantitative educational services, or investing available resources such as time, money, effort, and relationships by applying the theory of social development." In summary, human development is the process of expanding human capabilities so that they can lead healthy lives in terms of knowledge and acquire the necessary resources to maintain an adequate standard of living.

The term refers to the unique characteristics of human thought, which are often used in knowledge creation as a practical guide for developing mental skills and capacities. This contrasts with physical work, which depends on productivity factors related to cognitive abilities, such as speed of comprehension, execution, and quality. Efficiency can be defined as:

- The ability to expand knowledge generation through the quality of experience, increasing efficiency with training and education. This understanding leads to the investment of private human capital. Here, the economics of low productivity are replaced by the economics of self-development.
- Knowledge sharing and exchange among individuals and groups working within an organization, provided that this transfer does not prevent its use except in accordance with established regulations and rules.

The terms "knowledge" and "efficiency" are often used more broadly, including the ability to develop further cognitive capacities such as motor skills, technical abilities, and comprehension. Skill development depends on the ability to apply practically in a specific field. Some economists view "efficiency" or "capacity" as interchangeable terms that change according to environmental conditions. For example, knowledge equals intellectual capital, and emotion equals emotional capital, and both equate to reputation and non-material value. Human capital is of great importance, particularly in countries striving for progress and growth and aiming to eliminate surplus labor. These countries generally have higher birth rates due to prevailing climatic conditions, making surplus labor one of the most abundant human resources. This raw human resource can be transformed into human capital through effective inputs such as education, health, and the building of ethical values. Therefore, these countries seek to convert raw human resources into highly productive human capital through these inputs, a process akin to knowledge creation, to move away from ignorance. In light of this, the problem of material capital scarcity can be resolved by accelerating the growth rate of human capital with private and public investments across all national sectors[23].

In this context, material capital is an effective tool for promoting economic growth in every country. On the other hand, human capital is a tool for promoting comprehensive national development. Human capital is directly linked to human development. Thus, when human development is present, qualitative and quantitative national progress becomes a necessary endeavor, particularly in light of international changes. This importance becomes evident in all economic, social, intellectual, and cultural programs. For comparison and evaluation, economic development plays an active role in the progress of society. Accordingly, the United Nations publishes annual reports on human development in various countries, confirming that human or intellectual capital is a factor in the progress and growth of nations. It is also a blend of scientific progress, which in turn helps increase national income. For example, life expectancy reflects the health level of a country's population, the education index reveals the level of education and literacy rates among the population, and the income index indicates the population's living standards. If all these indicators show a positive upward trend over a long period, they result in an upward trend in the human development index. Therefore, human capital is developed through all levels of spiritual and material life. As a result, the components of the human development index—life expectancy, education, and income—are directly related to human capital formation. Thus, the human development index is a positive correlation indicator between human capital formation and economic development. As the human development index rises, human capital also increases, responding to improved education, health, and other factors. Conversely, if the human development index declines, individual income also decreases. This is evident in developing societies where human capital has failed to be properly directed in many higher education institutions. Thus, the human development index reveals that improving human capital efficiency increases knowledge creation and, consequently, individual income in society. Therefore, human development is the solid foundation for a sustained process of building society over a long period[23].

3. GROWTH OF HUMAN CAPITAL

Human capital differs significantly from material capital due to its unique cumulative growth characteristic. Unlike material capital, human capital grows steadily over long periods, as its foundation is built on leveraging economic, social, educational, and health wealth inputs[24]. With the qualitative development of current and future generations, human capital growth will accelerate. Educational and health input create more productive effects on the next generation, enabling the next generation to surpass the current one. In other words, the productivity of the next generation will exceed that of the current one[25]. Thus, the growth rate of human capital in the next generation occurs more rapidly than in the current one. This is the cumulative growth of human capital, resulting from the high quality of the workforce in the next generation compared to the previous one. Human development relies on human capital, and the institution's goals can only be achieved through the interaction of human capital with the institution's vision and mission by engaging in the following main activities[26]:

1. Knowledge creation in activities requiring cognitive growth.
2. Collaboration in activities involving more than one employee.
3. Operations: organizing knowledge-based activities and collaboration between the organizational structures of the institution.

The post-industrial revolution era witnessed the rise of the importance and power of material capital, which dominated the concept of capital from the industrial revolution until approximately the mid-21st century. However, with the advent of the information technology revolution and the growing importance of modern technology as a technical unit of wealth, knowledge gained prominence as a human unit for building creative capacities, experiences, skills, and individuals' abilities to generate knowledge wealth. This shift led to a new concept known as "intellectual capital"[27]. In light of the developments in modern technological concepts and advancements in knowledge and technology, new functional components have emerged that focus on the investment in intellectual capital[28]. This shift involves the evolution of traditional normative values into new methods for managing thought through the development of skills and cognitive abilities. It also emphasizes the individual's and society's affiliation with their intellectual and moral systems, as well as the values that organize relationships among community members. Intellectual capital is one of the key elements in knowledge management within organizations, academic institutions, or corporations. It includes identification, measurement,

evaluation, maintenance, and development of resources within an organization. Thus, intellectual capital has become an important variable, significantly influencing the success or failure of an institution, especially knowledge-based ones, as it directly impacts the organization's value and competitiveness in the labor market[29]. This growing importance has led stakeholders to pay increased attention to intellectual capital. The components of intellectual capital include human capital, which refers to the organization's human resources, including the knowledge that can be transformed into behavioral value. Structural capital involves the development of the institution's infrastructure. Business assets represent the organization's structural capital used to create value through its operational processes[30]. Intellectual assets, which encompass the intellectual property of an organization, provide legal protection through intellectual security or intellectual property rights. Significant efforts are being made to develop metrics and indicators to evaluate intellectual capital within institutions. Despite progress in this area, there remains disagreement among experts about these metrics, highlighting the need for further development and improvement, especially using artificial intelligence. In addition to intellectual capital, several functional components play a role in human capital investment. These include human resource management, which plays a vital role in technological and knowledge advancement globally, particularly in developed nations[31]. Key elements include employee lifecycle management, strategic planning, efficient service delivery, employee engagement, and fraud detection, all crucial for effective human capital management. Talent management is another essential area in institutions, focusing on acquiring, developing, and retaining talent through innovative methods. This includes talent acquisition, performance evaluation, career development, and succession planning to prepare for future leadership roles. Learning and development are also critical to ensure that both new and experienced employees maintain their skills through AI-based learning systems. Workforce management aims to reduce manual operations and improve efficiency using AI technologies[32]. Additionally, rewarding employees plays a key role in retaining talent and promoting ethical values. Strategic training, development, and recognition programs ensure data accuracy and help address current and future challenges in higher education, especially in a constantly changing global environment. However, several threats to human capital investment exist. These include poor planning, unbalanced development, limited employment opportunities, absenteeism, and poor time management, all of which hinder productivity. There is also a lack of clear knowledge programs, insufficient research, and a shortage of competencies that negatively impact human capital investment[33].

4. CONCLUSION

Despite the advantages of artificial intelligence, it has notable disadvantages. AI lacks creativity, as it operates within predefined frameworks and cannot think outside the box. Over-reliance on AI can also lead to users neglecting their critical thinking skills, and AI struggles to understand and implement ethical values, making it challenging to integrate ethical considerations into AI systems. AI also faces several challenges in higher education, including a decline in trust, difficulties in analyzing human emotions and behaviors, language challenges, and cybersecurity risks. AI's inability to grasp ethical values and biases further complicates its use in this field. In conclusion, AI holds the potential to revolutionize intellectual and cultural processes in higher education institutions, making operations more efficient and specialized. However, educators must recognize AI's challenges, including potential biases and over-reliance on technology. By utilizing AI responsibly and ethically, higher education institutions can promote behavioral values and foster an environment conducive to intellectual and cultural skill-building. To maximize AI's benefits, higher education institutions must adopt new approaches to AI applications, and governments should contribute to AI system development. Focus should be placed on training, aligning institutional needs with labor market demands, and creating legal frameworks to regulate AI's role in these processes.

Funding:

No external financial support or institutional grants were provided to the authors for this study. All research activities were carried out independently.

Conflicts of Interest:

The authors declare that there are no conflicts of interest.

Acknowledgment:

The authors would like to express their deepest gratitude to their institutions for their indispensable encouragement and professional guidance.

References

- [1] S. J. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed. Hoboken, NJ: Pearson, 2021.
- [2] N. J. Nilsson, *The Quest for Artificial Intelligence: A History of Ideas and Achievements*. Cambridge: Cambridge University Press, 2010.
- [3] M. Haenlein and A. Kaplan, "A brief history of artificial intelligence: On the past, present, and future of artificial intelligence," *California Management Review*, vol. 61, no. 4, pp. 5-14, Aug. 2019, doi: 10.1177/0008125619864925.
- [4] N. Bostrom, *Superintelligence: Paths, Dangers, Strategies*. Oxford: Oxford University Press, 2014.

- [5] D. S. W. Ting et al., "Development and validation of a deep learning system for diabetic retinopathy and related eye diseases using retinal images from multiethnic populations with diabetes," *JAMA*, vol. 318, no. 22, pp. 2211-2223, Dec. 2017, doi: 10.1001/jama.2017.18152.
- [6] I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*. Cambridge, MA: MIT Press, 2016.
- [7] A. M. Turing, "Computing machinery and intelligence," *Mind*, vol. 59, no. 236, pp. 433-460, Oct. 1950, doi: 10.1093/mind/LIX.236.433.
- [8] Y. LeCun, Y. Bengio, and G. Hinton, "Deep learning," *Nature*, vol. 521, no. 7553, pp. 436-444, May 2015, doi: 10.1038/nature14539.
- [9] M. Taddeo and L. Floridi, "How AI can be a force for good," *Science*, vol. 361, no. 6404, pp. 751-752, Aug. 2018, doi: 10.1126/science.aat5991.
- [10] P. Drucker, *Post-Capitalist Society*. New York: HarperCollins, 1993.
- [11] United Nations Development Programme, *Human Development Report 2019: Beyond Income, Beyond Averages, Beyond Today: Inequalities in Human Development in the 21st Century*. New York: UNDP, 2019.
- [12] A. Sen, *Development as Freedom*. New York: Anchor Books, 1999.
- [13] M. ul Haq, *Reflections on Human Development*. New York: Oxford University Press, 1995.
- [14] M. S. Mincer, *Schooling, Experience, and Earnings*. New York: National Bureau of Economic Research, Columbia University Press, 1974.
- [15] M. Simkovic, "Risk-based student loans," *Washington and Lee Law Review*, vol. 70, no. 1, pp. 527-648, 2013.
- [16] United Nations Development Programme, *Human Development Report 2019*. New York: UNDP, 2019, p. 46.
- [17] M. ul Haq, "The human development concept," in *Human Development and the International Development Strategy for the 1990s*, K. Griffin and J. Knight, Eds. London: Macmillan, 1990, pp. 1-9.
- [18] M. Spence, "Signaling in retrospect and the informational structure of markets," *American Economic Review*, vol. 92, no. 3, pp. 434-459, Jun. 2002, doi: 10.1257/00028280260136200.
- [19] A. Haq, "Sustainable human development," in *Encyclopedia of Human Development*, N. J. Salkind, Ed. Thousand Oaks, CA: SAGE, 2006, vol. 3, pp. 1221-1224.
- [20] M. Nussbaum, *Creating Capabilities: The Human Development Approach*. Cambridge, MA: Belknap Press, 2011.
- [21] T. Schultz, "Investment in human capital," *American Economic Review*, vol. 51, no. 1, pp. 1-17, Mar. 1961.
- [22] G. S. Becker, *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*, 3rd ed. Chicago: University of Chicago Press, 1994.
- [23] K.-E. Sveiby, *The New Organizational Wealth: Managing and Measuring Knowledge-Based Assets*. San Francisco: Berrett-Koehler, 1997.
- [24] A. Sen, "Human development and financial conservatism," *World Development*, vol. 26, no. 4, pp. 733-742, 1998, doi: 10.1016/S0305-750X(97)10058-0.
- [25] T. A. Stewart, *The Wealth of Knowledge: Intellectual Capital and the Twenty-First Century Organization*. New York: Doubleday, 2001.
- [26] L. Edvinsson and M. S. Malone, *Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower*. New York: HarperBusiness, 1997.
- [27] P. Sparrow, C. Brewster, and H. Harris, *Globalizing Human Resource Management*. London: Routledge, 2004.
- [28] J. Mincer, "Investment in human capital and personal income distribution," *Journal of Political Economy*, vol. 66, no. 4, pp. 281-302, Aug. 1958, doi: 10.1086/258055.
- [29] J. Liebowitz and L. C. Wilcox, Eds., *Knowledge Management and Its Integrative Elements*. Boca Raton, FL: CRC Press, 1997.
- [30] T. A. Stewart, *Intellectual Capital: The New Wealth of Organizations*. New York: Doubleday, 1997.
- [31] E. A. Hanushek and L. Woessmann, "The role of education quality for economic growth," *World Bank Policy Research Working Paper 4122*, Feb. 2007.
- [32] G. Psacharopoulos and H. A. Patrinos, "Returns to investment in education: A further update," *Education Economics*, vol. 12, no. 2, pp. 111-134, 2004, doi: 10.1080/0964529042000239140.
- [33] A. Harbison and C. A. Myers, *Education, Manpower, and Economic Growth: Strategies of Human Resource Development*. New York: McGraw-Hill, 1964.