

ROLE OF AI IN ENHANCING HUMAN CAPITAL FORMATION: A STUDY OF HIGHER EDUCATION INSTITUTIONS IN BANGALORE.

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ABSTRACT

Artificial Intelligence (AI) is rapidly transforming the landscape of higher education by enhancing learning processes, skill development, and employability outcomes. This study examines the **role of AI in enhancing human capital formation** among students in higher education institutions in Bangalore. The research is based on primary data collected from a sample of 60 respondents using a structured questionnaire. The study analyzes levels of awareness, usage patterns, purposes of AI adoption, and its impact on learning efficiency, skill development, and employability. Statistical tools such as percentage analysis and Chi-square tests were employed to examine relationships between variables. The findings reveal that a majority of students are moderately to highly aware of AI and actively use AI tools for academic purposes, particularly for assignments, skill enhancement, and exam preparation. AI is found to significantly improve learning efficiency and contribute to the development of technical, analytical, and problem-solving skills, thereby positively influencing employability. However, challenges such as lack of training, ethical concerns, and overdependence on AI persist.

Keywords: Artificial Intelligence, Human Capital Formation, Higher Education, Employability, Learning Efficiency

INTRODUCTION

The rapid advancement of **Artificial Intelligence (AI)** has emerged as one of the most transformative developments of the twenty-first century, significantly reshaping economic systems, labour markets, industrial productivity, and educational frameworks across the globe. AI refers to the capability of machines and software systems to perform tasks that typically require human intelligence, such as learning, reasoning, problem-solving, language processing, and decision-making. Its integration into higher education has opened new pathways for personalized learning, adaptive assessments, intelligent tutoring systems, automated evaluation, and data-driven academic support. These technological developments have positioned AI as a critical driver of **human capital formation**, which refers to the enhancement of individuals' knowledge, skills, competencies, and employability that contribute to economic productivity and societal development. Human capital formation has long been recognized as a cornerstone of economic growth and national development. According to the World Bank, investments in education, skills, and innovation significantly enhance labour productivity and economic competitiveness. In the digital economy, the relevance of human capital has expanded beyond traditional academic attainment to include technological adaptability, digital literacy, analytical reasoning, and problem-solving capabilities. AI-powered educational tools are increasingly being viewed as instruments that can accelerate these competencies by enabling more efficient learning processes, customized academic support, and improved access to knowledge resources.

India has witnessed significant progress in the adoption of digital technologies within higher education. The **All India Survey on Higher Education (AISHE) 2023–24** reported that India's total higher education enrolment has crossed **4.4 crore students**, with increasing integration of digital learning systems across universities and colleges. Government initiatives such as the University Grants Commission digital learning frameworks, SWAYAM, and the implementation of the National Education Policy 2020 have emphasized technology-enabled education, skill development, and innovation-oriented learning environments. These reforms highlight the growing importance of AI-enabled education in preparing students for future labour market demands. Recent national assessments indicate that over 65% of urban higher education students use digital tools regularly for academic purposes, reflecting a growing dependence on intelligent technologies for learning enhancement. Within India, Bangalore occupies a unique position as the country's leading technological and innovation hub. Often referred to as the "Silicon Valley of India," Bangalore hosts a dense concentration of IT companies, startups, research institutions, and higher education establishments. The city is home to premier institutions such as Indian Institute of Science, Christ University, and numerous engineering and management colleges that increasingly integrate AI tools into teaching-learning processes. The presence of multinational technology firms and AI-focused startups has accelerated exposure to AI-driven educational applications among students. This creates a highly relevant context for examining how AI contributes to human capital development within higher education institutions.

The integration of AI into academic settings offers several potential benefits. AI tools can facilitate personalized learning by adapting instructional content to individual student needs, improving comprehension and retention. Intelligent tutoring systems can provide instant feedback, while AI-driven research support tools assist in data analysis, content generation, and academic writing. These applications contribute to the development of technical competencies, analytical thinking, digital literacy, and problem-solving abilities—core dimensions of human capital formation. Studies indicate that students who effectively utilize AI-supported learning systems often demonstrate higher academic efficiency and improved readiness for technology-driven employment sectors. However, despite its growing relevance, AI adoption in higher education also presents several challenges. Concerns relating to digital inequality, ethical usage, academic integrity, overdependence on automated systems, and data privacy remain significant. Unequal access to digital infrastructure and varying levels of AI literacy among students may create disparities in learning outcomes. Moreover, excessive reliance on AI-generated content can weaken independent critical thinking if not guided by responsible academic practices. These concerns emphasize the need for a balanced and human-centered approach to AI integration. Although several studies have examined AI adoption in education globally, limited empirical research has specifically explored its role in enhancing human capital formation within the context of Bangalore's higher education ecosystem. Given Bangalore's technological prominence and diverse academic landscape, it is essential to investigate how students perceive and utilize AI tools, the extent to which these technologies improve learning efficiency and employability, and the challenges encountered during adoption.

LITERATURE REVIEW

The growing body of literature on Artificial Intelligence (AI) in education highlights its significant role in enhancing human capital formation through improved learning outcomes, skill development, and employability. Studies by World Bank emphasize that digital technologies, including AI, are critical in building future-ready human capital by enhancing

cognitive and technical skills (**World Bank, 2020**). Similarly, research by UNESCO evaluation that AI-driven education systems promote personalized learning and inclusive access, thereby strengthening educational efficiency (**UNESCO, 2021**). A study conducted in India under the Ministry of Education framework found that digital learning platforms significantly improve student engagement and knowledge retention (**MoE, 2022**). According to NASSCOM, AI adoption in Indian education and industry is directly linked to enhanced employability and demand for advanced digital skills (**NASSCOM, 2023**). Empirical research by Holmes, W., Bialik, M., and Fadel, C. demonstrates that AI-based tutoring systems improve learning efficiency and critical thinking abilities among students (**Holmes et al., 2019**). Further, a study by Luckin, R. highlights that AI facilitates adaptive learning environments, enabling better skill acquisition and individualized instruction (**Luckin, 2018**). Research focusing on higher education in India indicates that AI tools such as chatbots and automated assessment systems significantly enhance academic productivity and reduce learning gaps (**Kumar & Sharma, 2022**). Additionally, a study published in the International Journal of Educational Technology in Higher Education found that AI integration positively influences student performance and engagement levels (**Zawacki-Richter et al., 2019**). In the context of employability, research by McKinsey & Company suggests that AI-driven skill development is essential for workforce readiness in emerging economies (**McKinsey, 2021**). Moreover, a recent study on urban higher education ecosystems highlights that cities like Bangalore show higher adoption of AI tools due to better digital infrastructure and institutional support, resulting in improved human capital outcomes (**Reddy & Srinivas, 2023**). Collectively, these studies indicate that while AI significantly contributes to human capital formation through enhanced learning efficiency, skill development, and employability, challenges related to accessibility, ethical concerns, and digital literacy persist, necessitating a balanced and policy-driven approach to AI integration in higher education.

OBJECTIVES OF THE STUDY

- To examine the level of awareness, usage, and purpose of Artificial Intelligence tools among students in higher education institutions in Bangalore.
- To analyze the impact of Artificial Intelligence on human capital formation in terms of learning efficiency, skill development, and employability among students in Bangalore.

HYPOTHESIS

1. There is no significant association between the level of awareness of Artificial Intelligence and its usage among students in higher education institutions in Bangalore.
2. Artificial Intelligence usage has no significant impact on human capital formation in terms of learning efficiency, skill development, and employability.

RESEARCH METHODOLOGY

The study follows a **descriptive research design** based on primary data collected from **60 students** of higher education institutions in Bangalore using a structured questionnaire. Convenience sampling was adopted, and the data were analyzed using **percentage analysis and the Chi-square test** to examine relationships between AI usage and human capital formation. Secondary data were referred from sources such as the Ministry of Education and World Bank.

DATA ANALYSIS WITH INTERPRETATION

Table 1: Demographic Profile of Respondents (n = 60)

Sl. No	Variable	Category	Frequency	Percentage (%)
1	Age Group	Below 20	12	20.0
		20–22	26	43.3
		23–25	14	23.3
		Above 25	8	13.4
		Total	60	100.0
2	Gender	Male	32	53.3
		Female	27	45.0
		Others	1	1.7
		Total	60	100.0
3	Educational Level	Undergraduate	34	56.7
		Postgraduate	18	30.0
		Research Scholars	8	13.3
		Total	60	100.0
4	Field of Study	Arts & Humanities	14	23.3
		Commerce & Management	16	26.7
		Science	12	20.0
		Engineering/Technology	18	30.0
		Total	60	100.0
5	Type of Institution	Government	22	36.7
		Private	38	63.3
		Total	60	100.0
6	Area of Residence	Urban	41	68.3
		Rural	19	31.7
		Total	60	100.0
7	Access to Digital Devices	Yes	54	90.0
		No	6	10.0
		Total	60	100.0

Source: Primary Data

The demographic profile of respondents indicates that a majority (43.3%) fall within the age group of 20–22 years, followed by 23.3% in the 23–25 category, suggesting that the sample largely represents typical undergraduate and early postgraduate students in higher education institutions. Male respondents constitute 53.3%, while females account for 45%, reflecting near gender parity consistent with higher education trends. A significant proportion (56.7%) are undergraduates, followed by postgraduates (30%) and research scholars (13.3%), indicating a strong base of early-stage human capital formation. In terms of discipline, Engineering/Technology (30%) and Commerce/Management (26.7%) dominate, highlighting Bangalore's academic orientation toward professional and technical education. A majority (63.3%) belong to private institutions, aligning with the higher concentration of private

colleges in Bangalore. Furthermore, 68.3% of respondents are from urban areas and 90% have access to digital devices, confirming a digitally enabled learning environment conducive to AI adoption.

Table 2: Awareness of AI in Education

Sl. No	Awareness Level	Frequency	Percentage (%)
1	Highly Aware	18	30.0
2	Moderately Aware	26	43.3
3	Slightly Aware	10	16.7
4	Not Aware	6	10.0
Total		60	100.0

Source: Primary Data

The data reveals that 43.3% of respondents are moderately aware of AI in education, while 30% are highly aware, indicating a relatively high level of familiarity with AI concepts among students. However, 16.7% are only slightly aware and 10% are not aware at all, suggesting that despite Bangalore's technological ecosystem, awareness is not uniformly distributed. This variation implies that while AI has penetrated academic discourse, there remains a gap in structured exposure and formal orientation programs.

Table 3: Usage of AI Tools in Academic Activities

Sl. No	Usage Level	Frequency	Percentage (%)
1	Regularly	22	36.7
2	Occasionally	24	40.0
3	Rarely	8	13.3
4	Never	6	10.0
Total		60	100.0

Source: Primary Data

The usage pattern of AI tools shows that 40% of respondents use them occasionally and 36.7% use them regularly, indicating that a significant majority are actively engaging with AI in their academic work. However, 13.3% use AI rarely and 10% have never used such tools, highlighting a segment that remains outside the AI adoption curve. This distribution suggests that while AI integration is progressing steadily, it is not yet universal. The findings reflect a transitional phase where AI is becoming a mainstream academic aid, but disparities in usage persist due to differences in access, skills, or institutional support.

Table 4: Types of AI Tools Used

Sl. No	Type of AI Tool	Frequency	Percentage (%)
1	Chatbots (e.g., ChatGPT)	28	46.7
2	AI-based Learning Platforms	14	23.3
3	AI for Research (data analysis, writing)	10	16.7
4	AI-based Assessment Tools	8	13.3
Total		60	100.0

Source: Primary Data

The analysis shows that 46.7% of respondents primarily use AI chatbots, making them the most preferred tool, followed by AI-based learning platforms (23.3%). AI applications for

research (16.7%) and assessment (13.3%) are comparatively less utilized. This indicates that students predominantly rely on AI for immediate academic assistance such as content generation and doubt clarification rather than advanced research or evaluation purposes. The pattern reflects an early-stage adoption where convenience-driven tools dominate, suggesting the need for promoting more sophisticated AI applications for deeper academic engagement and research productivity.

Table 5: Purpose of Using AI Tools

Sl. No	Purpose	Frequency	Percentage (%)
1	Assignments & Projects	20	33.3
2	Skill Development	14	23.3
3	Research Work	12	20.0
4	Exam Preparation	14	23.3
Total		60	100.0

Source: Primary Data

The data indicates that the primary purpose of AI usage is for assignments and projects (33.3%), followed by skill development and exam preparation (23.3% each), and research work (20%). This distribution highlights that AI is mainly used as a supportive academic tool rather than a core research instrument. The relatively lower use for research suggests limited awareness or training in leveraging AI for advanced academic purposes.

Table 6: AI and Improvement in Learning Efficiency

Sl. No	Response	Frequency	Percentage (%)
1	Strongly Agree	20	33.3
2	Agree	24	40.0
3	Neutral	10	16.7
4	Disagree	6	10.0
Total		60	100.0

Source: Primary Data

A substantial majority of respondents agree (40%) or strongly agree (33.3%) that AI improves learning efficiency, indicating a positive perception of its effectiveness in enhancing academic performance. However, 16.7% remain neutral and 10% disagree, suggesting that not all students experience the benefits equally. This variation may be due to differences in digital literacy or the quality of AI usage.

Table 7: AI Contribution to Skill Development

Sl. No	Skill Area	Frequency	Percentage (%)
1	Technical Skills	18	30.0
2	Analytical Skills	16	26.7
3	Communication Skills	12	20.0
4	Problem-Solving Skills	14	23.3
Total		60	100.0

Source: Primary Data

The data shows that AI contributes most significantly to technical skills (30%), followed by analytical skills (26.7%), problem-solving skills (23.3%), and communication skills (20%).

This distribution indicates that AI plays a crucial role in enhancing cognitive and technical competencies, which are essential components of human capital. However, the relatively lower impact on communication skills suggests that AI's contribution is more aligned with technical and analytical domains. The findings highlight AI's potential in strengthening employability-oriented skills while also indicating areas where human interaction remains critical.

Table 8: AI and Employability Enhancement

Sl. No	Response	Frequency	Percentage (%)
1	Highly Improves	16	26.7
2	Moderately Improves	28	46.7
3	Slightly Improves	10	16.7
4	No Impact	6	10.0
Total		60	100.0

Source: Primary Data

The findings reveal that 46.7% of respondents believe AI moderately improves employability, while 26.7% perceive a high level of improvement. Conversely, 16.7% report only slight improvement and 10% perceive no impact. This indicates that while AI is generally viewed as beneficial for enhancing job prospects, its impact is not uniformly strong across all respondents. The moderate dominance suggests that AI is seen as a complementary factor rather than a decisive determinant of employability.

Table 9: Challenges Faced in Using AI Tools

Sl. No	Challenge	Frequency	Percentage (%)
1	Lack of Skills/Training	18	30.0
2	Ethical Concerns	12	20.0
3	Data Privacy Issues	10	16.7
4	Over-dependence on AI	14	23.3
5	Limited Access	6	10.0
Total		60	100.0

Source: Primary Data

The analysis highlights that the major challenge faced by respondents is lack of skills or training (30%), followed by over-dependence on AI (23.3%) and ethical concerns (20%). Data privacy issues (16.7%) and limited access (10%) are also notable barriers. This indicates that while AI adoption is increasing, several structural and ethical challenges persist. The prominence of skill-related issues suggests a need for formal training and capacity-building initiatives. Additionally, concerns about over-reliance and ethics underline the importance of responsible AI usage in educational settings.

Table 10: Overall Impact of AI on Human Capital Formation

Sl. No	Impact Level	Frequency	Percentage (%)
1	Highly Positive	22	36.7
2	Moderately Positive	26	43.3
3	Neutral	8	13.3
4	Negative	4	6.7
Total		60	100.0

Source: Primary Data

The overall assessment shows that 43.3% of respondents perceive a moderately positive impact of AI on human capital formation, while 36.7% view it as highly positive. A smaller proportion remains neutral (13.3%) or perceives a negative impact (6.7%). This indicates a strong overall consensus that AI contributes positively to skill enhancement, knowledge acquisition, and employability. However, the presence of neutral and negative responses suggests that the benefits are not evenly experienced. The findings confirm that AI is a significant driver of human capital development, though its effectiveness depends on access, awareness, and proper utilization.

TESTING OF HYPOTHESIS

H₀- There is no significant association between the level of awareness of Artificial Intelligence and its usage among students in higher education institutions in Bangalore.

Table 11: Chi-square Test

Test	Value
Chi-square (χ^2)	28.64
Degrees of Freedom	9
p-value	< 0.01
Significance	Significant

Based on the Chi-square test results ($\chi^2 = 28.64$, $df = 9$, $p < 0.01$), the p-value is less than the 1% level of significance, indicating that the result is statistically significant. Therefore, the null hypothesis (H₀) stating that there is no significant association between the level of awareness of Artificial Intelligence and its usage among students in higher education institutions in Bangalore is rejected. Hence, the alternative hypothesis (H₁) is accepted, confirming that a significant association exists between awareness and usage of Artificial Intelligence among students.

H₀-Artificial Intelligence usage has no significant impact on human capital formation in terms of learning efficiency, skill development, and employability.

Table 12: Chi-square Test

Test	Value
Chi-square (χ^2)	24.18
Degrees of Freedom	9
p-value	< 0.01
Significance	Significant

Based on the Chi-square test results ($\chi^2 = 24.18$, $df = 9$, $p < 0.01$), the p-value is less than the 1% level of significance, indicating that the result is statistically significant. Therefore, the null hypothesis (H₀) stating that Artificial Intelligence usage has no significant impact on human capital formation in terms of learning efficiency, skill development, and employability is rejected. Hence, the alternative hypothesis (H₁) is accepted, confirming that Artificial Intelligence usage has a significant positive impact on human capital formation among students in higher education institutions in Bangalore.

FINDINGS WITH SUGGESTIONS

- Majority of respondents belong to the age group of 20–22 years, indicating dominance of undergraduate students; therefore, institutions in Bangalore should focus more on early-stage skill development through AI-integrated learning modules.
- Near gender balance is observed among respondents, suggesting inclusive participation; hence, equal opportunities and access to AI resources should be ensured for all genders.
- Most students are moderately to highly aware of AI, but a small proportion lacks awareness; thus, awareness and orientation programs should be conducted to bridge this gap.
- A majority of respondents use AI tools regularly or occasionally, reflecting growing adoption; therefore, institutions should formalize AI usage through curriculum integration and guided learning.
- Chatbots and basic AI tools are widely used, while advanced tools are less utilized; hence, training should be provided to encourage the use of AI for research and higher-level academic activities.
- AI is mainly used for assignments and projects rather than research; thus, students should be encouraged to apply AI in analytical and research-oriented tasks.
- Most respondents agree that AI improves learning efficiency; therefore, institutions should incorporate AI-supported teaching methods to enhance academic performance.
- AI significantly contributes to technical and analytical skill development; hence, curriculum design should emphasize skill-based learning aligned with industry needs.
- AI moderately improves employability according to respondents; therefore, collaboration with industries is essential to align AI skills with job market requirements.
- Lack of skills and training is identified as a major challenge; thus, structured training programs and workshops should be organized for students.
- Ethical concerns and overdependence on AI are evident; hence, guidelines and policies for responsible AI usage should be implemented with support from bodies like the Ministry of Education.
- A significant relationship exists between awareness and usage of AI, and AI positively impacts learning efficiency; therefore, improving awareness and accessibility will further strengthen human capital formation outcomes.

CONCLUSION

The study concludes that Artificial Intelligence plays a significant and positive role in enhancing human capital formation among students in higher education institutions in Bangalore. The findings indicate that a majority of students are aware of and actively using AI tools, which contribute to improved learning efficiency, skill development, and employability. The statistical analysis further confirms a strong association between awareness and usage of AI, as well as its meaningful impact on learning outcomes. AI has particularly strengthened technical, analytical, and problem-solving skills, which are essential in a knowledge-driven economy. However, challenges such as lack of adequate training, ethical concerns, and overdependence on AI highlight the need for a balanced and guided approach. Therefore, while AI emerges as a powerful tool for academic and professional development, its effective integration requires institutional support, proper training, and

policy guidance from authorities like the Ministry of Education to ensure responsible and inclusive use, ultimately contributing to sustainable human capital development.

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