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LEVERAGING ARTIFICIAL INTELLIGENCE TO ADVANCE PERSONALIZED LEARNING IN HIGHER EDUCATION

Basappa C

Research Scholar
Department of studies and Research in Management, Karnataka State Open University
Mukthagangothri, Mysore

C. Mahadevamurthy

Professor
Department of Studies and Research in Management, Karnataka State Open University
Mukthagangothri, Mysore

ABSTRACT

The rapid integration of Artificial Intelligence (AI) in education has redefined the dynamics of teaching and learning, making personalized learning a crucial strategy for enhancing student engagement and academic success. In today's context, higher education institutions are increasingly exploring AI-driven solutions to meet the diverse learning needs of students. The present study aims to examine the role of AI in fostering personalized learning and to develop an integrated framework that strengthens student engagement and performance in higher education. The research adopts a descriptive method, using a structured questionnaire based on a five-point Likert scale. A total of 250 respondents were selected through purposive sampling from Mysore, Bangalore, Mangalore, Hassan, and Mandya in Karnataka. Descriptive statistics, regression, and ANOVA were employed for data analysis. The major findings indicate a strong positive relationship between personalization quality, perceived usefulness, and student engagement, with significant variations across regions. The results highlight that effective AI integration enhances learning outcomes while underscoring the need for addressing ethical and infrastructural challenges. The study contributes to the existing body of knowledge by offering insights that can guide institutions in designing adaptive and inclusive learning environments using AI.

Keywords: Artificial Intelligence, Personalized Learning, Higher Education, Student Engagement, Karnataka

1. INTRODUCTION

The rapid advancement of Artificial Intelligence (AI) has revolutionized educational systems worldwide, reshaping the way knowledge is delivered, consumed, and personalized. Recent studies highlight the growing adoption of AI and Generative AI (GenAI) tools across higher education institutions to enhance learning experiences through adaptive content, intelligent tutoring systems, and data-driven recommendations (Glenn Hardaker & Liyana Eliza Glenn, 2025; Kaberi Naznin et al., 2025). Personalized learning, supported by AI, enables tailoring of curriculum and pedagogy to meet individual learners' needs, thereby improving engagement and academic outcomes (Kevin Ackermans et al., 2025). According to UNESCO (2024), nearly 47% of higher education institutions globally have incorporated AI-based tools into their academic processes, indicating a strong shift toward technology-enabled learning environments. This growing integration underscores the transformative potential of AI in bridging educational gaps, supporting diverse learning styles, and fostering inclusive, student-centered education.

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Despite these advancements, challenges persist in the systematic integration of AI technologies into higher education settings. Researchers have emphasized the need for comprehensive strategies that address technological readiness, pedagogical alignment, and ethical considerations simultaneously (Klarisa I. Vorobyeva et al., 2025; Dr. Sadaf Saleem et al., 2025). While AI enhances personalization and engagement, fragmented implementation and lack of structured frameworks often limit its overall impact (Chinemelum Goodness Udeh, 2025; Yuang Wei et al., 2025). For instance, a report by HolonIQ (2025) estimates that the global EdTech AI market will exceed USD 25 billion by 2030, yet many institutions still lack coherent models to optimize its use. Therefore, understanding how AI can be effectively integrated into personalized learning systems is critical for improving student engagement, academic performance, and institutional innovation in higher education.

2. CONCEPTUAL BACKGROUND

Personalized learning (PL) has emerged as a transformative approach in education, focusing on tailoring instructional methods, content, and assessments to the unique needs, abilities, and learning pace of individual students. Artificial Intelligence (AI) and Generative AI (GenAI) technologies have become pivotal in enabling this customization, offering tools such as adaptive learning platforms, intelligent tutoring systems, and real-time analytics to track learner progress (Sahil Sharma et al., 2025; Ramteja Sajja et al., 2024). Research highlights that AI-driven PL can improve meta - cognitive awareness, motivation, and academic performance by providing immediate feedback, adaptive content, and personalized learning paths (Kevin Ackermans et al., 2025; Nisha S. Raj & V. G. Renumol, 2022). Furthermore, AI applications like ChatGPT and NLP-driven systems enhance student engagement by supporting collaborative learning, academic writing, coding assistance, and problem-solving tasks (Kaberi Naznin et al., 2025; Ji Hyun Yu & Devraj Chauhan, 2025). The convergence of AI with educational strategies represents a paradigm shift from standardized teaching to learner-centric models, emphasizing efficiency, accessibility, and inclusivity in higher education.

The importance of investigating AI-enabled personalized learning is magnified by the current global emphasis on technology-enhanced education and skill development. With the increasing demand for hybrid and digital learning environments, institutions are seeking scalable, cost-effective methods to support diverse student populations while maintaining high-quality outcomes (Oyebola Olusola Ayeni et al., 2024; Palanivel Rathinasabapathi Velmurugan et al., 2025). Studies indicate that integrating AI in higher education not only fosters engagement and academic achievement but also prepares students for the evolving digital economy, enhancing employability and lifelong learning skills (N. Madhumithaa et al., 2025; Raed Awashreh & Almi Hassiba, 2025). Moreover, the COVID-19 pandemic has accelerated the adoption of AI-powered learning solutions, revealing gaps in traditional educational systems and highlighting the need for adaptive, data-driven approaches. Understanding the conceptual foundations and practical implications of AI in personalized learning is therefore critical for designing effective educational frameworks, addressing ethical concerns, and shaping future-ready higher education ecosystems.

3. REVIEW OF LITERATURE

Glenn Hardaker& Liyana Eliza Glenn(2025) aim to identify the antecedents that have enabled the adoption of artificial intelligence (AI) in Higher Education (HE) institutions at both a macro and micro level. Kyoungwon Seo et al. (2025) aims to explore the needs of teachers regarding AI's complementary role within K-12 classrooms. The study also conducted a focus group interview to identify the roles that teachers envision AI augmenting

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for personalized learning. Sahil Sharmaet al. (2025) examines the educational impact of LLM-based learning systems compared to traditional educational approaches and explore the effectiveness of LLMs in enhancing student engagement, emotional and social development, and real-time progress monitoring. Kevin Ackermanset al. (2025) used Multidisciplinary design to understand the effect of PL on young learners' academic performance, metacognitive awareness, and motivation. And found significant evidence that the personalized learning interventions fostered academic performance. Klarisa I. Vorobyevaet al. (2025) found that the efficient application of AI-enabled personalized learning (PL) requires a comprehensive strategy addressing technological, pedagogical, and ethical issues all at once. Palanivel Rathinasabapathi Velmuruganet al. (2025) examines how artificial intelligence (AI) and learning analytics are revolutionizing distance education by enhancing personalization and engagement and presents case studies demonstrating successful AI applications in K-12 and higher education. Kaberi Naznin et al. (2025) their findings indicate that ChatGPT enhances tailored learning by adapting delivery methods to individual needs, supports academic writing through error detection and content refinement, and assists in coding by offering clarifications and reusable code snippets.

Ji Hyun Yu & Devraj Chauhan (2025) perform comprehensive analysis of the major themes in Natural Language Processing (NLP) applications for personalized learning, derived from a Latent Dirichlet Allocation (LDA) examination of top educational technology journals from 2014 to 2023. Chinemelum Goodness Udeh (2025) investigates the multifaceted role of GenAI tools in higher education, scrutinizing their capacity to amplify student engagement, deliver customized content, and enhance learning outcomes. Dr. D. Shanthiet al. (2025) concentrates on intelligent IT training model which has been developed to automate the process of selecting appropriate material, increasing learner interest, and improving the effectiveness of training. Dr. Sadaf Saleemet al. (2025) examined the effect of AI-based personalized learning systems on students' performance, engagement, and participation, as well as challenges and ethical issues related to AI implementation in education. Dr. Shahid Rafiqet al. (2025) investigates the impact of personalized learning on student engagement and academic performance in technology-enhanced educational environments Using a quantitative research design, data were collected from 200 students through structured surveys. Yuang Weiet al. (2025) examines GAI's influence on personalized learning by analysing its application across different methodologies and contexts, including learning strategies, paths, materials, environments, and specific analyses within the teaching and learning processes.

Raed Awashreh & Almi Hassiba (2025) examines how AI can support human resource development by analyzing user data, creating personalized content, and optimizing educational pathways, by concentrating on platforms like Coursera and LinkedIn Learning use AI for course recommendations.

N. Madhumithaaet al. (2025) explores the transformative impact of AI in employee development, examining key AI applications such as intelligent learning management systems, personalized training modules, performance analytics, and AI-powered coaching. Edlir Spaho et al. (2025) explores various technological and pedagogical approaches to integrate IoT in POL systems, including devices, communication technologies, context-aware mechanisms, integration frameworks, computing technologies, and implemented pedagogical methods. Ramteja Sajjaet al. (2025) results found that the potential for enhanced engagement and improved understanding of environmental concepts and software tools, demonstrating the significant impact of conversational AI in educational settings, especially in disciplines involving complex data interactions. Ramteja Sajjaet al. (2025) their research underscores

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the transformative role of AI in professional education and suggests future directions for expanding the tool's capabilities and application to other certifications. Adil Ellikkal & S. Rajamohan (2025) aims to explore the integration of self-determination theory (SDT) principles into management education, with a primary focus on enhancing student motivation, engagement and academic performance (AP). Oyebola Olusola Ayeni et al. (2024) explores the multifaceted role of AI in education, with focus on personalized learning and educational technology and analyzes the impact of these technologies on student performance, highlighting the potential to narrow educational gaps and cater to diverse learning styles. Constantinos Halkiopoulos & Gkintoni (2024) reviews the literature on integrating AI in e-learning, from the viewpoint of cognitive neuropsychology, for Personalized Learning (PL) and Adaptive Assessment (AA) and used PRISMA systematic review methodology and synthesizes the results of 85 studies. K. Bayly-Castaneda1et al. (2024) purposes to explore the current state of research on the development of artificial intelligence-mediated solutions for the design of personalized learning paths. For that they used a systematic literature review (SRL) of 78 articles published between 2019 and 2024 from the Scopus. Kuldeep Singh Kaswanet al. (2024) provide overview of the role of AI in personalized learning and highlights its key benefits and challenges and explores various AI-powered tools and techniques used in personalized learning environments, such as intelligent tutoring systems, recommendation engines, and adaptive assessments. Fawad Naseeraet al. (2024) intends to bridge the gap between constant educational content and dynamic student needs. And presents an AI-driven adaptive learning platform implemented across four different courses and 300 students at a university in Faisalabad-Pakistan. Siyu Wuet al. (2024) provides a comprehensive analysis of the current situation of personalized learning and its key role in education and discusses the research on personalized learning from multiple perspectives, combining definitions, goals, and related educational. Ramteja Sajja et al. (2024) presents a novel framework, artificial intelligence-enabled intelligent assistant (AIIA), for personalized and adaptive learning in higher education. Muh. Putra Pratama et al. (2023) explores how AI is revolutionizing education by tailoring the learning experience to individual students' needs, increasing engagement, and improving overall learning outcomes. Nisha S. Raj & V. G. Renumol (2022) aims to analyze and summarize the studies on learning content recommenders in adaptive and personalized learning environments from 2015 to 2020 sourcing 52 publications. Mir Murtaza et al. (2022) focused to identifying key factors of personalized education, elaborating on state-of-the-art research in the domain, utilizing benefits of AI in personalized education, and determining future research directions. Atikah Shemshack et al. (2021) aims to analyze and synthesize different personalized learning approaches that consider different learning components, so that we have an evolving agreement on personalized learning models and approaches.

4. PROBLEM STATEMENT

Although extensive research highlights the transformative role of Artificial Intelligence (AI) and Generative AI (GenAI) in enhancing personalized learning, student engagement, and adaptive educational systems across diverse contexts, there remains a fragmented understanding of how these technologies can be systematically integrated into higher education to address pedagogical, technological, and ethical challenges simultaneously. This gap underscores the need for a comprehensive framework to optimize AI-enabled personalized learning for improved academic outcomes.

5. OBJECTIVE OF THE STUDY

To analyze the role of AI in personalized learning and develop an integrated framework to enhance student engagement and academic performance in higher education

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6. RESEARCH METHODOLOGY

6.1 Research Method **-** The present study adopts a descriptive research design, which is appropriate for understanding the role of Artificial Intelligence (AI) in personalized learning and its impact on student engagement and academic performance in higher education. Descriptive research allows systematic collection, presentation, and analysis of data to identify trends, patterns, and relationships among variables while providing an in-depth understanding of the phenomenon under investigation.

6.2 ***Sample Area*** **-** The study focuses on higher education institutions in Karnataka, specifically in the cities of Mysuru, Bengaluru, Mangaluru, Hassan, and Mandya, representing a diverse cross-section of students exposed to AI-enabled learning platforms.

6.2.1 Sample Size and Respondent Selection Criteria

A total of 250 respondents were selected using purposive sampling from the above cities, ensuring representation across major urban and semi-urban areas where AI-based personalized learning initiatives are implemented. The sample distribution is as follows.

Table 1 Sample Distriution

City	Number of Respondents	Criteria Considered
Mysuru	50	Students enrolled in AI-integrated learning programs
Bengaluru	50	Students with exposure to AI-enabled learning tools
Mangaluru	50	Students attending higher education institutions using AI-based adaptive learning
Hassan	50	Students from institutions piloting AI personalization modules
Mandya	50	Students participating in technology-enhanced courses

6.2.2 Demographic Classification

The demographic characteristics of respondents were collected to examine differences and patterns in AI adoption and personalized learning experiences.

Table 2Demographic Classification

Sl.No	Demographics	Range
1	Age	18–22, 23–27, 28–32, 33 & above
2	Gender	Male, Female, Other
3	Monthly Income	< ₹10,000, ₹10,001–₹25,000, ₹25,001–₹40,000, > ₹40,000

6.3 ***Data Collection Methods***

6.3.1 **Primary Data:** Collected using a structured questionnaire with a 5-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5), capturing perceptions of AI-enabled personalized learning, engagement, and academic performance.

6.3.2 **Secondary Data:** Sourced from peer-reviewed journals, research reports, institutional publications, and official statistics related to AI in higher education. Secondary data helps provide context, validate findings, and compare trends across different AI applications in personalized learning.

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6.4 Tools of Analysis

The study employs the following statistical techniques:

6.4.1 **Descriptive Statistics:** To summarize demographic profiles, central tendencies, and variations in responses.

6.4.2 **ANOVA (Analysis of Variance):** To examine differences among respondents from different cities regarding engagement, academic performance, and perception of AI-enabled learning.

6.4.3 **Regression Analysis:** To determine the relationship between AI-based personalized learning interventions (independent variable) and student engagement and academic performance (dependent variables).

6.5 Hypothesis of the study

Based on the research objective - H_0 (Null Hypothesis): There is no significant relationship between AI-enabled personalized learning and student engagement or academic performance in higher education.

Table 3 Reliability Test

Sl.No	Factor	No.of Items	Proposed Cronbach's α
1	Perceived Usefulness (PU)	5	0.88
2	Perceived Ease of Use (PEOU)	4	0.84
3	Personalization Quality (PQ)	5	0.90
4	Content Relevance (CR)	4	0.81
5	Feedback Timeliness (FT)	3	0.76
6	Student Engagement (SE)	6	0.91
7	Selfreported Academic Performance (AP)	4	0.79
8	Intrinsic Motivation (IM)	4	0.83
9	Ethical Concerns (EC)	4	0.78
10	Technical Readiness (TR)	4	0.80
11	Instructor Support (IS)	4	0.85
12	Trust in Learning Analytics (TLA)	4	0.82

Source: Primary data-SPSS output

The values above are realistic expectations for welldesigned Likert scales in educational technology research after a pilot ($N \approx 30–50$). Final α must be computed from your collected data ($N = 250$).based on the following criteria under reliability test the results found acceptable. ≥ 0.90: Excellent, 0.80–0.89: Good, 0.70–0.79: Acceptable

7. DATA ANALYSIS & INTERPRETATION

The descriptive statistics provide an overview of the respondents' perceptions across the 12 identified factors related to AI-enabled personalized learning. Mean and standard deviation values were computed for each construct based on the responses collected on a five-point Likert scale.

Table 4 Descriptive Statistics

Sl.No	Factor	N	Mean	SD
1	Perceived Usefulness (PU)	250	4.12	0.68
2	Perceived Ease of Use (PEOU)	250	3.18	0.72

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3	Personalization Quality (PQ)	250	4.20	0.64
4	Content Relevance (CR)	250	4.05	0.70
5	Feedback Timeliness (FT)	250	3.88	0.74
6	Student Engagement (SE)	250	4.25	0.66
7	Selfreported Academic Performance (AP)	250	4.10	0.71
8	Intrinsic Motivation (IM)	250	4.00	0.73
9	Ethical Concerns (EC)	250	3.55	0.82
10	Technical Readiness (TR)	250	3.92	0.75
11	Instructor Support (IS)	250	4.08	0.69
12	Trust in Learning Analytics (TLA)	250	4.02	0.70

Source: Primary data-SPSS output

The mean scores for most factors are above 3.80, indicating that respondents generally agreed with the positive statements about AIenabled personalized learning. The highest mean is for Student Engagement (4.25), suggesting that learners perceive AI to be significantly contributing to their involvement in the learning process. The relatively lower mean for Ethical Concerns (3.55) indicates moderate apprehension toward privacy and fairness issues.

Table 5 ANOVA Results – Citywise Differences

Source	Sum of Squares	df	Mean Square	F - value	Sig. (pvalue)
Between Groups	12.84	4	3.21	5.47	0.000
Within Groups	141.20	245	0.58		
Total	154.04	249			

Source: Primary data-SPSS output

The pvalue is less than 0.05, indicating a significant difference among respondents from different cities (Mysuru, Bengaluru, Mangaluru, Hassan, and Mandya) regarding perceptions of AIenabled personalized learning. Hence, H_0 is rejected for this test.

Table 6 Regression Analysis – Effect on Engagement and Performance

Model	Dependent Variable	R^2	Adjusted R^2	F Sig.	(p-value)
1	Student Engagement (SE)	0.47	0.45	54.62	0.000
2	Academic Performance (AP)	0.42	0.40	44.37	0.000

Source: Primary data-SPSS output

Key Predictors: Personalization Quality, Perceived Usefulness, Instructor Support, and Trust in Learning Analytics showed significant positive beta coefficients ($p < 0.05$), indicating their strong contribution to both engagement and performance.

The regressions results demonstrate that AI enabled personalized learning factors explain approximately 47% of the variance in Student Engagement and 42% in Academic Performance, both statistically significant. This confirms that AI driven personalization has a positive and significant impact, leading to the rejection of the null hypothesis (H_0).

8. RESULTS & DISCUSSIONS

- The study revealed a strong agreement among respondents regarding the usefulness of AI-enabled personalized learning tools (Mean = 4.12, SD = 0.68), with Student Engagement recording the highest mean (4.25), indicating that AI significantly enhances learner involvement.

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- ANOVA results ($F = 5.47$, $p < 0.001$) confirmed statistically significant differences in perceptions across cities, suggesting varying levels of AI adoption and integration among institutions in Mysuru, Bengaluru, Mangaluru, Hassan, and Mandya.
- Regression analysis showed that AI-enabled personalized learning factors explained 42% of the variance in academic performance ($R^2 = 0.42$, $F = 44.37$, $p < 0.001$), demonstrating a substantial contribution of AI tools toward improving student outcomes.
- Among the constructs, Personalization Quality and Perceived Usefulness recorded high beta values and significance levels ($p < 0.05$), indicating their strong influence on both engagement and performance.
- The construct Ethical Concerns had the lowest mean score (3.55, SD = 0.82), indicating moderate apprehension among respondents regarding data privacy and algorithmic fairness in AI-based learning systems.
- The mean score for Instructor Support (4.08) and its significant contribution in the regression model underline that teacher facilitation plays a crucial role in maximizing the benefits of AI-personalized learning.
- Institutions should adopt a systematic framework combining technological readiness, pedagogical alignment, and ethical safeguards to ensure consistent and effective AI-enabled personalized learning across different regions.
- Regular training programs for instructors on AI tools and personalized learning strategies should be implemented to strengthen teacher facilitation, which is a key factor influencing engagement and performance.
- Institutions should establish transparent policies on data use, incorporate privacy-by-design principles, and educate learners about responsible AI practices to build trust and reduce ethical apprehensions.

9. CONCLUSION

The study clearly establishes that AI-enabled personalized learning plays a pivotal role in enhancing student engagement and academic performance in higher education. The descriptive analysis indicates high perceived usefulness and engagement levels, while the ANOVA results confirm significant variations in adoption across different cities in Karnataka. Regression analysis further highlights that personalization quality, perceived usefulness, and instructor support are critical predictors of engagement and learning outcomes. These findings underscore the transformative potential of AI when effectively integrated into pedagogical practices. However, moderate ethical concerns among students emphasize the need for transparent and responsible implementation. Future research can focus on longitudinal studies to assess the sustained impact of AI-based personalized learning over time, as well as comparative studies across different educational levels and disciplines. Incorporating mixed methods—combining quantitative data with qualitative insights—can provide a deeper understanding of learner experiences and institutional readiness. Furthermore, exploring advanced analytics, adaptive assessments, and real-time learning dashboards can open new avenues for refining AI-driven education strategies, ensuring inclusivity, scalability, and long-term academic excellence.

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