



IMPACT OF AI-DRIVEN PERSONALIZED LEARNING ON ACADEMIC ACHIEVEMENT AND STUDENT ENGAGEMENT IN HIGHER EDUCATION

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ABSTRACT

The application of Artificial Intelligence (AI)-based personalized learning is becoming popular in higher education as it offers customized learning tools, assessments, feedback, and recommendations depending upon the individual learning requirements. This study aims at exploring the effect of AI-driven personalized learning on academic performance and student engagement of higher education students. In order to conduct this study, a descriptive cross-sectional research design has been used, and data has been collected from 200 undergraduate and graduate students by using a structured questionnaire. Descriptive statistics and percentage analysis have been used in order to explore the experience, academic outcomes, and overall perception about AI-driven personalized learning. It has been found out that 69.0% of the respondents have prior experience with AI-based personalized learning. Automated feedback based on AI is the most common feature (84.0%) being followed by recommendations regarding learning materials (82.0%) and personalized revision tips (81.0%). The academic outcomes indicate considerable improvement in assignments (81.0%), academic performance (79.0%), course concepts (78.5%), and problem-solving skills (76.5%). The ability to remember information and test/examination performance have been shown to increase for 72.5% and 74.0% of the students, respectively. In addition, the perception of personalized learning through the use of AI has been found to be positive or very positive in 77.0% of the cases whereas only 8.0% of the people

had a negative or very negative perception of personalized learning. It can be concluded from this study that there is a lot of potential of AI personalized learning in higher education.

Keywords: Artificial Intelligence; Personalized Learning; Academic Achievement; Student Engagement; Higher Education; Adaptive Learning.

1. INTRODUCTION

Artificial Intelligence (AI) has become an innovation in higher education, bringing revolutionary changes in learning and teaching practices through intelligence, adaptability, and data. Personalized learning based on AI is capable of analysing learning behavior, performance, preferences, and progress of the learners and provides personalized materials, adaptive tests, automated feedback, and personalized suggestions. While traditional techniques usually offer the same instruction to all students, personalized learning powered by AI enables the adaptation of learning activities in accordance with learners' needs and speed of learning. That is why universities and colleges are looking for innovations in AI to enhance the quality of their learning and teaching activities. Consequently, higher-education institutions are increasingly exploring AI technologies to improve the quality, accessibility, and effectiveness of teaching and learning.

Personalized learning based on AI technology may also contribute to better academic performance and engagement of students. With personalized learning pathways, students may be able to concentrate on areas in which they need extra help, and with feedback and adaptive quizzes, students will have an opportunity to correct mistakes instantly. Moreover, similar to learning assistants and recommendation systems, personalized learning systems based on AI can motivate students to engage in more frequent interactions with learning content. However, whether these systems would be effective or not depends on many aspects including technological literacy of students, quality of AI content, accessibility of the technology and involvement of teachers into the process.

In the light of such trends, this research investigates the effect of AI-powered personalized learning on the academic achievements and involvement of students. In particular, it analyzes the extent to which the use of features provided by AI-based personalized learning influences the students' performance, comprehension of course materials, problem-solving skills, memory, motivation, involvement in class, and self-study. Thus, the results of the study can be helpful in exploring the opportunities of using AI-powered personalization as an approach that assists learning. The findings are expected to provide useful insights

into the potential of AI-driven personalization as a supportive approach for enhancing learning outcomes and creating more individualized and engaging higher-education environments.

2. LITERATURE REVIEW

Kolluru, Mungara, and Chintakunta (2018) investigated the application of artificial intelligence in adaptive learning systems to provide personalized learning experience. The investigation used the EdNet dataset and considered some AI techniques of tailoring educational materials depending on learners' needs, learning styles, and speed of learning. The authors employed some clustering algorithms and recommender systems to show how artificial intelligence could be used in personalizing learning material and adapting it to the learner's performance. The results revealed that adaptive artificial intelligence techniques facilitated better learning performance and provided more interactive environment.

Ciolacu et al. (2018) explored the implementation of artificial intelligence in Education 4.0, paying special attention to the early identification system aimed at ensuring success of students in higher education. In the study, the growing need for adaptive and personalized education was analyzed and the application of machine learning algorithms for identifying students who needed further academic assistance was examined. It was noted that the use of AI-based systems could allow creating more adaptive environments through the use of student-centered data. The study showed the potential of AI and machine learning technologies for personalized higher education.

Dabingaya (2022) studied the efficiency of AI-enabled adaptive learning systems in mathematics teaching by considering their impacts on engagement and learning results. In particular, the study utilized the quantitative research methodology by comparing the engagement and pre-test/post-test scores of the experimental and control groups. The results obtained proved that the engagement level of the students who utilized the system was higher in terms of both interaction frequency and duration than those of the control group. Moreover, the improvement in the post-assessment scores of the experimental group indicated that the group showed an improved mathematical competence. The study concluded that AI-powered adaptive learning could support individualized learning pathways while improving student engagement and academic learning outcomes.

3. RESEARCH METHODOLOGY

The methodological approach applied in evaluating the effect of personalized learning based on AI on academic performance and engagement of higher education learners is discussed in this part. The research

methodology, sample size, data collection tool and procedure, variables in the study, and data analysis approaches are included.

3.1 Research Design

The research design used in this study was a descriptive cross-sectional research design. This research design was thought to be suitable because it would be used to establish the effect that personalized learning using artificial intelligence had on the performance and engagement of the learners in universities.

3.2 Study Population and Sample

This study was undertaken among students admitted to higher education establishments. In total, 200 students took part in the study. Both undergraduate and postgraduate students were included in the sample, allowing comparisons at various levels of higher education. The respondents were chosen based on their willingness to take part in the study and their exposure to AI-based learning technologies.

3.3 Data Collection Tool

The data was gathered by means of a structured questionnaire that was designed based on the study objectives. The structure of the questionnaire involved questions pertaining to the respondents' demographics, their experiences with AI-enabled learning, familiarity with personalized learning aspects powered by AI, perceptions of academic success, and the perception of AI-powered personalized learning altogether. AI-related aspects included personalized learning trajectories, recommendations generated by AI, automatic feedback, adaptive quizzes, AI learning assistants/chatbots, and personalized revision tips.

3.4 Variables of the Study

The principal variables that were studied include personalized learning by artificial intelligence, achievement, and engagement. Personalized learning by artificial intelligence was measured through students' access and use of various tools for personalized learning enabled by artificial intelligence. Achievement was measured based on various parameters including comprehension of the course material, performance in examinations, performance in assignments, problem-solving skills, knowledge retention,

and overall achievement in academics. Engagement was measured in terms of student participation and involvement in the process of learning independently.

3.5 Data Collection Procedure

The questionnaire was filled by the respondents who were made aware of the aim of the study. The participation of the respondents was voluntary in nature, and the respondents were told that the data collected will only be used for the purposes of academic research. The completed questionnaires were checked for completeness before their analysis.

3.6 Data Analysis

Collected data were arranged and analyzed through the use of Microsoft Excel and descriptive statistics. Frequencies and percentages were computed to present the demographics of the respondents and the extent of their experience with AI-based personalized learning. Analysis of percentage was also employed to analyze changes in academic performance and perception of the respondents regarding AI-based personalized learning.

4. RESULTS

Table 1 shows the demographic profile of the 200 participants who took part in the research. Gender, age, level of education, and prior use of artificial intelligence-based learning were the demographic variables that were taken into account. Figure 1 illustrates the demographic data graphically.

Table 1: Demographic Profile of the Respondents

Demographic Variable	Category	Frequency	Percentage (%)
Gender	Male	92	46.0
	Female	108	54.0
Age	18–20 years	74	37.0
	21–23 years	86	43.0
	24 years and above	40	20.0
Level of Study	Undergraduate	126	63.0
	Postgraduate	74	37.0
Previous AI Learning Experience	Yes	138	69.0

	No	62	31.0
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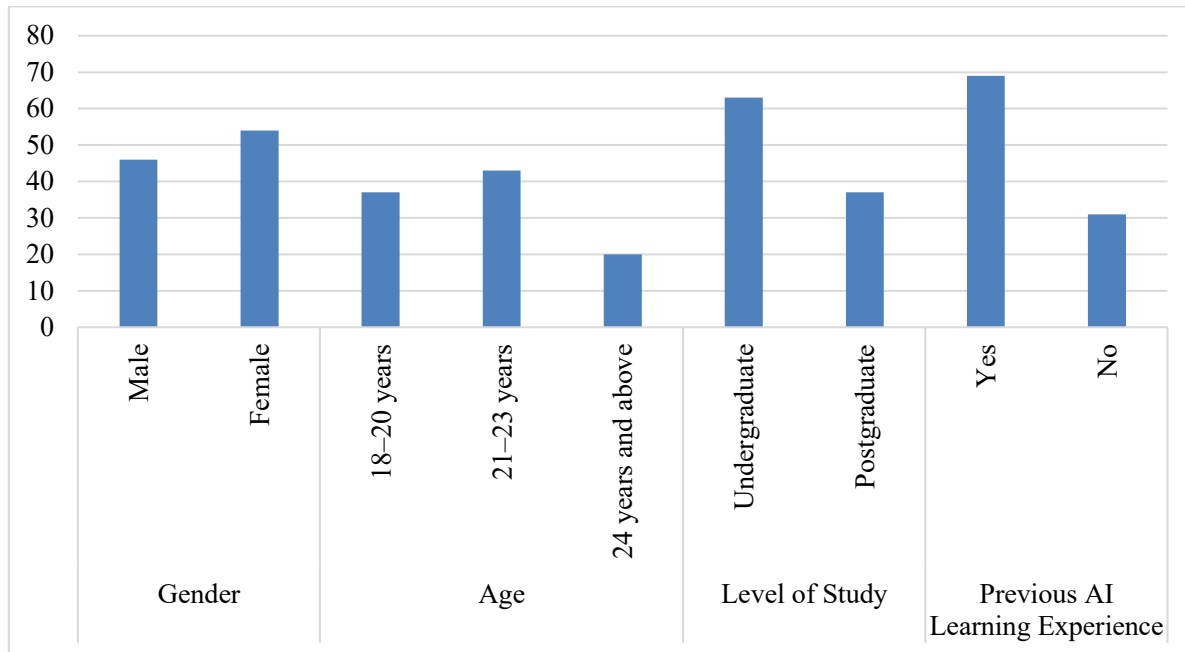


Figure 1: Graphical Representation of Demographic Profile of the Respondents

The analysis revealed that there were slightly more women (54.0%) than men (46.0%). In terms of age distribution, the largest age category was students who are between 21-23 years old (43.0%) followed by those who are 18-20 years old (37.0%), with 20.0% being 24 years old and above. In terms of educational status, there were more undergraduate students (63.0%) than postgraduates (37.0%) in the sample. Also, 69.0% of respondents reported experience with learning with the help of artificial intelligence while 31.0% did not have any such experience. These findings indicate that most respondents were young undergraduate students with prior exposure to AI-supported learning.

In Table 2 below are the students' exposure to and usage of different personalized learning features provided by AI. This includes AI-enabled recommendation systems, personalized learning journey, automated feedback, adaptive testing, AI-enabled learning assistants/chatbots, and personalized revision suggestions. The exposure of the students to these AI-enabled learning features is shown in Figure 2.

Table 2: Students' Exposure to and Use of AI-Driven Personalized Learning

AI-Based Personalized Learning Feature	Yes (%)	No (%)
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AI-based recommendation of learning materials	82.0	18.0
Personalized learning paths	76.5	23.5
AI-based automated feedback	84.0	16.0
Adaptive quizzes and assessments	79.5	20.5
AI-based learning assistants/chatbots	73.0	27.0
Personalized revision suggestions	81.0	19.0

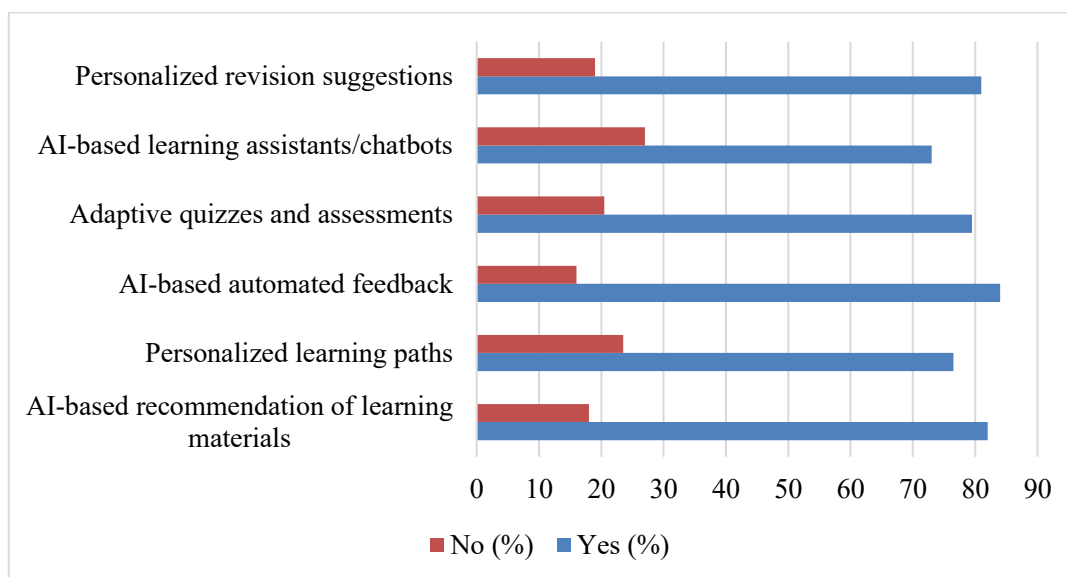


Figure 2: Graphical Representation of Students' Exposure to and Use of AI-Driven Personalized Learning

The findings revealed that there was a very high degree of exposure to the personalization techniques used by AI in the case of the students surveyed. The most prevalent personalization technique was AI-based automated feedback, which was used by 84.0%, followed by recommendations from AI regarding the learning materials, which was used by 82.0% of the students, and personalized revision suggestions by 81.0%. Adaptive quizzes and assessments were used by 79.5% of the students, while personalized learning paths were used by 76.5% of the students. Learning assistants or chatbots based on AI were the least-used personalization techniques.

Table 3 illustrates the effect that personalized learning through AI has on various dimensions of the academic achievement of students. These include understanding of course concepts, performance in

tests/examinations, performance in assignments, problem-solving skills, knowledge retention, and academic achievement as a whole. Figure 3 illustrates these effects in graphical form.

Table 3: Impact of AI-Driven Personalized Learning on Academic Achievement

Academic Achievement Indicator	Improved (%)	No Significant Change (%)	Declined (%)
Understanding of course concepts	78.5	17.0	4.5
Examination/test performance	74.0	21.5	4.5
Assignment performance	81.0	15.5	3.5
Problem-solving ability	76.5	19.0	4.5
Knowledge retention	72.5	22.0	5.5
Overall academic performance	79.0	17.0	4.0

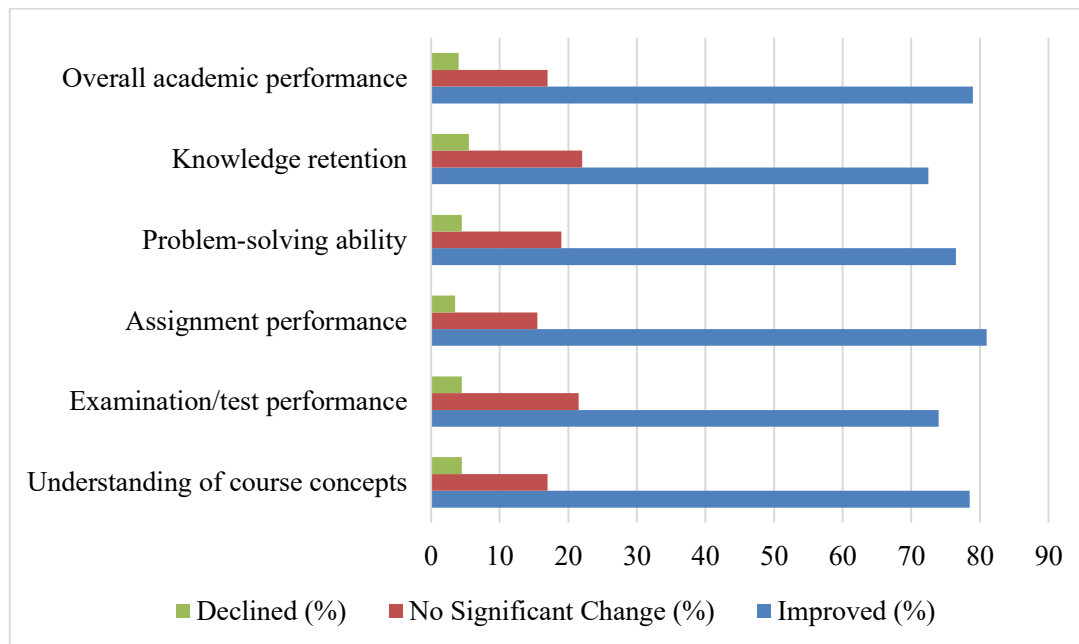


Figure 3: Graphical Representation of Impact of AI-Driven Personalized Learning on Academic Achievement

The findings indicated that there was a generally positive effect of AI-based personalized learning on academic performance. The largest percentage of improvement was registered for assignment performance (81.0%), followed by academic performance in general (79.0%), and course concept knowledge (78.5%).

Improvement was also registered for problem solving ability (76.5%), and examination/test performance (74.0%), while knowledge retention witnessed improvement among 72.5% of participants. The percentage of people who did not show any improvement varied between 15.5% and 22.0%, while those who experienced deterioration were within the range of 3.5% and 5.5%. Overall, the findings suggest that AI-driven personalized learning was associated with improved academic outcomes among most students.

Table 4 displays the overall perception of the impact of AI-enabled personalization learning among the respondents. The overall impact is divided into highly positive, positive, neutral, negative, and highly negative responses. Figure 4 shows the graphical display of the overall perception of the respondents.

Table 4: Overall Perceived Impact of AI-Driven Personalized Learning

Perceived Impact	Frequency	Percentage (%)
Highly Positive	72	36.0
Positive	82	41.0
Neutral	30	15.0
Negative	11	5.5
Highly Negative	5	2.5
Total	200	100.0

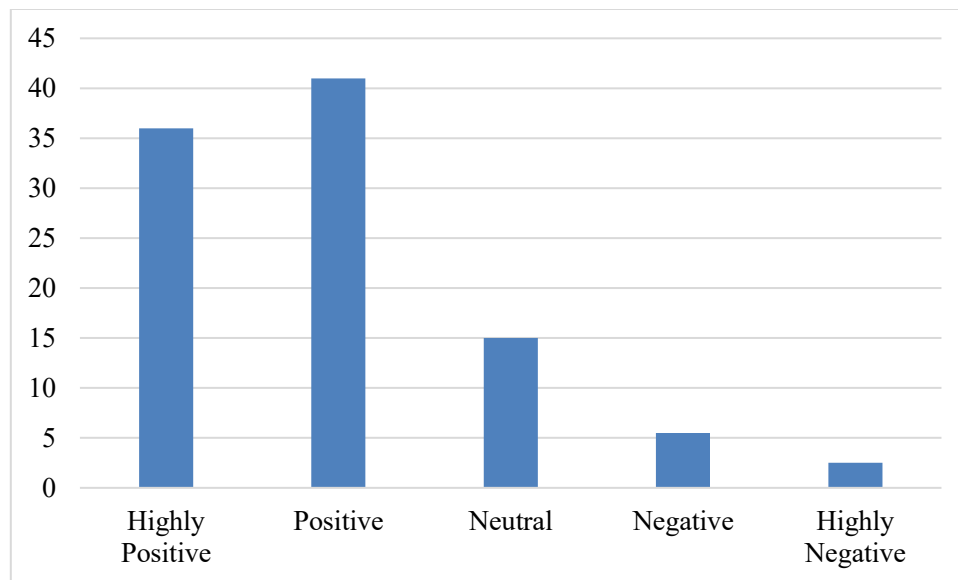


Figure 4: Graphical Representation of Overall Perceived Impact of AI-Driven Personalized Learning

The findings revealed that there was a predominance of positive perceptions of the effects of AI personalized learning. The number of respondents who perceived the impact to be positive stood at 41.0%, while those who perceived the effects to be highly positive stood at 36.0%, resulting in a total positive perception rate of 77.0%. On the other hand, 15.0% of respondents had a neutral perception. The number of people who felt the effects to be negative was 5.5%, while 2.5% felt that the effects were highly negative.

5. DISCUSSION

The results demonstrated that the utilization of AI-powered personalization for learning was positively influential on the students' educational experience and academic performance. The overwhelming majority of participants had prior experience with AI-powered learning (69.0%), whereas AI-powered automatic feedback (84.0%), material recommendations for learning (82.0%), and personalized tips for revision (81.0%) were used most frequently. There was improvement in academic results, especially in assignment completion (81.0%), overall academic performance (79.0%), and conceptual knowledge (78.5%). Therefore, it can be concluded that AI-powered personalization can offer relevant learning materials and feedback on an individual basis, which helps to improve academic performance.

Perceptions on the concept of AI-based personalized learning were equally positive, as 41.0% of students perceived its effect positively, while 36.0% viewed it as highly positive, making the overall positive response rate 77.0%. Only 8.0% of the participants noted negative or highly negative effects. The results

thus indicate that AI-based personalized learning can be used successfully to cater to the learning requirements of students. Nevertheless, proper integration of the technology and teacher supervision are essential for ensuring learning benefits.

6. CONCLUSION

The current research suggests that the personalized learning that is supported by AI positively affects academic performance and the learning process of students. The results indicate that the AI-based learning tools are popular; automated feedback (84.0%), learning material recommendations (82.0%), and personal revision recommendations (81.0%) are the most common elements of AI. Academic achievements have improved; students have improved in their assignments (81.0%), academic performance (79.0%), comprehension of courses (78.5%), and problem-solving skills (76.5%). Moreover, 77.0% of the surveyed students had either positive or highly positive attitude towards AI-driven personalized learning. In other words, they are positively disposed towards this approach to teaching and learning supported by AI. AI-driven personalization allows for providing personalized assistance, immediate feedback, and more responsive experience for learners. Nevertheless, its efficient use requires proper teacher intervention and the appropriate use of AI technologies.

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