



AI-BASED ADAPTIVE LEARNING SYSTEMS AND THEIR ROLE IN ENHANCING STUDENT ACADEMIC PERFORMANCE

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Abstract

The purpose of the study is to explore students' perception regarding AI-based adaptive learning systems and examine how students perceive that AI systems have impacted their academic performance. The study is focused on such fundamental areas like awareness, perceived usefulness, personalization, engagement, challenges, and behavioural intention to use adaptive technology on learning. The research approach was quantitative and survey-based design. The data was collected using a sample of 300 students of different levels of education who were previously exposed to AI-based adaptive learning systems. On the basis of the demographic features and various dimensions of adaptive learning, the responses were gathered with the assistance of a structured questionnaire. The analysis of the data was based on descriptive statistical tools, including frequencies, percentages, mean scores, and standard deviations. The results prove that the students are highly aware of the AI-based adaptive learning systems and that the students have high perceived usefulness of the technologies. It was also discovered that individualization and flexibility were strengths particularly in providing of personalized learning pathways and pacing. The research also indicates the presence of a positive impact on student engagement, self-directed learning, and perceived academic performance, particularly in reaching the learning objectives and positively affecting test performance. Nevertheless, such threats like the limitation of the internet, technical difficulties, and usability problems were discovered to impede optimal use. In spite of these obstacles, students were also reported to have a high behavioural intention to use AI-based adaptive learning systems again.

The paper concludes that AI-based adaptive learning systems can be highly effective to improve the student learning process and academic performance in case they are correctly implemented. To maximise their educational impact, it is necessary to address infrastructural and technical issues, as well as to offer institutional support and guidance. The results provide useful information to teachers, learning institutions, and system developers aiming to incorporate adaptive learning technologies to educational practice.

Keywords: Artificial Intelligence, Adaptive Learning Systems, Academic Performance, Student Engagement, Personalized Learning, Educational Technology

Introduction

The fast development of artificial intelligence has also had a substantial impact on educational practice,



especially the emergence of AI-based adaptive learning systems (Sari et al., 2024). These are systems that are aimed at customizing the learning experiences with the content, pace and feedback being adjusted to the needs of individual learners. Unlike the one-size-fits-all approach to instruction, adaptive learning systems have data analytics, intelligent algorithms to dynamically respond to student behaviour and performance (Ullah et al., 2024). As the number of educational establishments shifts to the digital learning format, AI-based adaptive systems have been viewed as a means of facilitated learning outcomes, engagement, and performance (Arshad et al., 2024).

The growing diversity of learners with regard to backgrounds, level of learning and academic preparation has become a leading issue in education where concentric teaching programs have become a source of disengagement, inequality in performance and learning gap (Afshar and Shah, 2025). AI-driven adaptive learning systems are attempting to overcome these barriers by continually monitoring the interaction of the learners and modifying the teaching paths according to the observation (Afzal et al., 2025). The systems are intended to support the learners more efficiently and promote self-directed learning by providing personalized resources, feedback, and interventions when they are needed.

The application of AI to the educational environment has been accelerating over the past several years due to the increased access to digital devices, online platforms, as well as learning management systems (Iqbal, 2023). Intelligent tutoring systems, recommendation engines, and adaptive assessment systems are being experimented by learning institutions at various levels (Imtiaz et al., 2025). These developments have further been enhanced by the necessity to be flexible and remote solutions in learning. Subsequently, students are more susceptible to artificially intelligent learning environments that define how they learn, and how they engage with learning content (Hasan et al., 2025).

Even though AI-based adaptive learning systems may be quite promising, the success of these technologies largely depends on the awareness, perceived utility, engagement, and willingness of the students to use these technologies (Gupta et al., 2024). Personalization, flexibility, and feedback experiences of learners are crucial in the construction of motivation and academic success (Cho, 2022). At the same time, the unavailability of resources, the urge to apply traditional methods of learning, technical issues, and usability can be viewed as a complex of barriers to successful implementation (Saleem et al., 2025).

There is a need therefore to know how students perceive AI-based adaptive learning systems and how such perceptions are related with academic performance (Habib et al., 2022). The evaluation of awareness, usefulness, engagements, personalization, and behavioural intention can provide valuable information on the situation, where the adaptive learning technologies can offer considerable educational value (Wang et al., 2024). The following paper will explore these dimensions based on the answers provided by students to the adaptive learning systems involving AI and assessing how they understood the impact of these systems on their academic performance. By doing so, the research will contribute to a more significant awareness of possibilities of successful integration of intelligent learning technologies into the educational practice.

Literature Review

AI-Based Adaptive Learning Systems

Adaptive learning systems, which consist of educational technologies, are based on artificial intelligence and adjust the learning experience according to the personal information of learners (Zaman & Akhter, 2023). These systems accumulate information regarding the performance of the learners, their growth, the preferences, and the manner in which they interact with each other to deliver to them customized instructional content (Das et al., 2025). The adaptive mechanisms permit constant modification of the difficulty levels, sequences of learning and feedback, which form a more learner-centred environment.

Awareness and Understanding of AI in Education

The awareness and familiarity of learners with AI-based systems determines the effectiveness of use of these tools. The more students are already acquainted with the concepts of adaptive learning and the functionality of the systems, the more they will apply it and use the available features (Asif et al., 2025; Mustafa et al., 2024). The institutional support, guidance, and training are very essential in fostering this awareness and minimizing resistance to new technologies (Sajja et al., 2024).

Perceived Usefulness of Adaptive Learning



The concept of perceived usefulness will be used to measure how much the learners perceive the AI-based systems to improve their learning performance. Adaptive learning tools are commonly linked to enhanced understanding of concepts, effective studying methods, and enhanced knowledge gap recognition (Asif & Asghar, 2025; Ezzaim et al., 2022). When learners perceive these systems as beneficial, they are more inclined to rely on them as part of their regular study routines.

Personalization and Adaptability

Personalization is one of the core features of AI-based adaptive learning systems. Another purpose of these systems is to assist the variation of learning pace, preferences, and ability levels through personalizing content and learning routes (Joshi, 2024). The adaptive pacing and personalized feedback can help to reduce cognitive overload and learning difficulties, thereby facilitating the more effective acquisition of knowledge (Ahmed & Asif, 2026; Younas et al., 2022).

Student Engagement and Motivation

Engagement and motivation are the factors that determine academic success. Interactive, real-time feedback, and adaptive challenges can help AI-based systems to engage the interest and attention of learners (Adewale et al., 2024). When the involvement is more, there is more self-directed learning whereby the students will be more accountable to their learning.

Impact on Academic Performance

The ultimate goal of adaptive learning technologies is better academic performance. Nevertheless, the use of AI-based systems may contribute to improved exam preparation, continuous performance increase, and achieving learning goals through the process of aligning the instruction with the needs of learners (Ullah et al., 2024). Nevertheless, it can have differing levels of influence based on quality of systems, learner traits, and contextual influence.

Challenges and Behavioural Intention

In spite of the benefits, AI-based learning systems have certain issues like technical constraints, usability, and access barriers. Acceptance can also be influenced by the preference of the learners to use a traditional method. The positive experiences and perceived challenges affect behavioural intention to use adaptive learning systems and influence long-term adoption and sustainability.

Problem Statement

The growing use of adaptive learning systems based on AI in education creates opportunities as well as challenges. Although these systems aim to make learning personal to learners and improve academic performance, their success is not assured without proper student awareness, acceptance and participation. This could be because many learners do not have enough knowledge on how adaptive systems operate and hence, they will not be utilized or used effectively. In addition, potential advantages of AI-inspired education can be undermined by technical issues, inadequate access, and resistance to adopting non-traditional learning methods. The empirical research does not also measure the interactive effect of the main variables such as perceived usefulness, personalization, engagement and behaviour intention on academic performance. The gaps will need to be bridged in such a way that the use of AI-based adaptive learning systems can really make a difference in the student learning outcomes.

Research Objectives

1. To examine students' awareness and understanding of AI-based adaptive learning systems.
2. To evaluate the perceived usefulness of AI-based adaptive learning systems in enhancing learning effectiveness.
3. To assess the role of personalization and adaptability in supporting student learning.
4. To analyse the influence of AI-based adaptive learning systems on student engagement and motivation.
5. To evaluate the perceived impact of AI-based adaptive learning systems on academic performance.
6. To identify challenges affecting the use of AI-based adaptive learning systems.
7. To examine students' behavioural intention to continue using AI-based adaptive learning systems.



Research Questions

1. What is the level of student awareness regarding AI-based adaptive learning systems?
2. How do students perceive the usefulness of AI-based adaptive learning systems?
3. To what extent do personalization and adaptability influence learning experiences?
4. How do AI-based adaptive learning systems affect student engagement and motivation?
5. What is the perceived impact of adaptive learning systems on academic performance?
6. What challenges do students face when using AI-based adaptive learning systems?
7. How do students' perceptions influence their intention to use adaptive learning systems in the future?

Significance of the Study

The significance of this work is in the fact that it provides empirical support to the knowledge about the impact that AI-based adaptive learning systems have on the learning process and academic outcomes of students. The research offers a critical description of the conditions that promote successful adoption through the study of awareness, usefulness, personalization, engagement, challenges, and behavioural intention. The results can help educational institutions to make informed decisions regarding the implementation of adaptive learning technologies and development of adequate support and training strategies. In the case of educators and system developers, the research points to the possibilities to enhance usability and the interaction with learners. Moreover, the study offers to the current body of research on AI in education and is one of the bases of the further research on the long-term learning outcomes and system efficacy.

Methodology

Research Design

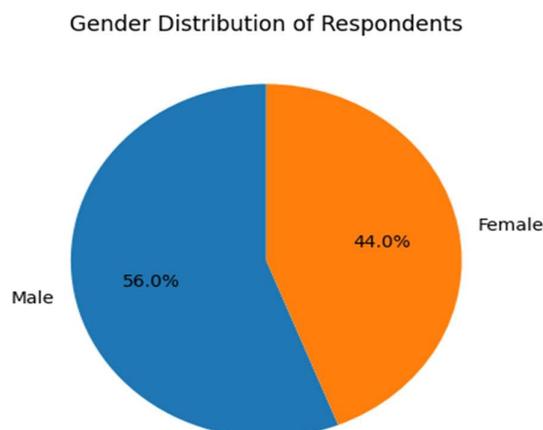
In this paper, the research design was quantitative in order to investigate how students see AI-based adaptive learning systems and their perceived impact on academic performance (Afzal et al., 2025; Ullah et al., 2024). The survey-based method was employed because it enables the collection of data in a large population systematically and statistical analysis of trends, relationships, and patterns. The quantitative design was deemed to be suitable in terms of measuring variables of awareness, perceived usefulness, personalization, engagement, challenges, and behavioural intention in a structured and objective way.

Population and Sample

The study target population was comprised of students of various learning levels such as secondary, undergraduate, graduate, and postgraduate students who had previously been exposed to AI-based learning systems. The number of respondents who took part in the study was 300. The sample comprised students with different ages, gender, academic levels, and experience with artificial intelligence levels. This diversity served to make sure that the findings are representative of a wide range of student views on adaptive learning technologies.

Figure 1

Gender distribution



Data Collection Instrument

A structured questionnaire was used to collect data to measure the constructs of interest that are



relevant to AI-based adaptive learning systems. The questionnaire was divided into several sections which included demographic data, understanding of AI-based adaptive learning systems, usefulness levels, personalization and adaptability, student engagement and motivation, effects on academic performance, challenges and limitations and behavioural intention to keep on using the systems. The responses were collected in the form of Likert-scale, where the respondents would indicate their degrees of agreement with each statement.

Data Collection Procedure

The questionnaire was sent out to the respondents electronically, so as to make it easily accessible and to ensure a greater participation. Before the data collection, the respondents were made aware of the objective of this study and were guaranteed that the information they would provide would not be disclosed to any third party. The study was voluntary and the questionnaire was free-flowing as the participants were asked to respond on their own experience with AI-based adaptive learning systems.

Data Analysis Techniques

Descriptive statistical methods were used to analyse the collected data. Demographic characteristics were summarized using frequencies and percentages whereas mean scores, and standard deviations were used to determine the perception of the respondents on various variables of the study. Results concerning awareness, perceived usefulness, personalization, engagement, academic performance, challenges, and behavioural intention were presented in graphical representations. These methods enabled one to make a clear interpretation and comparison of the responses based on dimensions.

Ethical Considerations

The study was done with ethical considerations being put into consideration. Anonymity and confidentiality of the respondents was ensured and no information that could be linked to a particular individual was gathered. Participation was completely voluntary, and the respondents were allowed to drop out anytime. The research followed ethical research conducts to promote integrity, transparency and respect to the participants.

Data Analysis

Data analysis is the labour of transforming nasty, dulling data into something that actually carries a meaning. It is about gathering, washing, and analysing data to uncover patterns, trends, and issues lurking in the plain sight. Good analysis can also assist people in making decisions relying on facts rather than guessing, which is unusual but pleasant. At the best, data analysis provides answers to actual questions and spares everyone the trouble of acting confidently in the wrong direction.

Table 1

Demographic Profile of Respondents

Variable	Category	Frequency	Percentage (%)
Gender	Male	168	56.0
	Female	132	44.0
Age Group	Below 18	24	8.0
	18–22	102	34.0
	23–27	84	28.0
	28–35	60	20.0
	Above 35	30	10.0
Level of Study	Secondary	66	22.0
	Undergraduate	132	44.0
	Graduate	60	20.0
	Postgraduate	42	14.0
Experience with AI	< 6 months	78	26.0
	6 months–1 year	72	24.0
	1–2 years	90	30.0
	> 2 years	60	20.0



Table 1 shows the demographics of 300 respondents. It has a small sample size that is male dominated with males constituting 56% and females 44% meaning that it has a fairly balanced gender distribution.

Regarding the age, most of the respondents are in the age group of 18-27 (62%), which demonstrates that the research is mostly based on young adults. The population between 28 and 35 years of age makes up 20% and those individuals over 35 constitute a lower percentage (10%). The lowest group includes participants who were younger than 18 (8%).

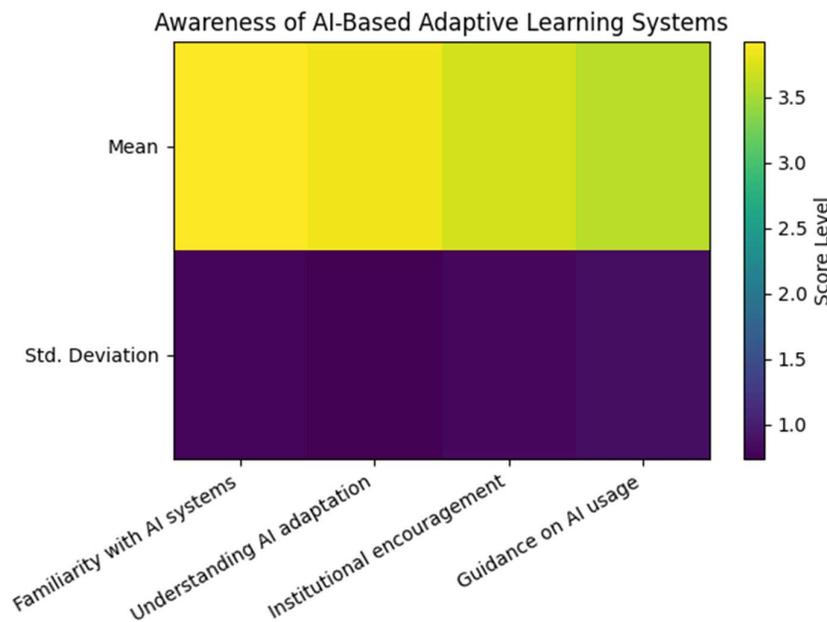
In terms of educational level, the majority of the respondents are undergraduates (44%), then there are secondary-level students (22%), and graduates (20%). The postgraduates represent the least percentage of 14% indicating that the sample is mostly made up of people in the early to mid-higher education stages.

Respondents have mixed experience with AI, with the most having 1-2 years of practice (30%). The 50% of the sample is represented by those who have less than one year experience and 20% had over two years experience. It shows an average level of exposure to AI, and most participants have a low level of experience in the long-term.

Overall, the sample of the respondents is relatively young, undergraduate, and moderately familiar with AI, which is suitable to analyse perceptions and the usage patterns of the early and young users of AI.

Figure 2

Awareness of AI-Based Adaptive Learning Systems



The findings show that the awareness of AI-based adaptive learning systems is high, in general, and that the dimensions of awareness are relatively high. The mean scores vary between around 3.6 and 3.9, which presupposes that the respondents are well familiar with the system of AI, and have a good grasp of the concept of AI-driven adaptation in learning settings.

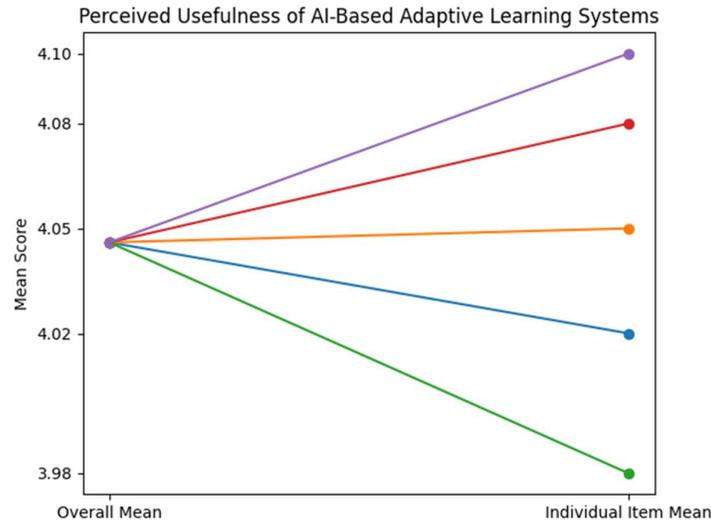
The familiarity with the AI systems is noted to have the highest average score that indicates the extensive exposure and general knowledge of the AI technologies. Mean values of institutional encouragement and guidance on AI use are slightly lower, but thematic as well, indicating that although awareness may be high, formal support and structured guidance by institutions may be relatively less prominent.

All variables have low values of standard deviation (around 0.75-0.9), which implies that there is not a high degree of variability in the responses. This is an indication that there is a general view of the respondents on the awareness of AI and there is little variance in the subjective views.

In general, the results represent a highly informed respondent pool with the same level of awareness of the AI-based adaptive learning systems, and a possible necessity of better institutional leadership and systematic assistance to the use of AI.



Figure 3
Perceived Usefulness of AI-Based Adaptive Learning Systems



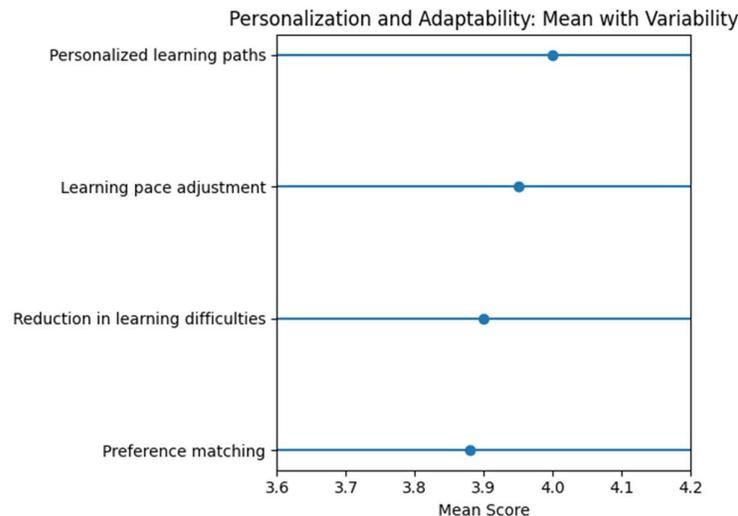
The results show that AI-based adaptive learning systems are highly perceived to be useful. The general mean and the separate item means are all above 4.0, which represents a great deal of consensus among the respondents about the merits of these systems.

There is a slight difference between the individual item mean, with the magnitude of difference being around 3.98 to 4.10. This limited dispersion indicates that the respondents have a fairly homogenous perception of various dimensions of usefulness, with no dimension having a significant advantage or disadvantage over the rest.

The fact that some of the individual items means slightly exceed the overall mean suggests that there are particular aspects of AI-based adaptive learning that are considered especially useful. On the other hand, the slight decrease on one item is within high agreement and does not mean dissatisfaction.

All in all, the data shows that there is a positive perception of the applicability of AI-based adaptive learning systems, which is consistent and has high levels of agreement between respondents and little variability in the measured items.

Figure 4
Personalization and Adaptability





The findings show that there is strong agreement concerning the personalization and adaptability aspect of AI-based adaptive learning systems. Overall mean scores of all dimensions are between about 3.9 to 4.1 which displays a positive perception among all respondents.

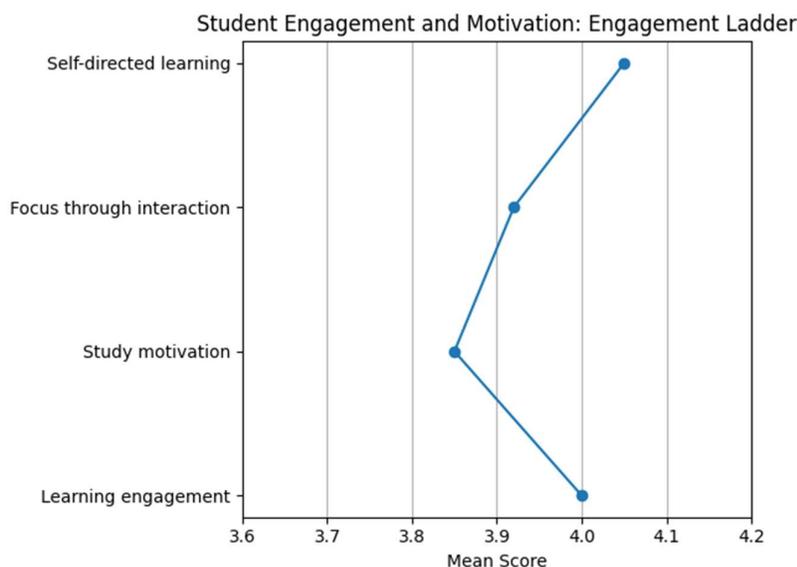
Individualized learning tracks note the largest mean score, indicating that the respondents are highly aware of the capability of the system to provide learning material that is designed to address individual needs. The learning pace adjustment is also rated very high, which implies that respondents appreciate the flexibility to advance at a pace that works well with their capabilities.

Reduction in learning challenges and affection an equivalent are somewhat lesser but yet high average scores, which means that even though the two properties are favourably viewed, their effectiveness is considered as somewhat inferior to the content customization and rate.

In general, the relatively low variance of items indicates a consistent response of participants. The results affirm that individualization and flexibility are the major advantages of the AI-based adaptive learning systems, and the adaptive pacing and the personalized learning paths are significantly supported.

Figure 5

Student Engagement and Motivation



The results reveal that the student engagement and motivation levels remain relatively high when using AI-based adaptive learning systems. The mean scores in all dimensions range between 3.85 and 4.05, which is a positive respondent perception.

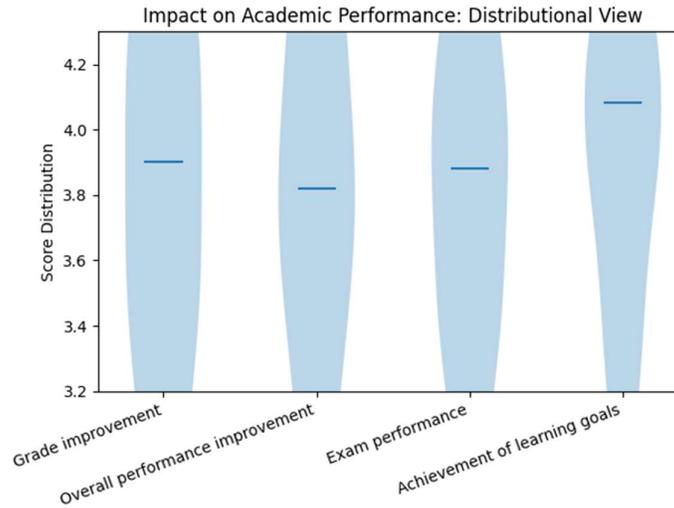
The mean score in self-directed learning is the highest, which indicates that AI-based systems are effective in facilitating learner autonomy and independent studying habits. The learning engagement also has a high mean value which implies that these systems are effective in keeping the students engaged in the learning process.

The interaction focus implies that the interactive properties have a moderately high mean score, which means that the interactive features bring a positive contribution to the process of retaining attention during learning procedures. The motivation in studies has the lowest relative mean, but it is still positive, which also means that AI systems facilitate motivation, but this effect is slightly less pronounced than their contribution to engagement and autonomy.

In general, the findings indicate that AI-based adaptive learning systems can be successfully used to increase student engagement and self-directed learning and have a consistent but less pronounced effect on intrinsic study motivation.



Figure 6
Impact on Academic Performance



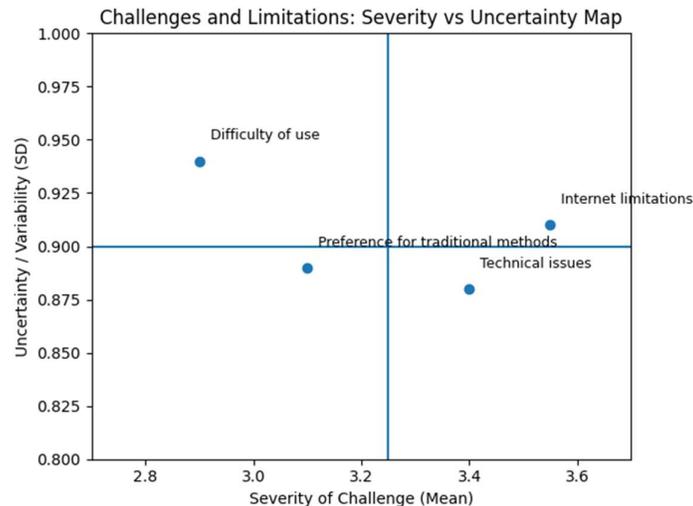
The analysis of the distribution reveals that AI-based adaptive learning systems have a positive perceived effect on academic performance. All the mean scores in the dimensions are concentrated towards the higher end of the scale which is around 3.8-4.1 which is a positive rating on the respondents.

The highest central tendency is achieved with the achievement of the learning goals, which implies that respondents view AI-based systems as especially efficient in assisting learners in achieving the set academic goals. Strong mean values are also exhibited in grade improvement and performance in exams demonstrating that these systems are considered as conducive to quantifiable academic performance.

The overall performance improvement has a slightly lower mean than that of other dimensions, however, it is within the positive range meaning that although general performance gains are admitted, they might not be as significant as specific outcomes-based improvements.

The fact that the distributions are relatively narrow indicates that there is consistency in respondent perceptions. Generally, the results validate the hypothesis that AI-based adaptive learning systems have a positive impact on academic performance, in particular, the attainment of learning objectives and enhancement of assessment-related outcomes.

Figure 7
Challenges and Limitations





The severity vs uncertainty map outlines the most common struggles connected with AI-based adaptive learning systems with the distinction made on the intensity and variability of responses.

The most severe issue is identified to be internet limitations, with the mean score being very high meaning that this factor has been seen as a major challenge to effective adoption. Its uncertainty is quite high, which implies that it affects different respondents in different ways, and that may be due to the differences in accessibility and infrastructure.

The severity is also high, but the uncertainty is relatively lower in technical issues, which opens to the understanding that the problems are well-known to most people, but they have a more similar perspective on their effects.

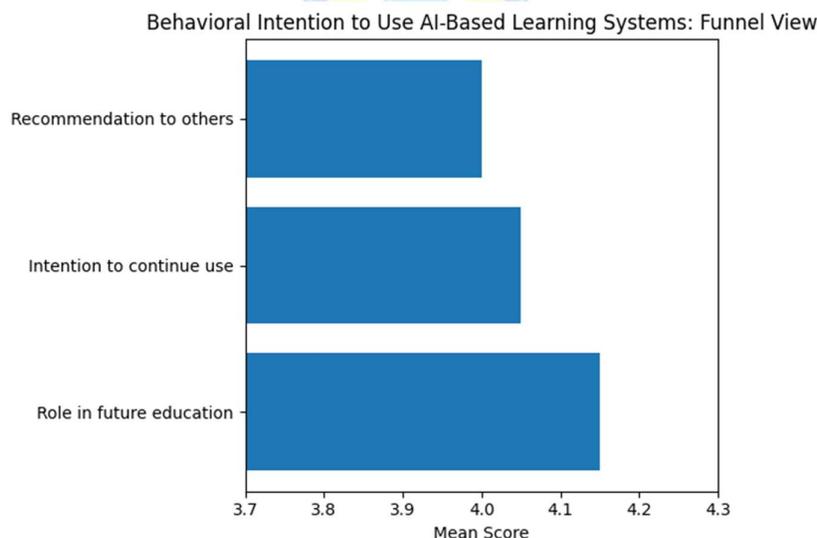
The difficulty of use is moderately severe but the most varied indicating a significant difference in the user experience across respondents. It means that the problem of usability is not universal and can be related to specific digital expertise or previous experience with the AI-systems.

The bias towards traditional processes marks the moderate levels of severity and decreased uncertainty and suggests a relatively moderate but not very acute opposition to the implementation of AI-based learning than technical and infrastructural barriers do.

On the whole, the results indicate that infrastructural and technical barriers can be considered as the most significant obstacles, whereas the issues of usability and opposition to traditional learning approach are more varied among users.

Figure 8

Behavioral Intention to Use AI-Based Learning Systems



The findings show that behavioural intention to further use the AI-based learning systems is strong and positive. All the dimensions have mean scores that nearly or exceed 4.0, which indicates a high acceptance of respondents.

The best mean score can be obtained concerning the perceived role of AI in future education, which means that the participants are highly convinced that AI-based learning systems will contribute significantly and permanently to the educational setting. This implies long term acceptance over short term experimentation.

Intention to carry on also scores high on mean score showing that the respondents are not only satisfied with the current usage but are also willing to continue to be engaged by these systems in the long run.

Recommendation to others has slightly lower mean score than the other dimensions, although it lies within the positive range. It indicates that, on the one hand, users might have a positive attitude to AI-based learning systems themselves, although they are somehow more hesitant to recommend them to others.

Overall, the findings show that the readiness to adopt and use AI-based learning systems is high, and



the attitude towards the prospect of their applicability to the educational sector is exceptionally positive.

Discussion

The findings of this study indicate that AI adaptive learning systems are noteworthy in enhancing the learning process and perception of academic achievement among students. The fact that the majority of the respondents indicated that they experienced high awareness level is a sign that learners are increasingly becoming familiar with the AI-driven educational technologies and this could be attributed to the popularity of use of digital platforms in the learning process. It is comparable to the prior research that reveals that awareness and institutional exposure are critical factors in successful adaptive learning system adoption (Mustafa et al., 2024; Sari et al., 2024). However, a bit lower perceptions regarding institutional guidance imply that, despite the students already being aware of AI tools, they require additional support systems.

The perceived usefulness emerged one of the strongest dimensions in the study, and the respondents constantly realized the usefulness of AI-based systems to improve the efficiency of the learning and comprehension process. The finding is consistent with other studies, which have indicated that the adaptive learning technologies are helpful to enhance the learning process by identifying the gaps in knowledge and providing targeted instructions (Ezzaim et al., 2022; Gupta et al., 2024). The fact that the respondents had an overwhelming agreement also signifies that usefulness is a significant factor that contributes to the acceptance and further use of AI-based learning systems.

Personalization and adaptability were also valued significantly, and this supports the essence of the core value proposition of adaptive learning technologies. Individualized learning paths and adaptive pacing proved to be significant advantages especially to respondents. The findings align with the existing literature that emphasizes the personalization process as the means of decreasing cognitive overload and ensuring the satisfaction of various learning requirements (Joshi, 2024; Younas et al., 2022). The capability to modify content, according to the performance of learners, seems to add value to enhanced learning experiences.

The responses to student engagement and motivation were positive but slightly different. Although the percentage of engagement and self-directed learning were highly rated, intrinsic motivation was rated relatively low. This indicates that regardless of the effectiveness of AI-based systems to improve interaction and autonomy, the motivation can still rely on other variables like instructional design, the purpose of learners, and external motivation. The same trends have been reported in previous studies investigating AI-supported learning settings (Cho, 2022; Adewale et al., 2024).

Regarding academic performance, the respondents believed that AI-based adaptive learning systems positively influenced, particularly the achievement of the learning outcomes and enhancement of the results associated with exams. It aligns with meta-analytic findings that adaptive systems have the potential to lead to measurable academic positive outcomes by creating successful implementations (Wang et al., 2024; Ullah et al., 2024). However, the overall performance increased slightly, which suggests that the influence on the performance in the academic sphere in the long run may have to be preserved and have the system optimized.

Even though these benefits have been mentioned, other factors such as internet restrictions and technical issues are a key setback. These findings are echoing the issues raised in past research regarding limitations in infrastructures as well as usability issues as the constraining factors in the uptake (Saleem et al., 2025). Nevertheless, the behavioural intention was also found to be high, and this suggests the possibility of AI potentially playing a role in education in the future offering hope that more support and infrastructure can be enhanced, then adaptive learning systems can become offered to approach the integration more broadly and effectively.

Conclusion

This study, in its turn, concludes that AI-based adaptive learning tools have a significant and positive impact on the learning process and perceived academic success of the students as well. Among the findings, it is possible to note that the students tend to be quite familiar with AI-based learning technologies, and they are aware of how useful they can be in supporting academic practices. Personalized learning paths, adaptive pacing, as well as real-time feedback, were identified as the primary strengths of such systems that enabled the learners to engage the content more effectively and progress in respond to its own needs. The results also suggest that AI-based adaptive learning applications promote self-directed learning and sustained interactions



which are essential aspects of effective academic performance. Students also perceive these systems as a helpful tool to achieve learning goals, improve test preparation, and academic performance, which implies that it can be used in modern education.

However, the paper also highlights several issues that are capable of limiting the potential of adaptive learning systems built on AI. Technical issues, lack of internet connection, and the existence of the disparity in the usability rates of the system were identified as one of the most crucial barriers. These issues indicate that although AI-based systems have robust pedagogical advantages, the success of the system is greatly contingent on the supportive infrastructure and the ease of use. Also, despite the high levels of engagement and autonomy, the relatively reduced effectiveness on intrinsic motivation suggests that adaptive systems are to be used as solutions to, as opposed to substitutes of effective instructional methods and human interaction. The results also indicate that students have a high behavioural intention to persist in using AI-based learning systems, which show their assurance in its future applicability and relevance to education.

Recommendations

It is possible to draw some recommendations based on these conclusions. To reduce the barrier to effective use of the systems through connectivity and technical barriers, educational institutions are encouraged to invest on reliable technological infrastructure. They would have also arranged training and orientation programs on how to maximize the adaptive learning systems provided by the institutions to ensure that they equip the students with the knowledge they require. Such attempts can enhance the use of the system, reduce frustration, and ensure active engagement. It is suggested that educators should contemplate deploying AI-based adaptive learning tools alongside traditional teaching methods to provide a balanced learning environment, where personalization should be combined with human guidance. A mixed solution of this kind can help address the motivational gaps and maximize the adaptive technologies.

The system developers should focus on improving the user interface design and responsiveness of the system to address the needs of learners of varying levels of digital literacy. Ease of navigation and making the process of content adaptation transparent would enhance user satisfaction and trust. Besides that, policymakers and academic planners should incorporate AI-based adaptive learning systems in a long-term educational plan to ensure that every student, irrespective of his or her socioeconomic status, has an equal access to the same. Finally, future research should examine the longitudinal effects of adaptive learning systems on academic performance and how specific system features might affect learning outcomes in other fields and groups of learners. Overall, it could be said that AI-based adaptive learning systems, when properly supported by infrastructure, training, and pedagogical alignment, can become the transformative force that would enhance the quality of education and student achievement.

Authors Contributions

All the authors participated in the ideation, development, and final approval of the manuscript, making significant contributions to the work reported.

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Statement of Data Availability

The corresponding author can provide the data used in this study upon request.

Conflicts of Interest

The authors declare no conflict of interest.

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