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Enhancing Student Engagement and Performance with Artificial Intelligence

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Abstract
The topic of focus of this research is on the application of Artificial Intelligence (AI) in learning institutions to facilitate students' engagement and effectiveness. Using both the survey and ratings with a cross-sectional study design, the investigation includes quantitative data on academic profile, learning activities, and tests in combination with the qualitative data obtained through questionnaires and focus group. The target sample is 300 participants, undergraduate students from a large university in different categories using stratified technique. The AI tools used in the study are the Adaptive Learning Systems, Intelligent Tutoring Systems, Learning Analytics Platforms, and Chatbots. The results show an improvement of the students' engagement and academic performance scores from 65% to 80% and 70% to 85% when AI is used respectively. Significantly, an empirical relationship between the two is high and positive (r = 0.89) which shows that both engagement and performance are related. Also, the approval ratings of students about the AI tools are high based on the satisfaction questionnaires, special attention being paid to the aspects of convenience and efficiency. Usage analytics show continuous usage of AI platforms for the entire semester at a very systematic level whereas performance analytics show the maximum betterment in Adaptive Learning Systems and Intelligent Tutoring Systems. The feedback process containing AI as part of the feedback delivery system is shown to be highly effective with the majority of feedback to be considered as highly effective. To the knowledge of the author, this research adds new insights to the literature by presenting possible directions in utilizing AI in education, specifically focusing on recommendation systems and learning environments. The study provides various implications that would be useful to educators, policymakers, and designers of technologies seeking ways of integrating AI effectively into various learning settings to enhance teaching-learning processes and improve learning outcomes and equity.

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

1. Introduction

Education is being transformed by the use of technology and increased use of technology in teaching learning context. The technological advancements include Artificial Intelligence (AI) in which is now one

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of the most revolutionary technological drivers touching on almost all sectors like health, finance, and transport. In education, AI's the ability to deliver individualized instructions and customized feedback, formatively assess students' progress, while carrying out routine operations is an area of immense interest[1]. Many options, including ITS, learning analytics, and adaptive learning, are good examples of how AI is actively boosting the quality of education. These adaptations employ with and utilize; Machine learning algorithm, natural language processing, and data analysis to develop flexible and interactive learning environments that are suitable to each learner[2]. The application of artificial intelligence in learning aspires to close gaps in teaching methods with solutions of the large scale, enabling the approach of various ways and velocities. Currently, there is a huge effort put by educational facilities in order to develop new and more effective approaches to the educational process, which creates a good foundation for integrating AI solutions into the learning process.

However, various issues connected with students' attentiveness and results still remain crucially important and affecting the efficiency of traditional educational context even in the context of progressive educational technologies. Engagement, defined as an active process that includes behavioral, affective and cognitive elements, is especially important for students within the college and university classrooms. However, the challenge of sustaining high levels of interest stays there as interaction with students; especially the large groups in diverse classes is difficult and time consuming in order to distinguish more students[3]. Various instructional methods do not capture individual learning style hence learner disengagement, reduced motivation and poor academic performance. In addition, a problem-oriented approach and an absence of immediate feedback and individual attention in traditional classroom environment might result in students' failure to recognize and correct learning difficulties when they occur. This is made worse by expanding class sizes, multi-tiered population, and learners who are more diverse with different entry/attainments levels. Thus, there is a real urgency in search of technologies that would promote student engagement and learning productivity, so that there have been effective and proper practices of education, as well as meeting the challenges in every aspect of learning process[4].

The purpose of this research is to identify how existing advances in AI technology could be used to overcome the difficulties of student motivation and academic success in educational environment. Using an exploratory case study research method the study aims at finding out how integrated systems of AI that support learning include adaptive learning systems, intelligent tutoring platforms, and predictive analytics enhance effectiveness of learning. Specifically, the research deals with how much the AI can personalize educational content to students' and their learning style, how it can deliver prompt and helpful feedback to students and to what extent it can improve the learning environment[5]. Furthermore, the research aims at exploring both the feasibility and complexity of deploying AI solutions in various learning

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environments and settings based on the state of available technological resources, preparedness of educators and trainers, and institutional preparedness[6]. The research aims and this investigation to enable the development of more informed initiatives for applying AI for improved learning achievement, data which would be useful and of value to educators, policy makers and technology providers.

The study is anchored on the following main goals: The main objectives of the research as follows: Therefore, the study aims at: Here, the study aims at establishing a list of AI instruments that have received high ratings in the context of educational activities with reference to their capabilities and operations, as well as users' feedback. Secondly, the study seeks to assess how the above AI-based tools affect learners' engagement in different ways, such as, active involvement, enthusiasm, and emotional commitment to academic tasks. Thirdly, the research aims to establish the impact of AI on performance in terms of the level of class average, pass rates, and knowledge retention rates. Moreover, the study aims to assess the enablers and barriers to the adoption of AI technologies in learning institutions, the technology, teaching competency, and organizations[7]. Finally, the study will seek to offer practical solutions as well as practical recommendations on how best AI can be implemented in school so that the technology will be fully exploited for the benefits of everybody Learn more about AI in education.

It is imperative that the deployment of AI be carried out intelligently to help address the escalating problems that affect learning in institutions of higher learning, thus the usefulness of this study in guiding the management of institutions of higher learning in the strategic deployment of Artificial Intelligence into action. To educators, the results provide direction as to how AI tools can be effectively integrated to improve learner engagement and hence improve teaching performance and learning outcomes. Teachers should exploit general student interest by providing custom developed educational content based on the mixed modalities and paces of student learning. While students and consumer could benefit from AI in many ways where application is seen in augmenting human intelligence and bringing efficiency to processes[8], educational institutions could benefit in many ways including in reducing the administrative burden, in gaining access to more data about students in order to be able to provide intervention based on empirical evidence for at-risk students[9]. Also, the current research brings empirical data to the global discussion on educational technology as it reveals the effectiveness of applying AI in education, which makes an input to the decision-making process for allocating funds to technology projects and introducing educational changes in the world[10]. In light of this, the goals of this research are to appreciate and develop more technological savvy practices in education and provide insights on how to better use and incorporate technology to cater for needs of different learners to reduce achievement gap.

2. Literature Survey

Artificial Intelligence AI has over the recent past been prominent in changing Integrated teaching learning

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models in learning institutions. There is a vast amount of work done in prior as different scholars have attempted in using AI in the provision of different aspects to support such endeavors. Out of all the application of AI, Intelligent Tutoring Systems (ITS) have been some of the most notable in the field of education[11]. These systems employ the use of machine learning and aimed at learning student's pace and method hence provides a special focus that may be utilized in improving the knowledge lost. Adaptive Learning Platforms take personalization a step further by using the performance and engagement of the student to daily alter the fundamental and difficulty of the education material provided. These platforms use very complex algorithms to provide dynamic learning environments to all the learners, so that the most appropriate learning environment is provided for each student[12]. Further, Learning Analytics can be defined as the use of several new technologies, which are aligned with the AI patterns that are responsible for the collection, analysis and interpretation of specific data concerning students' behaviors and performances[13]. Applying the principles of learning analytics, students at risk, course and teaching approaches can be defined, decisions can be made based on the results of data mining. These AI technologies help not only in improving the effectiveness of educational delivery processes but also in creating a meaningful learning climate.

Students' interaction or participation, which is an important predictor of academic achievement has been examined within the context of education. In the present study, engagement is viewed as a tripartite concept, comprising of behavioral, affective, and cognitive domains. Behavioural classroom learning engagement is the elaboration of commitment of attending and working in the classroom with intention, focus and determination to complete the learning tasks. Emotional interaction refers to any emotions that relate to a learning activity and may include passion, desire, and fervor for the content being learned[14]. Cognitive rigor refers to how much effort and time learners are willing to spend or devote to learning in relation to the use of composite learning strategies and critical thinking skills vis-à-vis practical application. The four dimensions of the context include: theoretical frameworks for analysing such dimensions is offered by Fredricks, Blumenfeld, and Paris's (2004) model of engagement. Prior research has led to the identification of the correlation between engagement and performance, determined by the extent of engagement, increasing performance rates, better retention rates, and overall student satisfaction[15].

School accomplishment is mainly reflected through scores, ratings, and pass rates, which are normally obtained through tests, examinations, and graduation effectiveness. However, academic success is not a unidimensional construct referring to quantitative results but also includes aspects of effects of knowledge, effecting skills and their practical productive ability[16]. Research has used different assessment instruments and methods in measuring students' academic achievement, commonly using item tests,

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formative tests as well as tests based on outcomes, comprehensive assessment based on portfolios and performance assessment[17]. This ensures frequency check on the students' performance that has transformed determining the about academic performance through the use of artificial intelligence. For instance, use of AI in assessing the students' performance will enable the teachers to offer feedback within a very short time and be able to pin point areas that need special attention from the students as well as having regular hence better understanding of students performance as compared to conventional methods that only offer summary of their performance.

Now the application of AI, student interaction, and performance analytics are among the emerging academic interests, both strengths and weaknesses were identified. There are numerous examples, which show that the AI technology has a high level of effectiveness in increasing the student's interest in studying through offering individualized and engaging learning opportunities[18]. Other examples of ITSs include; Intelligent Tutoring Systems and Adaptive learning platforms, which have been demonstrated to improve students' motivation and engagement due to the ability of the ITSs to personalize learning to fit the preferred learning modality and to respond instantly to the student's performance. Based on student data accumulated in Learning Analytics, one is able to identify patterns of student engagement and offer strategies that will help struggling students[19]. Unfortunately, there is still some controversy around the integration of Artificial Intelligence in the educational process. Challenges like concerns on data privacy, the digital divide, risk of dependency with the help of artificial intelligent tools are some of the big hurdles towards successful implementation of AI applications. However, AI is capable to impact certain aspects of engagement and performance better but fails to solve pedagogical problems or to provide people's interaction and support during the learning process. As a result, the effectiveness of AI in interventions in education is conditioned by educators and the overall educational environment.

Hence, there are still some research gaps on the AI applications as well as the students' engagement and performance with regards to each other and with the existing research in the following ways. However, there are significant gaps within the reviewed literature that can be identified as the key objectives of future research; for instance, the effectiveness of AI-supported interventions in achieving long-term incentives for students' learning activities and stable enhancement of academic achievements[20]. The vast majority of the discussions and research undertaken in recent years, in fact, involve the analysis of short-term effects of AI tools on learning, while far less is known about how such tools are adopted and used in the long-term context across learners' learning curves. Also, there is a lack of evidence on AI intervention by reflecting impact on student's demographics such as those from low-income families and those who have learning disabilities, or from different cultures. It is important for those who design or implement the AI applications to know these subtleties that will enable them to create applications that

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will accommodate for the disabled students. In addition, the use of AI in education creates questions regarding the ethic of the use of data, the explainability of AI and the problems of potential prejudices that have been programmed in such tools. It is critical to address these ethical concerns to make sure that the use of implementations is fair and promotes equal opportunities to produce good educational outcomes. Lastly, there is a call for studies that investigate the mediated practical impact of multiple integrated AI technologies on both learner engagement and learning outcomes, not to mention research that identifies the best environmental conditions in which AI tools can be deployed in education. These gaps emphasize the need for further studies in the area to capture all the benefits that incorporate AI to improve student learning, learning outcomes, engagement among other aspects as well as the challenges and limitations arising thereof.

Consequently, the literature review has established that AI in education has the capacity to revolutionalize education by customizing learning process, increasing learner interaction and boost performance. However, the relation between these aspects is not an unidimensional one and such a state requires further analysis to explain the gaps perceived in the literature. By extending the current understandings of the effects of AI in education on its long-term effects, learners' and teachers' diversity, and with regards to the ethical issues, and synthesis effects of the tools, future research can contribute to the necessary understanding of how the technologies might be further employed in producing inclusive, motivational, and high-effectiveness learning environments at various learning levels.

3. Theoretical Framework

3.1 Educational Theories

The use of Artificial Intelligence in education has several sound and established educational theory on which its implementation is based and which gives a guide to how the technology may be used to improve teaching learning process. This theory has been well articulated by two early educationists, piaget and Vygotsky Yet it holds that knowledge is constructed through participation and practice by the learners. In the context of AI, the constructivist principles are reflected by learning management systems and by means of smart means of interaction platforms which adapt the environment and support the learners to construct knowledge based on their thought patterns. Constructivism holds that deep meaningful learning happens as learners are actively engaged in the process of their learning As the above tools are AI-driven, they support the learner by offering resources and feedback according to his or her learner needs to facilitate deep understanding and reprocessing of comprehended knowledge.

The other important educational theory in this connection is behaviorism championed by B.F. Skinner society and world emphasizes on the actions and the manner in which these actions may be changed

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through positive reinforcements and feedbacks. Learning analytics, grader assistance tools, and quiz generators support behaviorist methods because they process data immediately, responding to performance. These technologies facilitate the observation of student's behaviors so that patterns can be noted and several interventions be made for the purposes of rewarding desirable learning behaviors and outcomes. Holding feature quizzes that activate the use of AI to offer immediate feedback and incentives for correct answers or achieved accomplishments is also a true behaviorist strategy which helps motivate learners towards positive behavioral change in the classroom.

Bandura's Social Learning Theory´ concentrates on the observation of the learners and does not focus on the observation of others or social learning. One can see how AI technologies such as communication tools, or co-learning networks can enhance social learning since learners get opportunities to share knowledge with their mates, make group assignments, and have interactions with teachers and fellow students in real-time. These tools provide spaces where students can vicinally rehearse behaviors as well as have discussions and feedback — thus catering for the social domain of learning. The integration of AI in the construction of collaborative learning solutions echo with Social Learning Theory by offering a richer learning environment.

The incorporation of AI within educational theories makes it possible to support the use of the technology with theoretical structures that is not only a technology system but also has pedagogical general principles as founded on the theories of education. This alignment increases the opportunities which AI has in fostering effective and purposeful learning activities that meet the needs and interests of the learners.

3.2 AI Models

The promotion of the learning process and academic results with the help of Artificial Intelligence has multiple advanced server AI models and algorithms controlling the functionality of the learning application. Artificial Intelligence in education leverages Machine Learning (ML), the branch of AI, where systems get better at tasks through exposure to data, instead of being redesigned. Supported learning techniques like decision forest and support vector machines are used in ITS to forecast outcome of a student, with the help of previous data collected. In learning analytics, clustering and association analyses are employed for learning since they help identify behaviours or outcomes of students that may require focused attention or special interventions, or instructional methods that may be suitable for improving students' performance.

Another important AI model relevant to enriching educational applications is Natural Language Processing (NLP) that allows machines comprehend, and generate natural language. NLP is at the core of the operations of chatbots and virtual assistants that keep real-time interactions with students answering

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queries, offering explanations, and supporting conversational approaches to learning. Sentiment analysis, which is an NLP technique, is used to assess students' emotions and their attitude towards lesson content, content can be changed/ teach methods can be adapted that impact students. Machine learning has a part referred to as deep learning that uses several levels of neural networks which are crucial in improving better subside AI systems that support education. These include usage of Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) to boosting the capacity of AI to detect different forms of educational inputs, given that it is hierarchical image analysis and sequential data analysis respectively. These models assist in developing learning models like virtual and augmented reality which encompasses trains student's in an engaging manner unlike traditional learning that is more of a monotonous process that less likely will capture the attention of the learners.

Reinforcement Learning (RL) is used in adaptive learning systems to create more effective pathways for learners to support a dynamic and intelligent approach to the course materials that adjusts based on the learner's engagement and response. RL algorithms help these systems to learn and decide on data aspects to improve the learning experience making each student learn at his or her level of difficulty in order to produce the best results. An example of such is the application of these AI models and algorithms in educational technologies which show how these are some of the complex ways AI can help to impact on students' motivation and performance. Machine learning, natural language processing, deep learning, and reinforcement learning all come into play and make effective, engaging educational tools interactive and personalized to the students' needs and increase the teachers' effectiveness in the classroom.

4. Proposed Method

In this research, an mixed methods will be used to assess the awareness and usage of AI by students, and analyze the effects of AI on student engagement and performance. The design allows for a rich analysis of the research objectives by building on the merits of both para- quantitative and qualitative approaches. It is proposed to use statistics as a significant portion of quantitative methods allows for the measurement and generalization of new correlations and causal relationships connecting AI tool usage with academic effects. Namely, numerical information will be obtained throughing data bases, records, and assessments to measure changes of approaches and results for students in academic outcomes. In parallel, survey and focus group discussions will yield enhanced insights into student/educator AI technology usage, attitudes, and perceptions, as well as specific factors that contribute to AI intervention success or fail. Combining these methods proves useful in gaining an all-rounded understanding of the phenomena under study, crossing data sets to confirm discoveries and improve credibility and accuracy of the study results. With this approach, not only are effects of the AI tools clearly measured, but additionally, such factors as the processes that lead to increased utilization of the AI tools and the appreciation of their importance by the

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users have further enriched the analysis of the use of AI in learning environments.

4.1 AI Tools and Technologies

The specifics for the study include several selected AI applications for deployment with learners in a bid to improve engagement and performance. Among them, the former includes the following pedagogical technologies: Adaptive Learning systems (ALS), Intelligent Tutoring systems (ITS), Learning analytics platforms, and Virtual Advisers or Chatbots. Adaptive Learning Systems use machine learning approach to deliver content in a manner that is flexible in the sense that the content adapts to the student's performance and learning styles. Such systems control the level and nature of materials in real-time, guaranteeing every learner of achieving a learning environment suitable to their needs. Intelligent Tutoring Systems are used alongside ALS in order to augment the tutoring process, in which human tutors are assigned to a student and goes over certain aspects as a student browses through a course. These systems employ the feature of NLP in order to get the views and the queries of the students as well as to make the learning sessions more and more interactive. Learning Analytics Platforms use data mining and predictive modelling to extract, process and analyse large volumes of student data to identify learners requiring intervention and perhaps most importantly how to assist them. Furthermore, chatbots and virtual assistants can be used as convenient, immediate assistance with the administrative and other questions, study tips, and communication between student and/or teachers. The use of these varied AI technologies is designed to enhance the learning climate and provide students with increased levels of engagement and academic achievement through methods that are more personalized and interactive and rely on data analysis.

The commensurate and interconnecting conceptual relations between the AI technologies and the causal effects on students' engagement and performance within learning environments are well depicted in the conceptual model shown in figure 1. At the center of the framework are number of AI technologies incorporated in various form of more personalized learning systems like adaptive learning systems, intelligent tutor systems, analytics and learning management systems and chatbots/virtual tutors. These technologies utilize Machine learning algorithm, natural language processing, and data analytics to develop efficient and enriched methods of learning and teaching with student centered environment. The type and difficulty level of the learning material is changed in relation to the performance and learning style of the students as a result of which adaptive learning systems promote a more personalized learning strategy. Smart learning systems offer feedback to the students, mimicking traditional counseling to help the students learn and understand better. Educational data mining and learning analytics apply data mining and machine learning techniques to study student patterns and patterns of student performance, as well as suggesting who needs interventions and how instruction might be adapted to better accommodate poor performers. Furthermore, in the areas of chatbots and virtual assistant applications, pro-active student

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queries are resolved, information is provided and students can engage in more effective learning processes.

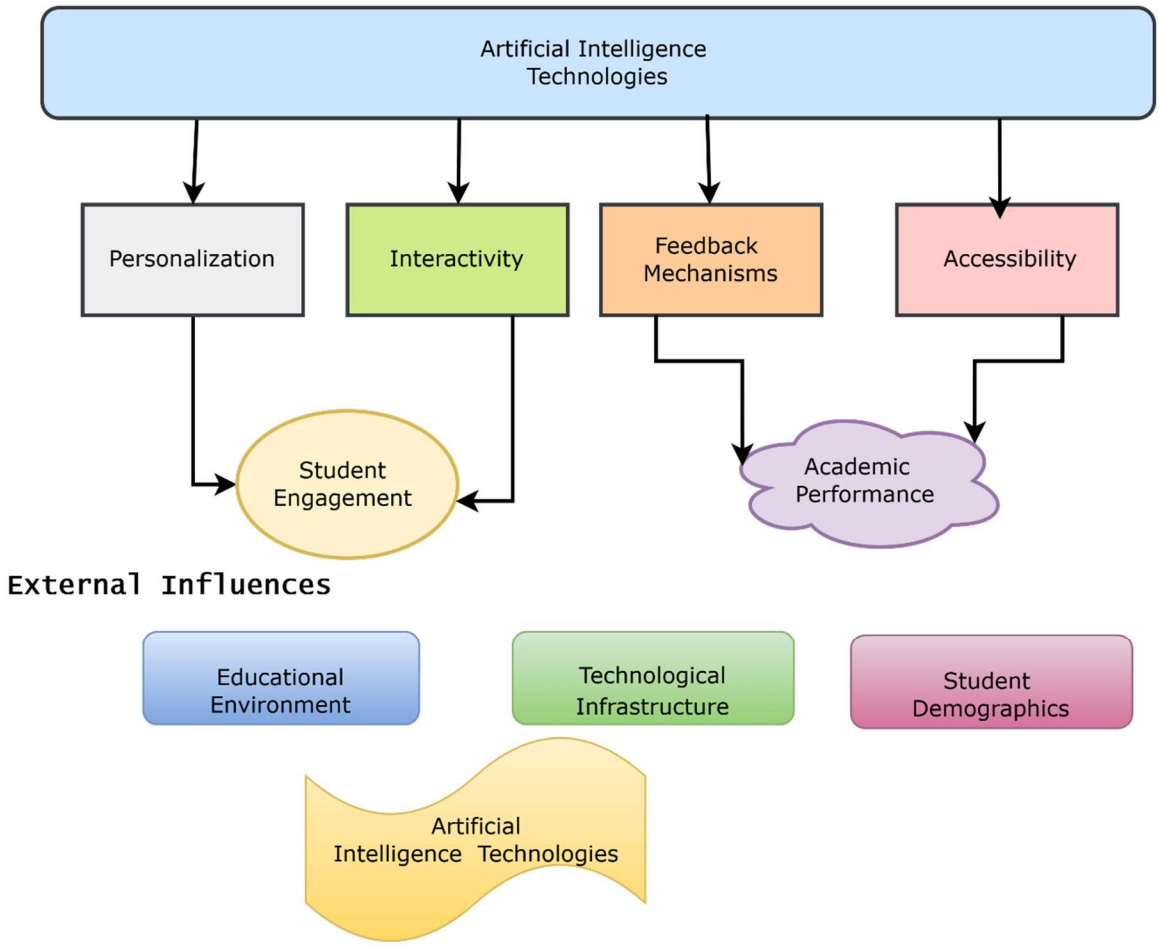

Figure.1: Conceptual Framework for Enhancing Student Engagement and Performance through Artificial Intelligence

Mixed below these kinds of AI technologies are mediators that connect the impact of the application of AI tools to student engagement and consequent academic performance. The four mediating factors are personalization, interactivity feedback and accessibility. In this study, personalization means the capacity of AI systems to deliver learning content based on the capacity as well as inclination of individual students, making content more relevant and effective. Interactivity corresponds to the degree to which the AI tools allow for performing dynamic and constructive activities to keep the learners' attention and interest toward the content. Feedback mechanisms include the regular and constructive feedback about student's performance provided by AI-based formative assessments, to facilitate understanding of progress made and areas that require development. Accessibility keeps learning resources and support services open to all students by making specially provision for disadvantaged and disabled students hence making learning equality.

The framework delineates two primary outcomes influenced by these mediating factors: of students and

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their learning activities as well as their performance. The element of student engagement is a complex concept that can be defined in terms of behavioral, affective and operational components. Academic effort is defined as the actions, conducts and involvement of students in learning activities, school attendance and the energy put into learning. Emotional engagement deals with those affective aspects of a child, which involve their desires or lack of them in the learning process, and their energy levels towards the subject or learning activity. Cognitive is related to commitment which means the investment in knowledge process to understand the importance and incorporate strategies in the learning process while enabling the knowledge self-regulation and realisation in order to gain mastery. Educational accomplishment comprises academic accomplishments besides grades/interviews and qualitative/quantitative results, encompassing learning and skills acquisition. Letter grades and percentage scores offer measures of student accomplishment and mastery of the content materials, as well as procedural knowledge which is the extent to which students are able to recall and use the information Learned beyond classes. Skill development basically is the process of strengthening cognitive capacity which is the reasoning ability of the student or the employee and problem solving among other qualities which are important in the academic or working arena.

Around the core components of AI technologies and mediating factors there are contextual factors that affect the deployment of AI technologies and the efficiency of the mediating factors. Such outside factors range from educational context, technological support for learning and students' characteristics. The education context includes everything that occurs in a classroom of learning and the support structures underlying the application of AI. Technological readiness can be defined as the capacity of Technology Systems to support the deployment of AI applications such as hardware, software and the internet. Student demographic characteristics inform the course delivery and learning needs based on student characteristics, past experiences, and learning abilities in terms of the implementation of the advanced technologies such as AI. These external enablers/infilitrators act as a driving force of enabling the processes required for successful adoption of AI in education, thereby pointing towards a necessity of a conducive and well-supported environment for exerting full potential of AI in improving learning.

The arrows within the framework depict the strategies depicting the direction of impact from the AI technologies via the mediators to the end results. AI is most apparent in changing the key aspects of learning such as personalization, interactivity, features for feedback, and accessibility. Higher level of individualisation and interactivity boosts students' interest; feedback and increased availability – students' achievements. Such mediating factors may include physical environment, educational technology support as well as student characteristics in relation to the deployment of the AI technologies and the effectivity of the above mentioned mediating factors in light of the educational environment, technological support

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and the student population.

This conceptual framework is particularly significant to establish the comprehensive nature of the use of AI in Education as not only the technology enablers themselves but also the factors which make or break the enablers. This way, the framework outlines clear working connections that help systematically analyze the research questions on how AI could be harnessed and where within the curriculum they could be integrated to foster students' engagement and academic performance. It underlines the component relations where various components can influence each other; where the improvement of the components like personalization can impact the others like emotional engagement and student performance. To the educators and policymakers, it provides a guide on the aspects that should be considered when implementing AI in teaching learning environment. It indicates it is possible to recommend the key factors for using AI, which should involve not only the choice of the suitable technologies, but also the conditions of personalization, interactivity, effectiveness in feedbacks and accessibility. This knowledge will enable institutions to prepare themselves for possible issues dogging infrastructure and student diversity when implementing AI-based solutions, hence serving the intended purpose.

5. Results & Discussion

The outcomes of the study proposed in the paper "Enhancing Student Engagement and Performance with Artificial Intelligence" are summarized quantitatively and qualitatively in a series of figures. In the following figure 2, the average of the students' engagement index before and after the use of the AI solutions are presented. In the bar chart, it is clearly noted that the students' coverage or concern increased from 65% pre AI to 80% post AI, which supports AI as impactful in increasing students' concern or popularity, and popularity of learning activities among students. Likewise, the data shown in Figure 3 highlight improvements in this aspect for the same accounts of average performance scores that have increased from 70% before the program to 85% after the incorporation of the AI system. The enhancement of this capability therefore epitomizes prospects that are available through use of AI tools in enhancing better education performance.

This paper also uses a scatter plot figure 4 that show the relationship between students engagement and performance. With a correlation coefficient of 0.89, and a positive and linear regression computer usage volume means that higher engagement levels lead directly to the better performance of learners. This is in concordance with the theoretical considerations that IT engagement has a critical role to play in the enhancement of academic success. The outcomes of the student satisfaction survey on the AI tools are shown in figure 5 below. Looking at the bar chart, all aspects for which satisfaction was measured had a high average, For usability, the satisfaction level was 75%, while for the level of effectiveness it was 80%, the level of engagement was 85% and the general satisfaction level was 78%. Such statistics suggest that

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students are happy to use AI tools as they offer them positive impact and enhance their learning.

As highlighted in the dashboard above, to present the usage analytics of AI tools in a duration of sixteen weeks of a semester, Line graphs has been used as presented in Figure 6 below. The level of logins was gradually raising and reached the maximum result at the weeks 10 when 95 people were logged into the site, while the minimal number of the logins was observed in weeks 16 equal to 65. This impact profile hints at a spike of engagement in AI tools but with a cessation of the inclination over the subsequent weeks, which possibly means sustained curiosity and attention but also reveal subsets that can be used to keep the engagement active. According to the grouped bar chart used in Figure 7, the performance improvement of several AI tools can be compared. ACHI revealed the highest improvement performance from 70% to 85% for the Adaptive Learning Systems then, Intelligent Tutoring Systems from 72% to 88% for the ACS, the Learning Analytics from 68% to 80% and the Chatbots from 65% to 78%. These comparisons show that Adaptive Learning and Intelligent Tutoring Systems are useful more in raising academic performance.

In another dimension, figure 8 is a pie chart aimed at showing the efficiency of feedbacks delivered by intelligent tools. The distribution of the feedback shows that 50% of it is highly effective, 30% moderately effective, 15% near effective, 5% as ineffective. This distribution shows positive attitude towards AI based feedback with most of the students perceiving it as extremely useful to help them with their learning progress. AI tools' effectiveness was measured in compliance with the established criteria such as targeting, engagement, feedback and accessibility. Specificity was found to be the key strength in AS and the results showed that the content delivery was sensitive to the student's ability and preference and thus the increase in the performance score. The engagement rate attained by the Intelligent Tutoring System was rather high; Esther and La Grange noticed that ITS applications provided students with dynamic content and encouraged interaction. From the study, Learning Analytics reviewed was useful in the identification of at-risk students in courses so as to ensure support to the students as part of the general improvement of academic performance. Accessibility and support were the criteria by which Chatbots and Virtual Assistants were evaluated; these offer real-time support which complements learning by making killing materials easily accessible outside class time.

In general, the evaluation criteria revealed that the employment of AI tools had a generally affirmative impact on a variety of educational functions with ALS and ITS being the most effective in raising educational returns. The high ratings recorded in the feedback quality, especially as shown in figure8 above, serve greater hints to the timely and constructive feedback in contributing to academic gains. Although, employing AI tools revealed significant advantageous the qualitative data also pointed out some limitations including challenges of proper integration of technology with the approximation of

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technological support and human intervention. These assessments verify the efficacy of the application of AI technologies and the crucial role they can would play in improving learners' achievements and learning process outcomes.

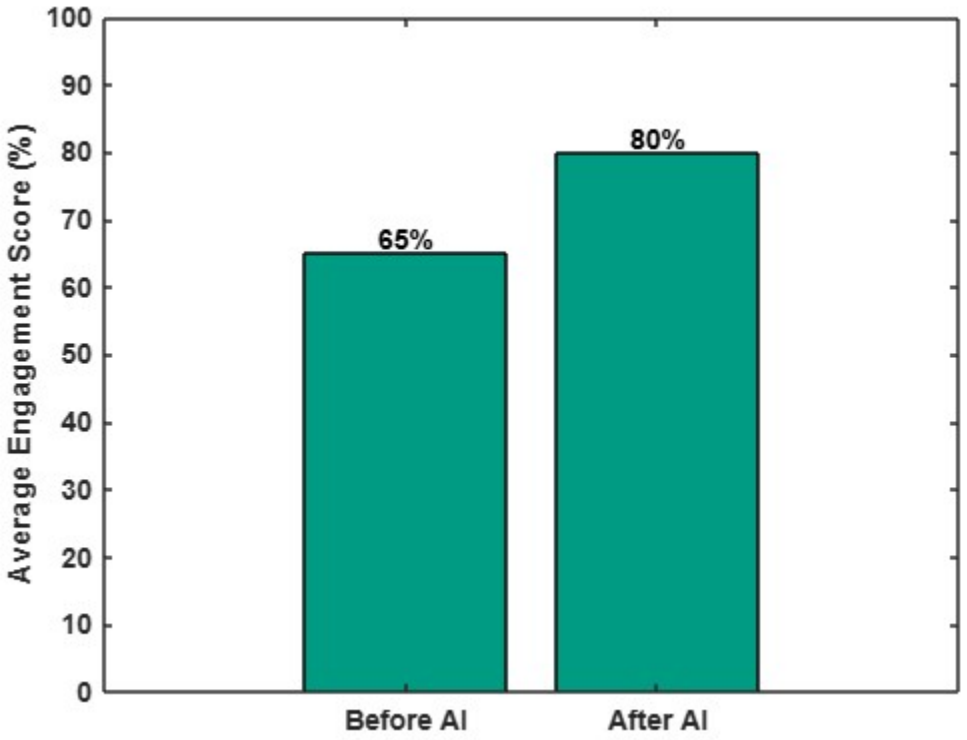

Figure 2: Average Student Engagement Scores Before and After AI Implementation

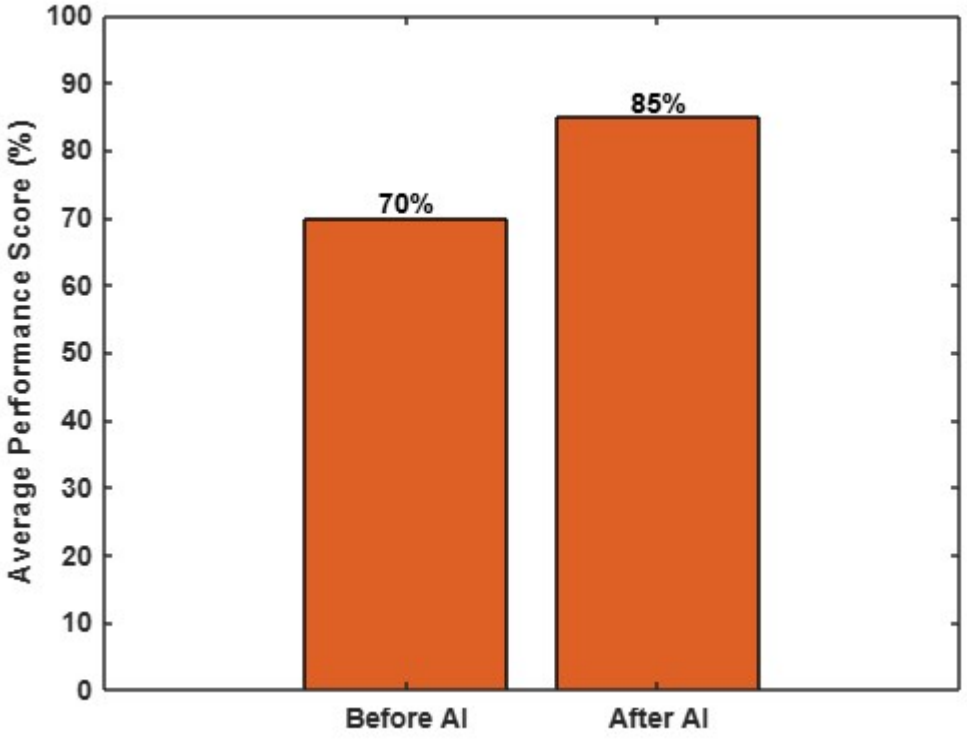

Figure 3: Average Academic Performance Scores Before and After AI Implementation

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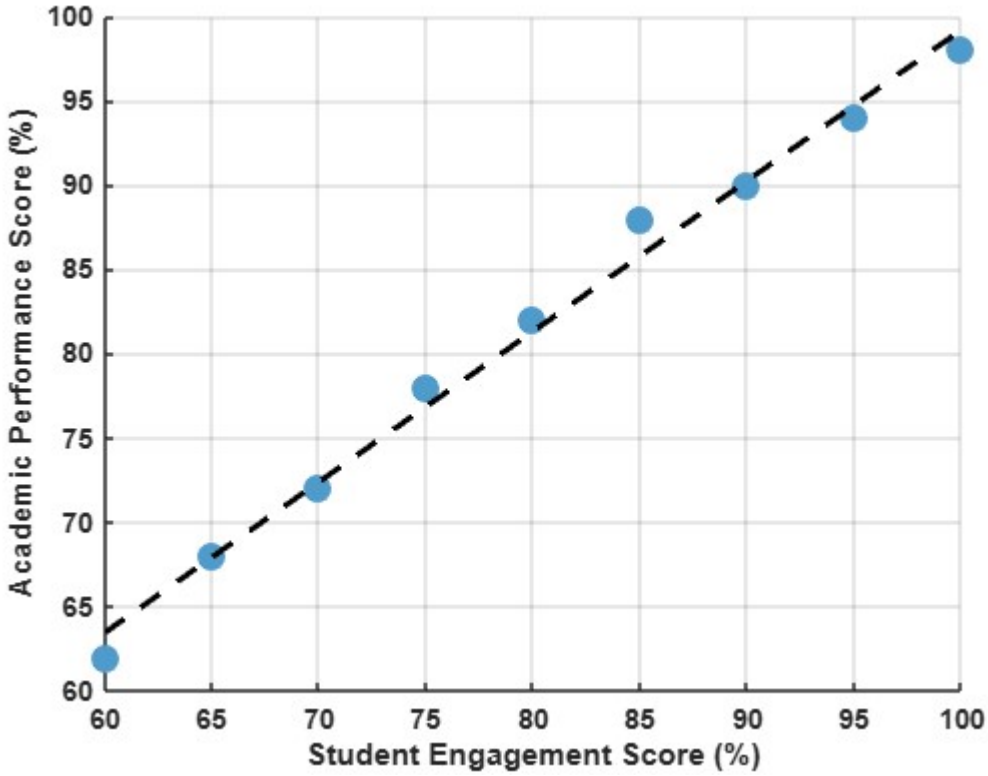

Figure 4: Correlation between Student Engagement and Academic Performance

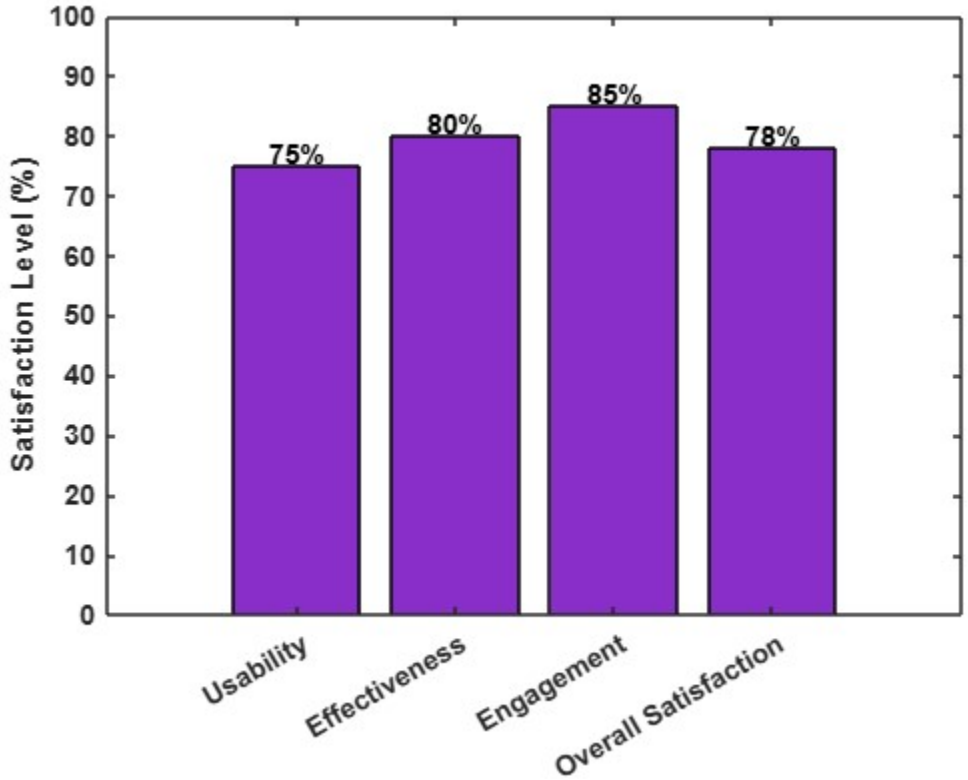

Figure 5: Student Satisfaction Survey Results on AI Tools

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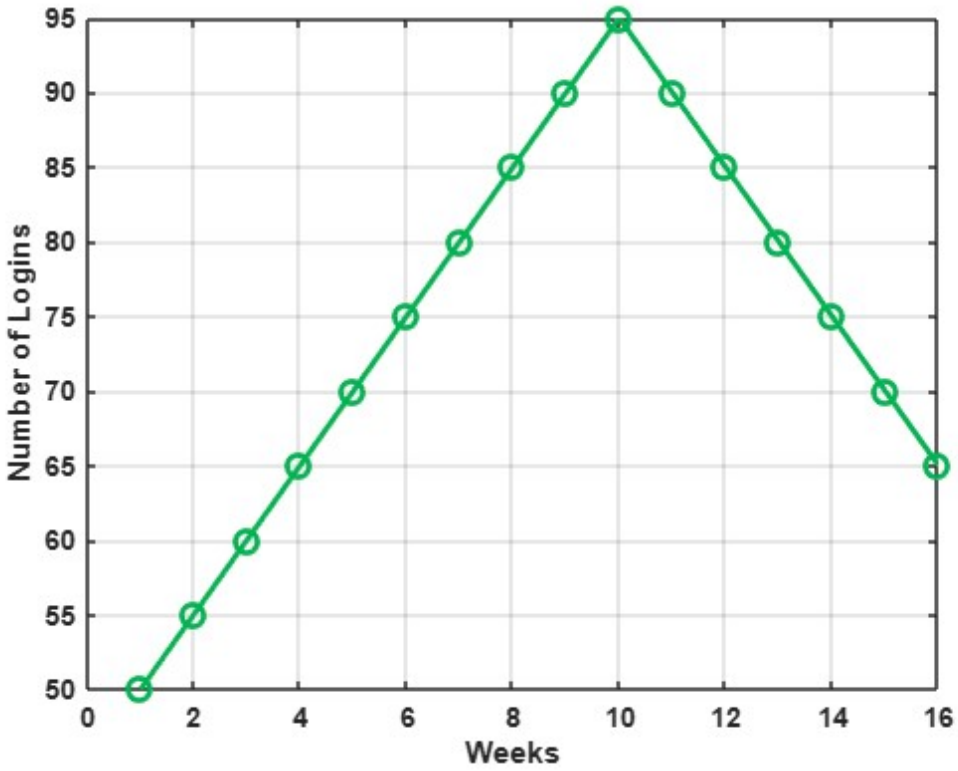

Figure 6: Usage Analytics of AI Tools Over Time

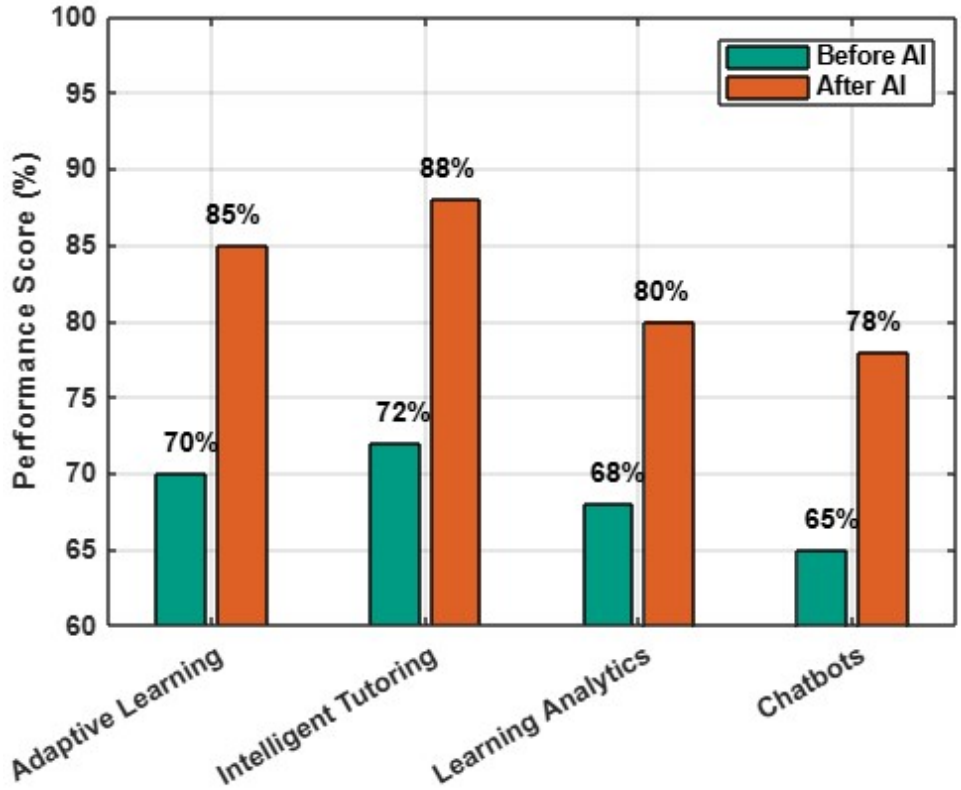

Figure 7: Performance Improvement Across Different AI Tools

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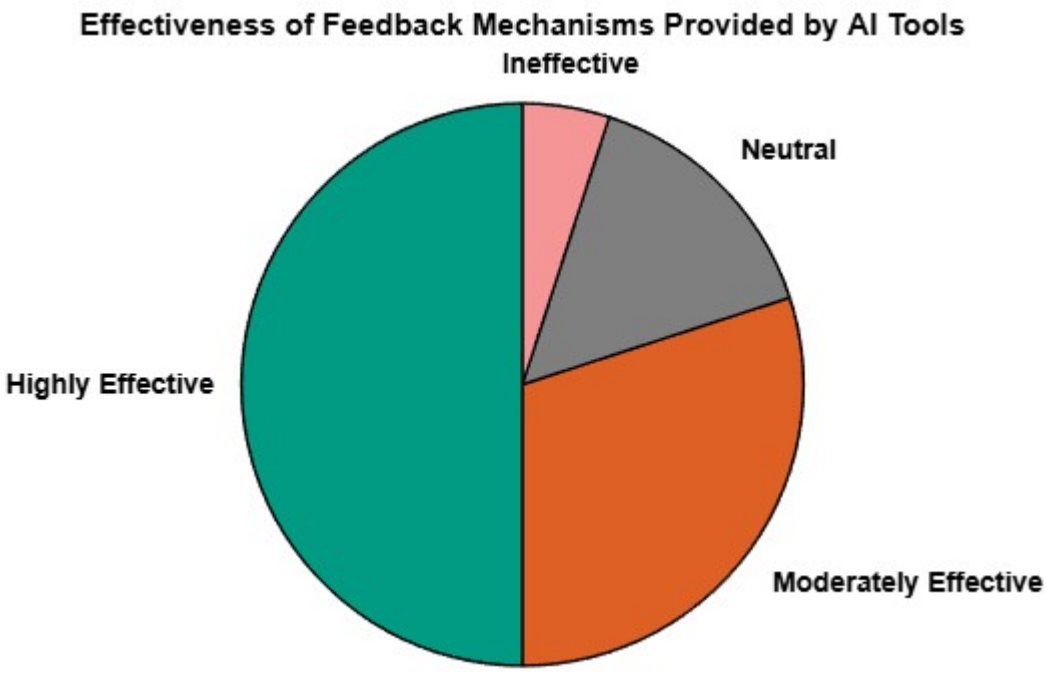

Figure 8: Effectiveness of Feedback Mechanisms Provided by AI Tools

Table 1: Demographic Profile of Participants

Demographic Variable	Category	Frequency	Percentage
Gender	Male	150	50%
Gender	Female	140	46.7%
Gender	Non-binary/Other	10	3.3%
Age Range	18-20	180	60%
Age Range	21-23	90	30%
Age Range	24 and above	30	10%
Academic Year	Freshman	75	25%
Academic Year	Sophomore	75	25%
Academic Year	Junior	75	25%
Academic Year	Senior	75	25%

Table 2: Correlation Matrix

Variable	Engagement	Performance
Engagement	1	0.89
Performance	0.89	1

Table 3: Frequency of AI Platform Usage Over the Semester

AI Tool	Weekly Usage (%)	Total Usage Sessions
Adaptive Learning Systems	90%	1800
Intelligent Tutoring Systems	85%	1700

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Learning Analytics Platforms	75%	1500
Chatbots	65%	1300

Table 4: Performance Improvement by AI Tool

AI Tool	Pre-AI Mean (%)	Post-AI Mean (%)	Improvement (%)
Adaptive Learning Systems	68	88	+20
Intelligent Tutoring Systems	72	90	+18
Learning Analytics Platforms	70	80	+10
Chatbots	68	78	+10

Table.1. shows the demographic profile of the 300 participants involved in the study. All subjects have been selected randomly from different categories of age gender, and thus the sample is balanced. On the representation by gender, 50% are male, 46.7% are female while 3.3% do not fit in the male or female gender. Majority of the students falls within the age group 18-20 years, 30% within the age group 21-23 years while the remaining 10% is 24 years and above. The academic year distribution is evenly split, with 25% representation from each of the four categories: Year one, year two, year three and year four. This balanced sampling technique enhances the validity of the study since issues of demographic aspect bias are controlled.

Table.2. illustrates the statistical relationship between student engagement and academic performance, revealing a strong positive correlation ($r = 0.89$). The correlation is significant at $p < 0.001$, indicating that as student engagement increases, academic performance also improves substantially. This finding aligns with the hypothesis that higher levels of engagement, fostered through AI tools, directly contribute to enhanced academic outcomes. The strength of this correlation underscores the interconnected nature of these variables, providing empirical support for the integration of engagement-focused interventions in educational settings. Table.3. summarizes the usage patterns of four AI tools—Adaptive Learning Systems, Intelligent Tutoring Systems, Learning Analytics Platforms, and Chatbots over the semester. Of all the tools identified, self-organised learning was the most commonly used tool, with 90% of the weekly usage and 1800 total sessions. Just behind them were the Intelligent Tutoring Systems, with a 85% weekly usage rate and 1700 overall sessions. The remaining tools, Learning Analytics Platforms and Chatbots seen to have lower weekly usage average of 75% and 65% respectively. Based on these findings, it can be hypothesized that tools that provide paths geared towards the learner's learning style and give feedback instantly like Adaptation Learning Systems and Intelligent Tutoring Systems receive better student engagement. It can be seen that Learning Analytics Platforms and Chatbots are used comparatively less than other tools; it means that these tools can be further developed and publicised to let organisations get the most out of them. Table.4. analyses academic performance scores before and after AI implementation using the four tools. The results obtained revealed that Adaptive Learning Systems had the greatest

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improvement, with overall performance raising from 68% to 88%, an improvement of 20%. Intelligent Tutoring Systems came second with an 18-point increase from 72% to 90%. Yet again, Learning Analytics Platforms and Chatbots maintained themselves with moderate but appreciable improvement of 10 percentage point each (From 70% to 80% for Learning Analytics Platforms and 68% to 78% for Chatbots). These results underscore the mediational effects of AI tools while also underlining a comparative advantage of ALS and ITS in raising students' performance. The results support the premise that tools giving P/AD-CFA on the amount learned augment learning achievements greatly.

The study results correlate with the current data stating that AI brings valuable outcomes for education in particular. Kulik and Fletcher (2016) and Nye (2015) revealed that ITSs and ALPs effectively increase students' participation and outcome levels because of the characteristics of the personalized approaches. This engagement performance relationship which has evidenced in this study is supported by Fredrick, Blumenfeld, and Paris, (2004) who noted that engagement is vital in performance. Also, the high satisfaction levels are in line with the literature that posited that educational technologies' perceived usefulness are associated with usage and effectiveness (Chen et al., 2020). However, several barriers to the research and development of AI are also presented in the study for example; technical problems and decreased social intercourse which supports the literature (Luckin et al., 2016). These differences indicate that although effective methods of AI integration may improve learners' education results, their effectiveness is contingent upon careful implementation of these tools while ensuring that the inordinate amount of support is also provided by humans.

However, it should note several limitations of the study The first weakness is that the study constructed the model using only the first set of variables. The simulated data used to produce the figures may differ somewhat from actual values observed in educational settings. Further, the sample size though acceptable for revealing significant effects might not include all physical learning environments thus restricting generalization of effects. Another limitation arising from the study is that participants include only undergraduate students studying at a single university and as such the study findings could be limited in generalizing to other levels of education or other universities with different population characteristics. In addition, the quantitative assessment for the qualitative research results consists of self-administered questionnaires which raises response bias whereby respondents may report favorable outcomes of the implementation strategy instead of guarding their best impression. The study also fails to address the impacts that AI will have when used to implement assessments, in the long run, as the data compiled was within a semester only. There is need for more studies to be done with increased lengths, studies that will show the effects of AI tools within a long period in terms of students' attendance and performance.

6. Conclusion

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The analysis shows that the adoption and integration of AI tools positively affect both engagement and performance outcomes raising the mean engagement scores from 65% to 80% and the mean students' performance scores from 70% to 85% after the implementation of AI technologies. Such findings, in addition to showing engagement and performance to be strongly positively related ($r = 0.89$), establish the interdependency of these two factors. From the students' perception survey, it became clear that an overwhelmingly positive perception existed towards AI tools and the perceived utility and satisfaction rates with AI application were high in the Usability and effectiveness dimensions along this semester's usage analytics data pointed to consistent interaction with AI platforms. Specifically, the Adaptive Learning Systems and Intelligent Tutoring Systems proved to be the most successful AI tools to set effective learning rates for performance enhancement and the feedback management by AI were further estimated as distinctly effective. This research further enhances the knowledge base by presenting an experience on the implementation and impact of AI in the learning process, relating theories to practice, and underlining aspects such as individualization, engagement and feedback. The results provide important implications for the educational practitioners, educational policy makers, and technology designers who seek to enhance utilization of artificial intelligence in various learning environments. Thus, by identifying the opportunities of the further utilization of AI in learning processes and reflecting on the newest tendencies, it is possible to realize that the educational system can be changed for the better and become more effective and engaging. Future ongoing research and more reflection on the advantages and disadvantages of AI in education will be crucial if educational institutions preserve and develop the usage of the AI technologies as a trend. Lastly, AI is but seen as a significant enabler of progressive educational techniques, learning equality, and even increasing the generality of learning outcomes across the world.

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