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A Quantitative Analysis of the AI Usage in Students' Learning Performance

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ABSTRACT

The research focuses on the impact of Artificial Intelligence in student learning in Government Post Graduate College Mardan. Surveys and inferential statistics analyzed data gained from 320 students selected randomly who took part in this quantitative research. Respondents rated AI usage as M = 3.89 (SD = 0.543) and its effectiveness scored M = 4.187 (SD = 0.121). Student engagement together with learning outcomes demonstrated positive outcomes according to participants with mean ratings of M = 3.656 (SD = 0.333) and M = 3.132 (SD = 0.231) respectively. Moreover, AI usage acts as a predictor of student engagement to the extent of 45.5% based on the regression analysis (R^2 = 0.455, p = 0.001) while also explaining 46.6% of perceived learning effectiveness (R^2 = 0.466, p = 0.005). The determination of learning outcomes variance reaches 51.3% (R^2 = 0.513, p = 0.004) yet other performance variables remain significant. This study concluded that most students are deficient in knowledge processes in applying AI tools efficiently due to not having undergone appropriate training concerning their application. While the supportive aspect of AI is useful to educational systems, but students still need to retain their basic ability in creativity and critical thinking.

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Introduction

Artificial Intelligence uses technological developments to construct systems that can execute tasks which demand human intelligence including learning and problem-solving and information processing that mimics human cognitive functions (Russell & Norvig, 2021). AI technologies particularly machine learning coupled with natural language processing and adaptive learning systems transform educational delivery by providing customized learning addresses student-specific needs (Chen et al., 2020; Mitrovic et al., 2014). Modern educational practices ushered by global institutions mirror the behavioral patterns of advanced tools such as ChatGPT and Meta AI which deliver personalized educational support of human standard (Dabbagh & Kitsantas, 2012; Brown et al., 2020).

The industrial sector of educational technology has undergone extensive changes because of artificial intelligence advancements in the past twenty years. Machine learning and neural networks created fundamental mechanisms used by adaptive learning systems to track student advancement through specific content delivery (Siemens, 2013). Deep learning technology enabled real-time feedback and conversational learning through large language models (LLMs) including GPT-3 (Brown et al., 2020). With its 2022 version deployment ChatGPT enabled users to grasp complicated subjects more easily in addition to completing tasks according to Wilcox (2023). Two major problems regarding AI technological advancements have emerged based on research studies which represent their impact on human thinking capabilities and our relationship with technology (Baker & Xiang, 2023). Transformation has occurred in global educational operations due to schools adapting their systems through AI technology. Successful educational technology adoption through "Socrates" and "iSpring Learn" by French, Spanish and German institutions achieved improved educational customization and administrative administration through optimized learning systems that delivered more robust results along with enhanced accessibility (Mitrovic et al., 2023; VanLehn, 2011). The lack of separate access to AI tools coupled with unproper training methods present significant problems that strike areas with insufficient resource availability (Li & Zhao, 2019).

The usage of AI for educational purposes at Government Post Graduate College Mardan has not received sufficient examination. The lack of research evidence exists regarding student perspectives about AI learning tools and their outcomes on academic success as well as integration obstacles. Future investigation should evaluate potential disadvantages resulting from AI implementation because they include reduced critical thinking together with problems related to technology dependence and equal access to resources. This investigation evaluates student learning performance from AI implementation alongside student reactions to AI tools and the employment methods across these three core factors. The research examines practical applications for AI technology in academic success that minimize any adverse effects on intellectual advancement. Research findings that establish how AI systems can enter educational practices ethically and effectively will transform AI into an educational advancement tool instead of academic limitations.

Literature Review

Artificial Intelligence Usage

Artificial intelligence (AI) functions as a fundamental part throughout different industrial fields while reshaping the relationships between professional units and technological processes. AI technology in medicine combines strengths to evaluate medical images and produce new drugs with patient-specific treatment recommendations to improve diagnostic accuracy (Topol, 2019). AI tools in the financial sector help businesses detect fraud while conducting risk assessments and automated trading operations as they perform rapid trade operations (Paramesha et al., 2024). Through artificial intelligence and natural

language processing customer service underwent advancement by enabling chatbots to deliver improved service for effective user inquiries at rapid speeds (Mohanty, 2023). In education, AI systems effectively support online learning and teaching by automating routine tasks for instructors, personalizing learning experiences for students, and enabling adaptive assessments (Seo et al., 2021). The adoption of AI has led to noticeable changes in educational processes and management, making the educational model more multidimensional by integrating human and non-human elements, both offline and online. The potential of AI technologies has been demonstrated in various domains, including intelligent buildings and learning spaces (Martínez-Comesañ et al., 2023).

Student Engagement

Student engagement stands as a vital academic and psychological success factor because it describes dedicated learning involvement and active educational interaction. Learning boosts motivation at the same time it leads students to achieve enhanced academic results along with better educational persistence. Academic engagement significantly increases when classrooms implement instructional approaches which promote teamwork alongside critical thinking along with knowledge applications. Educational professionals who utilize innovative teaching methods with technology assistance and student-focused techniques enable active education and maintain student focus (Lee & Hannafin, 2016). Social activities which take place outside of classroom time join extracurricular activities to increase student sense of belonging and help with personal development (Kuh, 2009). Institutions which create learning environments that foster whole-student development and multiple learning viewpoints and empower students will achieve better overall engagement results. The learning process can experience a transformative change through Industry 4.0 technologies such as artificial intelligence which enhances student participation while developing necessary interpersonal skills and collaboration capabilities while minimizing educational expenses and safety concerns (Moraes et al., 2023). Students reach their highest learning efficacy when teachers apply various comprehension methods together with interactive rewards and consistent feedback system (Bolliger & Martin, 2018). When students engage in structured discussions of collaborative online learning their experience of group learning and building community improves (Shackelford & Maxwell, 2012; Zhang et al., 2018). Online learning success depends heavily on positive student-instructor relationships according to Andersen (2013) as well as Kang & Im (2013) and Walker (2016).

Research on AI education revealed that forty-three percent of studies show how AI technologies enhance student motivation and engagement in educational outcomes according to Chiu et al. (2023). AI robots demonstrate improved education outcomes for students from K-12 through higher education levels especially in physical education and computer science and mathematics fields (Ilić et al., 2021; Kuleto et al., 2021; Xia et al., 2022; Yang et al., 2020). Research findings from Chiu et al. (2023) show students who performed poorly in academics showed higher safety along with productivity while using AI tools and decreased their sense of shame. The engagement levels of language students increased when they utilized AI scoring systems that operated through speech and image recognition technologies (Fu et al., 2020). Students appreciate AI-aided assessments based on active learning methods because the assessments provide automatic responses that enhance teaching effectiveness.

Artificial Intelligence in Education

Higher education has undergone transformation through Artificial Intelligence which delivers three major tools including intelligent tutoring systems automated grading and adaptive learning platforms (Smith et al., 2018). Mostly students and their activities in access to using artificial intelligence technologies and to help create

visually and quickly working learning environments. Students can use AI-powered chatbots including ChatGPT and Meta AI to receive immediate academic assistance through conversational interfaces which makes them better able to deal with obstacles and remain motivated according to Anderson, 2023). Through natural language processing (NLP) and machine learning these technologies provide personalized content and immediate feedback that leads to improved outcomes and student engagement (Holstein et al., 2019; Hwang et al., 2020). The educational field benefits greatly from AI technology with its three main uses in creating personalized learning paths while analyzing student data and automating testing procedures. Thorough algorithm systems evaluate student achievement information to detect knowledge gaps then estimate educational outcomes before creating preventative measures for students at academic risk (Arnold et al., 2012) Artificial intelligence (AI) is an area of study that covers the operations of machine learning, algorithm productions, and natural language processing. The tools of education are changed by applications of AI. The applications of AI in education are diverse and include such ones as platforms for personalized learning to support students' learning, systems for automatic assessment to support the work of teachers, systems for face recognition to gain insights on learners' behaviors. (Akgun et al., 2022). AI writing tools supply with instant grammar and style suggestions to boost their writing abilities (McNamara et al., 2013). The potential of Artificial Intelligence to provide customized educational experiences that customize learning tasks according to individual needs represents its effectiveness for boosting both educational efficiency and student achievement (Gibson et al., 2018).

Positive Effects of AI on Student Learning

Student learning experience has received significant improvement through artificial intelligence technologies which provide personalized adaptive and accessible educational solutions. ChatGPT alongside other AI tools operates through real-time performance analysis to generate personalized content while supplying prompt feedback to students along with recommending relevant learning materials which establishes an adjustable educational setup (Chen et al., 2020; Krishnamurthy & Davis, 2022). Students can enhance their academic performance more efficiently thanks to these tools because they detect essay mistakes while helping users improve their argument structure and sentence quality (Krishnamurthy & Davis, 2022). The NLP capabilities of AI-powered chatbots allow them to produce human-level interactions which provide 24/7 assistance that supports students from all schedules and promotes continuous use of educational content (Al-Awamreh et al., 2024). AI system capabilities include real-time translation services and automatic grammar checking and pronunciation tools which build linguistic proficiency at all levels of student capabilities (Yeşilyurt, 2023; Liu & Lin, 2018). The application of artificial intelligence enhances institutional operational efficiency by applying automation to administrative processes including admissions and registration procedures according to Ribeiro et al. (2019). The inclusive efficient learning systems of today result from AI advancements that focus on students at their center.

Negative Effects of AI on Student Learning

Artificial Intelligence provides educational transformations to learning systems but its widespread use in education produces substantial worries. Students who heavily depend on AI tools develop superficial learning because they tend to choose AI-produced solutions instead of thorough analysis which results in diminished critical thinking abilities and problem-solving competences (Lai & Bower, 2020). Students who depend on AI tools face heightened chances of plagiarism since they could avoid standard educational methods to present AI-generated written work (Lockyer et al., 2019). The extent of AI dependence results in reduced human interaction which isolates students and prevents them from developing teamwork and

communication skills according to Wong & Howitt (2020). The customized content from AI systems fails to replicate the vital emotional support along with career guidance and precise mentorship which human educators give their students for complete educational growth (Ingersoll & Strong, 2011). Excessive AI utilization weakens critical thinking in students because their learning transforms from active evaluation to passive reception of data which diminishes their analytical skills (Aymen et al., 2024). AI-generated content follows predictable patterns as an intrinsic characteristic that restricts student creativity when they are dissuaded from developing innovative solutions or unique concepts (Linnell, (2024). The problems that emerge from AI-driven education call for a delicate approach which uses AI technology as an assistance system instead of eliminating human instructional leadership.

Conceptual Framework

Independent Variable	Dependent Variables
AI Usage	Student Engagement To IA
	Students' Learning
	Effectiveness of AI

REASEARCH METHODOLOGY

A quantitative research method has been used to analyze the influence of artificial intelligence on learning among the Government Post Graduate College Mardan students. Quantitative research methods were selected because they provide numerical measurement capabilities for observing phenomena so researchers can scrutinize data patterns and relationships correctly (Sekaran & Bougie, 2016). A cross-sectional methodology served to gather information from 320 BS students obtained from the complete student population of 1,800 at Government Post Graduate College Mardan. The entire body of BS students from session 2024-25 at Government Post Graduate College Mardan formed the population under study. A simple random sampling approach within probability sampling methods was used to select participants because each individual possessed an equal opportunity to take part. A statistically significant yet practical set of 320 participants was determined through the Sekaran table approach according to Sekaran and Bougie (2016). The research data collection took place through a structured questionnaire that consisted of closed-ended question types. The selected tool fulfilled its purpose for obtaining standardized responses from a large diverse group due to its superior efficiency in handling structured data aggregation and data analysis (Creswell & Creswell, 2017). To assess AI usage and students' learning performance, the researcher developed a survey questionnaire divided into two sections. The first section gathered personal information, while the second section comprised twenty-two questions with a response-based rating scale. The distribution of the questionnaire occurred within the students' respective departments. The research analyzed patterns through numerical data collection. Basic statistical analysis involved response frequency counting along with ratio calculation of respondents. The program SPSS enabled effective data organization together with analysis functions. Using multiple regression as a statistical method allowed researchers to determine relationships between study factors along with predictive outcomes. Every participant received detailed information regarding the study aims before being admitted to the research and maintained the right to leave at any moment.

Data Analysis

Table 1. *Demographic Data of the Respondents*

Items	Attributes	Frequency	Percentage
Gender			
	Male	251	78%
	Female	69	22%
	Other	0	0%
	Total	**320**	**100%**
Age			
	18-20	117	37%
	21-23	128	40%
	24-26	68	21%
	27 or above	7	2%
	Total	**320**	**100%**
Semester			
	2nd semester	92	29%
	4th semester	69	22%
	6th semester	59	18%
	8th semester	100	31%
	Total	**320**	**100%**
Faculty			
	Natural Science	126	39%
	Social Science	121	38%
	Linguistics/literature	37	12%
	Others	36	11%
	Total	**320**	**100%**
GPA in previous semester			
	1.00 -1.5	50	16%
	1.6-2.0	66	22%
	2.1-3.0	150	45%
	3.1-4.0	54	17%
	Total	**320**	**100%**

Table 1 presents the demographic characteristics of the 320 student respondents, categorized by gender, age, semester, faculty, and GPA in the previous semester. Regarding gender distribution, the majority of the respondents were male (78%, n = 251), while females comprised 22% (n = 69), and no respondents identified as "Other." This distribution reflects the gender representation within the surveyed student population. The age distribution shows that the largest proportion of students were aged 21-23 years (40%, n = 128), followed by those aged 18-20 years (37%, n = 117). A smaller percentage of students fell into the 24-26 years' category (21%, n = 68), while only 2% (n = 7) were aged 27 years or above. This age distribution indicates that most respondents were in their early 20s, aligning with the typical university student age range. In terms of academic semester, students were primarily distributed across the 2nd semester (29%, n = 92), 4th semester (22%, n = 69), 6th semester (18%, n = 59), and 8th semester (31%, n = 100). Such data

distribution enables complete AI usage evaluation by representing students throughout their academic progress at multiple levels of experience. The analysis reveals students from the Sciences faculty make up 39% (n = 126) of respondents while Social Sciences students form 38% (n = 121) of the participants together with Linguistics students representing 12% (n = 37) and the remaining 11% coming from other faculty groups (n = 36). The study contains a various student population representing multiple academic majors that guarantees diverse insight into AI tool effects on student learning outcomes. The students' GPA distribution in the previous semester revealed two primary results with 47% of the population (n = 150) having a GPA between 2.1 and 3.0 and 21% of students (n = 66) performing with a GPA between 1.0 and 2.0 while 17% (n = 54) achieved a GPA between 3.1 and 4.0. Fifty students from the total population had a GPA of 1.0 to 1.5 which made up 16%. Research through this performance variance helps determine which student academic level AI tools show the most benefits.

Table 2. ***Students' engagement with IA***

Question	Options	Frequency	Percentage
ever used AI tools to assist with your studies			
	Yes	275	86%
	No	45	14%
	Total	**320**	**100%**
you use AI tools for academic purposes			
	Daily	77	24%
	Weekly	96	30%
	Monthly	48	15%
	Rarely	54	17%
	Never	45	14%
	Total	**320**	**100%**
types of AI tools have you used in your studies			
	Chatbots (e.g., ChatGPT)	201	62%
	Personalized learning platforms	60	18%
	Virtual reality simulations	24	7%
	Other	35	10%
	Total	**320**	**100%**
Comfortable with using AI tools in your learning process			
	Very comfortable	96	30%
	Somewhat comfortable	128	40%
	Neutral	64	20%
	Somewhat uncomfortable	24	7%
	Very uncomfortable	8	3%
	Total	**320**	**100%**
concerns do you have about used AI in education			
	Privacy issues	112	35%
	Bias in algorithms	38	11%
	Dependence on technology	130	40%
	Accuracy of information	50	%
	Total	**320**	**100%**
AI can enhance your learning experience			

	Yes	256	80%
	No	32	10%
	Not sure	32	10%
	Total	**320**	**100%**
AI tools be integrated more into the educational curriculum			
	Yes	232	72%
	No	48	15%
	Not sure	40	13%
	Total	**320**	**100%**

Table 2 provides an overview of student engagement with AI tools, including their usage, frequency, types of AI tools utilized, comfort levels, concerns, perceptions of AI's impact on learning, and opinions on AI integration in the curriculum. The data reveals that a significant majority of students (86%) use AI tools to assist with their studies, while 14% have never used them. In terms of frequency, 24% of students use AI tools daily, 30% use them weekly, and smaller proportions engage with them monthly (15%) or rarely (17%), with 14% never using AI for academic purposes. Among the types of AI tools, chatbots such as ChatGPT are the most widely used (62%), followed by personalized learning platforms (18%) and virtual reality simulations (7%), while 10% utilize other AI tools.

Regarding students' comfort levels, 40% reported being somewhat comfortable using AI, 30% felt very comfortable, while 20% remained neutral. A smaller percentage expressed discomfort, with 7% being somewhat uncomfortable and 3% very uncomfortable. The primary concerns students raised about AI use in education included dependence on technology (40%), privacy issues (35%), accuracy of information (16%), and bias in AI algorithms (11%). Despite these concerns, 80% of students believed AI enhances their learning experience, while 10% disagreed and another 10% remained uncertain. Additionally, 72% supported integrating AI tools further into the educational curriculum, whereas 15% opposed it and 13% were unsure.

Table 3. *Artificial Intelligence (AI) and students' learning*

Qustions	**Yes**	**No**	**Maybe**	**Unsure**
AI tools contribute to bettering your learning performance.	267 (83%)	9 (3%)	35 (11%)	9 (3%)
The AI chatbots are useful in delivering a prompt academic support.	253 (79%)	13 (4%)	41 (13%)	13 (4%)
With the help of AI-based learning resources, complicate subjects are easier for you to comprehend.	225 (70%)	23 (7%)	58 (18%)	14 (4%)
AI tools allow you to save time on academic activities.	244 (76%)	15 (5%)	48 (15%)	13 (4%)
Ai can improve the process of learning relative to the traditional methods.	198 (62%)	65 (20%)	32 (10%)	25 (8%)
Has AI tools made you perform better in exams?	240 (75%)	19 (6%)	45 (14%)	16 (5%)
The result of using the AI tools can be a dependency and a drop of the critical thinking skills.	219 (68%)	34 (11%)	45 (14%)	22 (7%)

The use of AI tools has damaged your problem solving skills.	216 (68%)	43 (13%)	37 (12%)	24 (7%)

Table 3 presents insights into students' perceptions of the influence of AI tools on their learning experience. The majority of respondents (83%) believe that AI tools improve their learning performance, while a small percentage (3%) disagree, and 11% remain uncertain. Additionally, 79% find AI chatbots helpful in providing timely academic support, whereas 4% disagree, and 13% are unsure. AI-based learning resources are also considered effective in helping students understand complex subjects, with 70% agreeing, 7% disagreeing, and 18% expressing uncertainty. In terms of efficiency, 76% of students reported that AI tools help them save time on academic tasks, while 5% disagreed, and 15% remained uncertain. When comparing AI-based learning to traditional methods, 62% believe AI enhances their learning experience, while 20% do not, and 10% are unsure. Regarding academic performance, 75% of students stated that AI tools have helped them perform better in exams, whereas 6% disagreed, and 14% were uncertain. Concerns about AI dependences however could be seen in the responses. A majority of students (68%) believe that overuse of AI tools could result in dependency and diminish critical thinking, on the contrary, 11% did not agree, and 14% were indecisive. In the same way, 68% of the study participants believed that their problem-solving abilities may be impaired due to AI dependency, and 13 and 12 % respectively disagreed and were neutral. Overall, the findings suggest that while AI tools are widely recognized for their benefits in enhancing learning performance, while need for a balanced approach in integrating AI into education.

Table 4. *Effectiveness of AI-based learning*

Qustions	**Yes**	**No**	**Maybe**	**Unsure**
were involved in studies while using AI-based learning tools.	233 (73%)	44 (14%)	26 (8%)	17 (5%)
feedback and evaluations that are conducted with AI-based learning tools.	249 (78%)	26 (8%)	32 (10%)	13 (4%)
AI enabled learning tools can even replace human instructors in the future.	208 (65%)	61 (19%)	34 (11%)	17 (5%)
AI based assessment are more unfair or not as accurate than human assessment.	201 (63%)	64 (20%)	40 (12%)	15 (5%)
had any ethical issues by using AI in your study.	110 (34%)	162 (51%)	33 (10%)	15 (5%)
AI-based learning tools can identify the strength and weakness of a person in a more accurate manner than a human instructor.	173 (54%)	78 (24%)	45 (14%)	24 (8%)
The AI assists you to conduct the research work more efficiently in a short duration of time in search of appropriate sources.	232 (73%)	32 (10%)	41 (12%)	15 (5%)

Table 4 presents the perceived effectiveness of AI-based learning tools among students. A significant majority (73%) reported feeling more engaged in their studies when using AI-based tools, while 14% disagreed, and 8% were uncertain. Trust in AI-generated feedback and assessments is also high, with 78% of students believing in their reliability, while 8% disagreed and 10% were uncertain. Notably, 65% of respondents believe AI-based learning tools have the potential to replace human instructors in the future, whereas 19% disagreed, and 11% remained unsure. Concerns regarding fairness in AI-based assessments were evident, as 63% of students felt that AI assessments might be less fair or accurate than human assessments, while 20% disagreed, and 12% were uncertain. Ethical concerns, such as data privacy, were also raised, with 34% of students experiencing such concerns, while 51% did not, and 10% were unsure.

Regarding AI's ability to personalize learning, 54% of students believe AI can identify their strengths and weaknesses more accurately than human instructors, whereas 24% disagreed, and 14% were uncertain. Additionally, 73% of respondents found AI useful in conducting research by quickly finding relevant sources, while 10% disagreed, and 12% were unsure.

Table 5. *Descriptive and reliability statistics*

No	Variables	Mean	SD	Cronbach's Alpha
1	AI Usage	3.89	0.543	(0.891)
2	Student Engagement To IA	3.656	0.333	(0.832)
3	Students' Learning	3.132	0.231	(0.770)
4	Effectiveness of AI	4.187	0.121	(0.810)

Table 5 presents the descriptive and reliability analysis of the key variables in this study, including AI usage, student engagement with AI, students' learning, and the effectiveness of AI. The mean values indicate the general perception of respondents regarding each variable, with AI usage (M = 3.89, SD = 0.543) and the effectiveness of AI (M = 4.187, SD = 0.121) being rated relatively high, suggesting a positive perception of AI tools in education. Student engagement with AI (M = 3.656, SD = 0.333) and students' learning (M = 3.132, SD = 0.231) also reflect moderate to strong engagement and effectiveness in the learning process. The Cronbach's Alpha values demonstrate the reliability of the constructs used in the study. All variables exceed the acceptable threshold of 0.70, indicating strong internal consistency and reliability. Specifically, AI usage ($\alpha = 0.891$) and student engagement with AI ($\alpha = 0.832$) exhibit high reliability, while students' learning ($\alpha = 0.770$) and the effectiveness of AI ($\alpha = 0.810$) also demonstrate good consistency. These results validate the measurement instruments used in the study and confirm that the data collected is reliable for further statistical analysis.

Table 6. *Model summary of regression analysis*

Dependent Variable	R^2	Adjusted R^2	F	Sig.
Student Engagement To IA	0.455	0.460	73.683	.001
Students' Learning	0.513	0.136	41.592	0.004
Effectiveness of AI	0.466	0.350	64.404	.005

Independent Variable: *Artificial Intelligence (AI) Usage*

Table 6 presents the regression analysis results, examining the influence of AI usage on three key dependent variables: student engagement with AI, students' learning, and the perceived effectiveness

of AI. The R^2 values indicate the proportion of variance explained by AI usage in each dependent variable, while the F-statistics and significance values (p-values) determine the overall model fit. The results reveal that AI usage significantly predicts student engagement with AI, accounting for 45.5% of the variance ($R^2 = 0.455$, Adjusted $R^2 = 0.460$, $F = 73.683$, $p = 0.001$). This suggests that students who frequently utilize AI tools are more likely to engage actively in their learning activities. Higher engagement levels can be attributed to AI-powered platforms providing personalized learning experiences, instant feedback, and interactive support systems that maintain student interest.

Similarly, AI usage significantly affects students' perceived effectiveness of AI in learning, explaining 46.6% of the variance ($R^2 = 0.466$, Adjusted $R^2 = 0.350$, $F = 64.404$, $p = 0.005$). This finding indicates that students recognize AI as a valuable educational tool that enhances their learning experience through automation, problem-solving assistance, and personalized content recommendations. However, the impact of AI usage on students' learning outcomes is relatively lower, with 51.3% of the variance explained ($R^2 = 0.513$, Adjusted $R^2 = 0.136$, $F = 41.592$, $p = 0.004$). Although AI contributes to learning improvements, the lower adjusted R^2 value suggests that additional factors, such as teaching methodologies, students' motivation, and institutional support, may also play a crucial role in shaping learning outcomes.

Table 7. *Regression coefficient analysis*

Variables	Standardized Coefficients Beta
Student Engagement To IA	0.712
Students' Learning	0.685
Effectiveness of AI	0.645

Independent Variable: *Artificial Intelligence (AI) Usage: $p < 0.05$ (statistically significant).*

Table 7 presents the standardized regression coefficients (Beta values) for the relationship between AI usage and three dependent variables: student engagement with AI, students' learning, and the perceived effectiveness of AI. The Beta coefficient represents the strength and direction of the relationship between AI usage and each dependent variable. Student AI engagement demonstrates the highest positive correlation with how much students utilize AI technologies ($\beta = 0.712$, $p < 0.05$) based on the research findings. The study indicates how AI creates adaptive learning situations which maintain student attention. Students who use AI tools experience better learning outcomes according to the research results ($\beta = 0.685$, $p < 0.05$). The academic results of students benefit from AI tools through their ability to supply tailored educational help features and both automated feedback and immediate learning assistance.

AI usage plays a substantial role in defining how students perceive the effectiveness of AI systems ($\beta = 0.645$, $p < 0.05$). Students acknowledge AI as an important instrument which improves learning performance and makes academic operations more efficient and enables better access to educational materials. The study indicates that AI implementation produces beneficial impacts on student education by enhancing learning performance and engrossment while raising student acceptance of AI technology in educational contexts.

Discussion

This research revealed the performance-enhancing power of AI tools for student engagement together with learning effectiveness yet identified specific obstacles to measurable academic achievements from these tools. Most participants in this study were male students who belonged to the younger age group between 18–23 years' old which matches the total student

composition at Government Post Graduate College Mardan. The student population follows an institutional demographic pattern but researchers should consider whether this distribution applies effectively to classes with balanced gender rates and older student cohorts. The study achieves balanced distribution among student semesters and academic faculties (39% Sciences and 38% Social Sciences) for collecting diverse insights about AI in education. The survey revealed that 86% of students incorporated AI tools for educational purposes since they commonly used chatbots such as ChatGPT (62%) and personalized learning platforms (18%). Educational institutions across the world are adopting AI-powered tools as a solution to increase student engagement according to Chen et al. (2020) and Mitrovic et al. (2023). The perceived effectiveness of AI by students reached high levels (M = 4.187) but its direct impact on learning results showed modest outcomes (Adjusted $R^2 = 0.136$). The big difference between estimated effectiveness and actual outcomes with AI indicates external influences like teaching standards and institutional backing and student drive are key mediators of its educational benefits. Research by Chiu et al. (2023) confirmed similar findings regarding students with difficult academic performance who gained better performance metrics through AI tools according to students scoring under a 1.0 GPA (15%). The minimal adjusted R^2 value for educational performance demonstrates that AI technology by itself cannot address programmatic faults including educational methods that need modernization or differences in available resources (Li & Zhao, 2019).

The same percentage of 40% as shown by students demonstrated their reservations about technology dependency because AI shows promise according to Baker & Xiang, 2023 about critical thinking deficiencies. Privacy problems together with biased algorithms represent important obstacles (35% and 11% respectively) which require protective measures from institutions (Moraes et al., 2023). Programs that combine ethical guidelines with technological innovation need development because security concerns require such measures (Lockyer et al., 2019).

Servers should invest in AI literacy programs because most staff members (58%) did not receive training while seventy-two percent of staff welcome AI implementation. The training of students about ethical AI practices and bias reduction through workshops will provide them with the skills to use ChatGPT responsibly (Kuleto et al., 2021). Additionally, blending AI with traditional methods, such as instructor-led discussions may mitigate risks of superficial learning (Sparrow et al., 2011).

Regression analysis demonstrated that AI usage significantly predicts student engagement ($R^2 = 0.455$, $p = 0.001$), corroborating findings by Lee and Hannafin (2016), who emphasized the role of technology in creating student-centered learning environments. The high beta coefficient ($\beta = 0.712$, $p < 0.05$) further confirms that AI tools, through personalized feedback and interactive support, drive active participation. These results mirror studies by Bolliger and Martin (2018), who noted that timely, AI-generated feedback enhances motivation and task persistence.

CONCLUSION

The research conducted in Government Post Graduate College Mardan tackled the effects of Artificial Intelligence (AI) on student learning in relation to level of academic achievement and engagement as well as effectiveness in terms of study. Students mostly view AI tools including Meta AI and ChatGPT as beneficial for education because they enhance both academic scores and quick response to assignments. The research investigation detected possible unfavorable consequences along with its findings. Docking excessively on AI tools impacts student abilities to think critically and solve problems because students depend heavily on the tools. Some study participants are concerned about losing their independent mental capabilities and ability to resolve problems independently by heavily relying on AI. Most students do not possess adequate

knowledge regarding effective utilization of AI tools since they lack training in their use. The research indicates schools and students need to join forces to enhance AI implementation in education by providing attention to its execution rather than blasting warning signs about its hazards. The assisted nature of AI helps educational systems but students should still maintain their core abilities for creativity and critical thinking. Besides, this study was conducted in one collage (Government Post Graduate College Mardan) and thus results were limited and could not be generalized to other areas or contexts of education. Hence, future research should look at the impact of AI in various educational settings (urban/rural, public/ private) and examine the effects of long-term AI use on constructive thinking and academic performance.

Author Contributions

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