Alqalam Journal of Medical and Applied Sciences. 2026;9(8):2388-2395
https://doi.org/10.54361/ajmas.269810

Original article

The Influence of AI-Powered Learning Tools on Academic Student Performance in Higher Education

Awatef Saad*[1], Aziden Abokhwet[2], Reda Shaban[2]

[1]*Department of Information Technology, University of Zawiya, Faculty of Education, Ajilat, Libya*
[2]*Department of Information and Communication Technology, College of Science and Technology, Jado, Libya*
Email. *a.saad@zu.edu.ly*

Abstract
Academic learning has been transformed since the integration of Artificial Intelligence (AI) in education, offering opportunities for students' development. This study aims to examine the effect of AI-powered tools on academic performance, conducted among students at the Faculty of Education at Ajilat city. Also, the analysis explores the potential benefits and challenges of AI technology in education. Data were collected using Google Forms via a 39-item questionnaire, as follows: 20 questions assessing AI-powered tools and 19 questions measuring academic student performance. The total number of respondents was 175 male and female students. The data analysis was conducted using the SPSS program and Smart Pls software. Quantitative data were analyzed using frequency and percentage (demographic variables) calculations by SPSS. The percentage of males was 16 (9.1%), and the percentage of females was 159 (90.9%). Descriptive analysis for academic performance and AI-powered tools showed that both of them had a positive effect on their studies, represented respectively as (3.53) and (3.67). Quantitative responses were subjected to thematic analysis using smart pls (SEM). This allows us to analyze both direct effects and test if relationships are linear or nonlinear (between the dependent variable and independent variable); there was a significant, large positive relationship between them, R2 (50%) and Beta (0.709). Also, evaluate the relationship's strength and significance through indicators like outer loadings, path coefficients, and Average Variance Extracted (AVE), as explained by CA (0.945) and (0.972) and AVE (0.567) and (0.683).
Keywords. AI-Powered Tools, Academic Performance, Smart Pls (SEM), Higher Education.

Introduction

We currently reside in an epoch characterized by continuous transformation and advancement, and the methodologies and innovative strategies in pedagogy and learning are similarly evolving. It is, therefore, essential for educational institutions, scholars, and researchers to periodically monitor these changes [1-3]. Within the realm of higher education, AI-driven technologies are increasingly recognized as indispensable resources for students, not only facilitating their academic endeavors but also influencing their recreational activities [4,5]. Artificial Intelligence (AI) has emerged as a pivotal agent of change across diverse sectors, including the field of education. Educational institutions are progressively integrating AI-driven tools—such as adaptive learning platforms, AI tutoring systems, and intelligent note-taking applications—to provide tailored learning experiences, optimize administrative processes, and improve student outcomes. By accommodating individual requirements, AI has the potential to enhance study efficiency, alleviate stress, and elevate academic achievement.

From AI-enhanced learning platforms and individualized study assistants to recreational applications and virtual communication tools, the significance of AI in students' lives has reached unprecedented levels [6]. Pre-service teacher training institutions also endeavor to remain abreast of contemporary practices and equip prospective educators with the competencies required to adapt to the rapidly changing landscape of information technology. Moreover, in recent years, artificial intelligence (AI) has swiftly emerged as one of the most vital facilitators in this educational advancement [7-11]. This signifies the quest for innovative educational methodologies within the ongoing educational revolution, representing merely a minuscule segment of the extensive array that AI-driven tools can offer educators and trainers. These instruments possess the potential to significantly reform traditional pedagogical practices and afford students a dynamic, immersive, and customized learning experience [8,12]. Educators can curate personalized learning experiences with the assistance of available tools to modify instructional approaches and educational materials in accordance with the unique needs and preferences of each student [12-15].

Similarly, chatbots and virtual assistants powered by AI can assist students in remaining oriented by addressing inquiries and facilitating content navigation [8,16,17]. Furthermore, through AI, data must be meticulously analyzed utilizing AI algorithms to identify patterns and trends that can inform educators' data-driven decisions regarding instructional strategies and the development of data-informed curricula [9,13]. Considering that we find ourselves at a pivotal juncture where technology and intelligence in education must be interconnected, we must engage in deeper contemplation regarding the implications of intelligence [7,8]. The salient aspect pertains to the comprehension of the concrete ramifications and outcomes concerning the achievements, preparedness, and ambitions of educators to emerge as influential figures and pivotal agents in the construction of modern educational paradigms [7,8, 16,17]. Furthermore, the integration of intelligent technologies within educational environments signifies a transformative shift in pedagogical methodologies [12,16,17].

Investigating the influence of artificial intelligence on education enables scholars and educators to discern its capacity to enhance student engagement, cognitive skills, and academic performance [7,8,17]. Students are increasingly allocating substantial periods of time in front of digital screens, depending on AI for a myriad of tasks, frequently under the guidance

Received: *02-06-2026 -* ***Accepted:*** *29-07-2026 -* ***Published:*** *06-08-2026*

of their educators, who advocate for the utilization of these technologies in the context of assignments and research endeavors [18]. In numerous instances, students resort to AI to procure rapid solutions, automate tasks, or tailor their learning experiences to their individual needs [19].

Beyond the realm of academia, AI-enabled instruments wield a comparably significant influence in entertainment, as students engage with these systems for activities such as social media interaction, gaming, and other forms of digital engagement during their leisure time [20]. Moreover, research conducted by [21] suggests that excessive screen exposure may lead to complications, including digital fatigue, social isolation, anxiety, and adverse mental health outcomes. Considering the pivotal role of AI in the educational and social spheres of students, it becomes imperative to critically assess its effects on their overall well-being. Gaining insight into the extensive implications of AI on the psychological and emotional health of students is essential, not only for the students themselves but also for educators and policymakers responsible for the incorporation of AI technologies into educational curricula and student support frameworks [22]. As AI-driven applications persist in their advancement, it is crucial to evaluate both the advantageous and detrimental aspects of their utilization in order to formulate informed strategies that foster not merely academic achievement but also comprehensive student well-being [23]. This study aims to examine the effect of AI-powered tools on academic performance, while this study conducted at faculty of Education student's at Ajilat city.

What is AI?

Artificial Intelligence (AI) constitutes a conceptual framework that encompasses the emulation of human cognitive functions within computational systems, enabling them to replicate human-like thinking and behavior. The principal aim of AI is to engineer machines capable of executing tasks conventionally performed by intelligent beings, including visual perception, auditory recognition, decision-making, learning, and linguistic translation [24]. AI systems are meticulously crafted to analyze and interpret data, identify patterns, and render decisions predicated upon that acquired knowledge. [24] Articulates AI as “the study of how to make machines behave intelligently, to solve problems and achieve goals in the kinds of complex situations in which humans require intelligence to achieve goals.” John McCarthy, a seminal figure in the development of AI, characterizes it as “the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable” [25]. In its fundamental essence, artificial intelligence represents a scholarly domain that integrates computer science with extensive datasets to enhance problem-solving capabilities. Furthermore, it encompasses specialized subfields such as machine learning and deep learning, which are frequently discussed in conjunction with artificial intelligence. These domains involve sophisticated AI algorithms designed to construct expert systems that are proficient in making predictions or classifications through the analysis of input data [26].

AI in Education

Artificial Intelligence (AI) is progressively exerting substantial influence on the educational sector, revolutionizing the methodologies through which students acquire knowledge, educators impart instruction, and educational institutions function [27-30]. [27] articulated that AI has the potential to act as an invaluable educational instrument, alleviating the burdens borne by both educators and learners while promoting efficient learning experiences. Alongside ongoing educational transformations such as the digitization of learning materials, gamification, and tailored educational approaches, there are myriad opportunities for the advancement of AI applications within the educational realm. A prominent illustration of this is the methodical application of AI methodologies to design interactive and adaptive educational programs, thereby establishing personalized learning environments. This compensatory strategy addresses the shortage of educators through the deployment of Intelligent Tutoring Systems (ITS) [31]. ITS furnishes customized learning experiences via four primary mechanisms: monitoring student engagement, delivering suitable assignments, offering constructive feedback, and enabling interfaces for human-computer interaction [28]. The proliferation of Intelligent Tutoring Systems (ITS) across diverse educational disciplines indicates a transformative role for educators, necessitating a potential reconceptualization of pedagogical frameworks. However, rapid advancements in technology inherently present a multitude of risks and challenges. For instance, there are apprehensions among educators regarding the extent to which artificial intelligence may jeopardize their professional roles. Numerous scholars contemplate whether the evolution of artificial intelligence could potentially challenge or even supplant educators, similar to the automation trends observed in various occupations [32]. It is increasingly acknowledged that as artificial intelligence continues to advance, the professional responsibilities of teachers will require significant adaptation, leading to the formation of novel organizational paradigms. The challenges that arise also include student perceptions toward these transformations [33]. While students, as digital natives, can harness artificial intelligence to augment educational outcomes, there exists the potential for them to encounter difficulties in appropriately applying AI methodologies within particular academic contexts, which may inadvertently foster adverse attitudes toward learning [34]. Within the domain of e-learning, artificial intelligence has exhibited extraordinary potential to substantially enhance both instructional and learning outcomes through the provision of personalized educational experiences, adaptive feedback mechanisms, and efficient data analytics. AI-driven systems, encompassing intelligent tutoring and adaptive learning platforms, possess the capacity to analyze extensive volumes of student data in real-time, thereby enabling educators to tailor content to the distinct needs, preferences, and progress of each learner [35,36]. These instruments not only facilitate enhanced

Received*: 02-06-2026 -* ***Accepted****: 29-07-2026 -* ***Published****: 06-08-2026*

personalization but also cultivate dynamic and interactive educational environments that promote heightened student engagement and motivation [37]. For example, AI algorithms are capable of identifying deficiencies in a learner's understanding and dynamically modifying the complexity of tasks, thereby offering personalized feedback and targeted recommendations for enhancement [35]. By delivering such adaptive feedback, AI systems assist learners in developing critical thinking capabilities and fostering deeper cognitive engagement [38]. Moreover, artificial intelligence amplifies the efficacy of data analysis by perpetually gathering and interpreting student performance metrics. This continuous monitoring empowers educators to closely observe learners' progress and intervene as necessary [39]. With these advanced capabilities, teachers can more effectively manage larger class sizes and make informed, data-driven decisions that enhance instructional methodologies. By customizing content to address individual student requirements, AI further advances educational equity, ensuring that learners of varying abilities and backgrounds receive the necessary support. AI instruments within e-learning contexts not only enhance individual academic outcomes but also provide educators with actionable insights to refine teaching strategies. These technologies play a crucial role in promoting flexible, personalized, and more efficacious learning experiences in both digital and blended educational settings. This investigation aims to explore the impact of artificial intelligence on the academic performance and perceptions of pre-service students within an e-learning framework, with a particular emphasis on AI-powered tools.

Methodology

Survey Design

Based on a study conducted by [40], the researchers utilized the questionnaire implemented in the aforementioned study. Furthermore, the majority of the items employed a five-point Likert scale, ranging from (1) "strongly disagree" to (5) "strongly agree," to evaluate the independent variable of AI-powered tools and the dependent variable of Academic Performance. In order to maximize the reach of the questionnaire to the largest possible cohort of study participants, the research provided response options in two languages, namely English and Arabic. The questionnaire is comprised of two sections:

- The initial section delineates demographic variables such as gender and specialization.
- The subsequent section encompasses both the dependent and independent variables, specifically AI-powered tools (20 items) and Academic Performance (19 items).

Sampling and Data Collection

In accordance with the data regarding the total number of students enrolled in the Faculty of Education, which amounts to approximately 2100, an online survey utilizing Google Forms was disseminated across various social media platforms and email addresses. The survey was conducted from June 2025 to September 2025, strategically targeting students within the Faculty of Education in Ajelat city. A cumulative total of 175 responses were obtained.

Result of the Study

Respondents' Demographic Profile

Table 1 delineates the demographic characteristics of the respondents. This table indicates that a predominant proportion of respondents are female (90.9%), whereas only (9.1%) are male, which can be attributed to the college's policy of transitioning entirely into a women's institution, resulting in no new male admissions for an extended period. In terms of specialized areas of study, Humanities account for (50.9%), closely followed by Applied Sciences at (49.1%).

Table 1. Respondents' Demographic Profile

No	Respondent Characteristics		Frequency	Percentage
1	Gender	Male	16	9.1%
		Female	159	90.9%
2	Specialization	Applied Sciences	86	49.1%
		Humanities	89	50.9%

AI-powered tools (independent variable)

(Table 2) shows that the majority of respondents have a positive opinion on using AI-powered tools in their study, except for some paragraphs that contain a point of view different from the majority. But in general, most respondents (students) have a positive opinion on using AI-powered tools in their study.

Table 2. AI-powered tools

Received*: 02-06-2026 -* ***Accepted****: 29-07-2026 -* ***Published****: 06-08-2026*

https://doi.org/10.54361/ajmas.269810

Items	Strong disagree	Disagree	Neutral	Agree	Strong agree	Mean	St.Dev
	N(%)						
I frequently use AI tools (such as ChatGPT and Grammarly) to assist me with my studies.	-	4(2.3)	35(20)	114(65.1)	22(12.6)	3.88	0.636
I use AI tools daily.	3(1.7)	39(22.3)	47(26.9)	78(44.6)	8(4.6)	3.28	0.920
I rely on these tools for most of my academic tasks.	-	41(23.4)	21(12)	105(60)	8(4.6)	3.45	0.901
I use AI tools consistently throughout the semester.	-	27(15.4)	49(28)	85(48.6)	14(8)	3.49	0.850
I use AI tools frequently when I have upcoming assignments or exams.	-	15(8.6)	41(23.4)	108(61.7)	11(6.3)	3.65	0.724
I rely on them to organize my study schedule daily.	12(6.9)	35(20)	44(25.1)	65(37.1)	19(10.9)	3.25	1.106
I use them even for simple academic tasks.	22(12.6)	41(23.4)	24(13.7)	81(46.3)	7(4)	3.05	1.168
I tend to use them more when I have multiple assignments.	11(6.3)	3(1.7)	28(16)	110(62.9)	23(13.1)	3.74	0.931
I find myself using them regularly in my weekly study routine.	7(4)	33(18.9)	38(21.7)	68(49.1)	11(6.3)	3.34	0.987
I often start my study sessions by opening AI tools.	15(8.6)	48(27.4)	34(19.4)	67(38.3)	11(6.3)	3.06	1.120
I use a variety of AI tools regularly.	10(5.7)	36(20.6)	31(17.7)	94(53.7)	4(2.3)	3.26	0.999
I use different AI tools for different subjects or tasks.	10(5.7)	11(6.3)	42(24)	104(59.4)	8(4.6)	3.50	0.902
I use AI tools to help me take notes, create flashcards, or review content.	3(1.7)	22(12.6)	22(12.6)	113(64.6)	15(8.6)	3.65	0.869
I switch between multiple AI tools based on my academic needs.	7(4)	14(8)	36(20.6)	108(61.7)	10(5.7)	3.57	0.873
AI-powered tools I use cover a wide range of academic functions (e.g., writing, studying, organizing).	3(1.7)	3(1.7)	39(22.3)	113(64.6)	17(9.7)	3.78	0.707
I frequently explore new AI-powered study tools.	3(1.7)	18(10.3)	37(21.1)	110(62.9)	7(4)	3.57	0.798
I use specialized AI tools for complex subjects.	-	3(1.7)	26(14.9)	99(56.6)	47(26.9)	4.08	0.693
My academic assignments require the use of multiple AI-powered tools.	7(4)	18(10.3)	49(28)	75(42.9)	26(14.9)	3.54	0.998
I adapt my use of tools according to the course requirements.	-	9(5.1)	34(19.4)	121(69.1)	11(6.3)	3.76	0.640
I find comfort in using multiple AI tools for different learning styles.	3(1.7)	10(5.7)	30(17.1)	117(66.9)	15(8.6)	3.74	0.761
Total mean						3.53	

Academic Performance

(Table 3) show that majority of respondents notice the effect positive of using AI tools on their academic performance, except for some paragraphs that contain a point of view different from the majority such as paragraph (I often start my study sessions by opening AI tools,, I use a variety of AI tools regularly, I use them even for simple academic tasks and I rely on them to organize my study schedule daily). But in general, there is a positive effect on academic performance. were a total mean of academic performance (3.67).

Table 3. Academic Performance (dependent variable)

Items	Strong disagree	disagree	neutral	agree	Strong agree	Mean	St. Dev
	N (%)						
My grades have improved since using AI-powered study tools.	11(6.3)	25(14.3)	24(13.7)	72(41.1)	43(24.6)	3.63	1.18
I now feel better prepared for exams thanks to these tools.	11(6.3)	25(14.3)	38(21.7)	75(42.9)	26(14.9)	3.45	1.10
AI tools improve my ability to retain information for exams.	15(8.6)	22(12.6)	20(11.4)	84(48)	34(19.4)	3.57	1.18
These tools have improved the quality of my assignments.	-	21(12)	41(23.4)	90(51.4)	23(13.1)	3.65	0.85
I feel more confident taking exams thanks to AI-powered study tools.	19(10.9)	28(16)	28(16)	74(42.3)	26(14.9)	3.34	1.22

Received: 02-06-2026 - **Accepted**: 29-07-2026 - **Published**: 06-08-2026

I rely on these tools to review and reinforce exam content.	7(4)	15(8.6)	32(18.3)	99(56.6)	22(12.6)	3.65	0.94
AI tools help me better understand the topics covered in exams.	-	17(9.7)	19(10.9)	109(62.3)	30(17.1)	3.86	0.80
These tools help me track the topics I need to study for exams.	-	21(12)	27(15.4)	98(56)	29(16.6)	3.77	0.86
I score higher on exams when I use AI study tools.	11(6.3)	37(21.1)	24(13.7)	70(40)	33(18.9)	3.44	1.19
I find it easier to recall information during exams with the help of these tools.	11(6.3)	18(10.3)	34(19.4)	75(42.9)	37(21.1)	3.62	1.11
I can complete assignments more accurately thanks to AI support.	7(4)	26(14.9)	11(6.3)	90(51.4)	41(23.4)	3.75	1.09
These tools help me produce well-organized assignments.	3(1.7)	14(8)	27(15.4)	101(57.7)	30(17.1)	3.80	0.87
My problem-solving skills have improved thanks to the use of AI tools.	7(4)	10(5.7)	30(17.1)	92(52.6)	36(20.6)	3.80	0.96
AI tools improve the clarity and coherence of my written work.	7(4)	14(8)	27(15.4)	100(57.1)	27(15.4)	3.72	0.95
I can meet deadlines more easily using these tools.	7(4)	11(6.3)	41(23.4)	86(49.1)	30(17.1)	3.69	0.96
My assignments contain fewer errors thanks to these tools.	8(4.6)	25(14.3)	24(13.7)	89(50.9)	29(16.6)	3.60	1.06
AI tools help me generate ideas and content for my assignments.	7(4)	11(6.3)	16(9.1)	103(58.9)	38(21.7)	3.88	0.95
These tools improve my ability to find reliable sources for assignments.	8(4.6)	10(5.7)	27(15.4)	89(50.9)	41(23.4)	3.82	1.00
These tools ensure that my assignments meet academic standards.	4(2.3)	18(10.3)	30(17.1)	97(55.4)	26(14.9)	3.70	0.92
Total mean						3.67	

(Fig. 1) illustrates the Smart-PLS regression analyses, highlighting R-square values [41]. This figure elucidates the various utilized items (factor loading) and the interdependencies among the studied variables, namely AI-powered tools and Academic Performance.

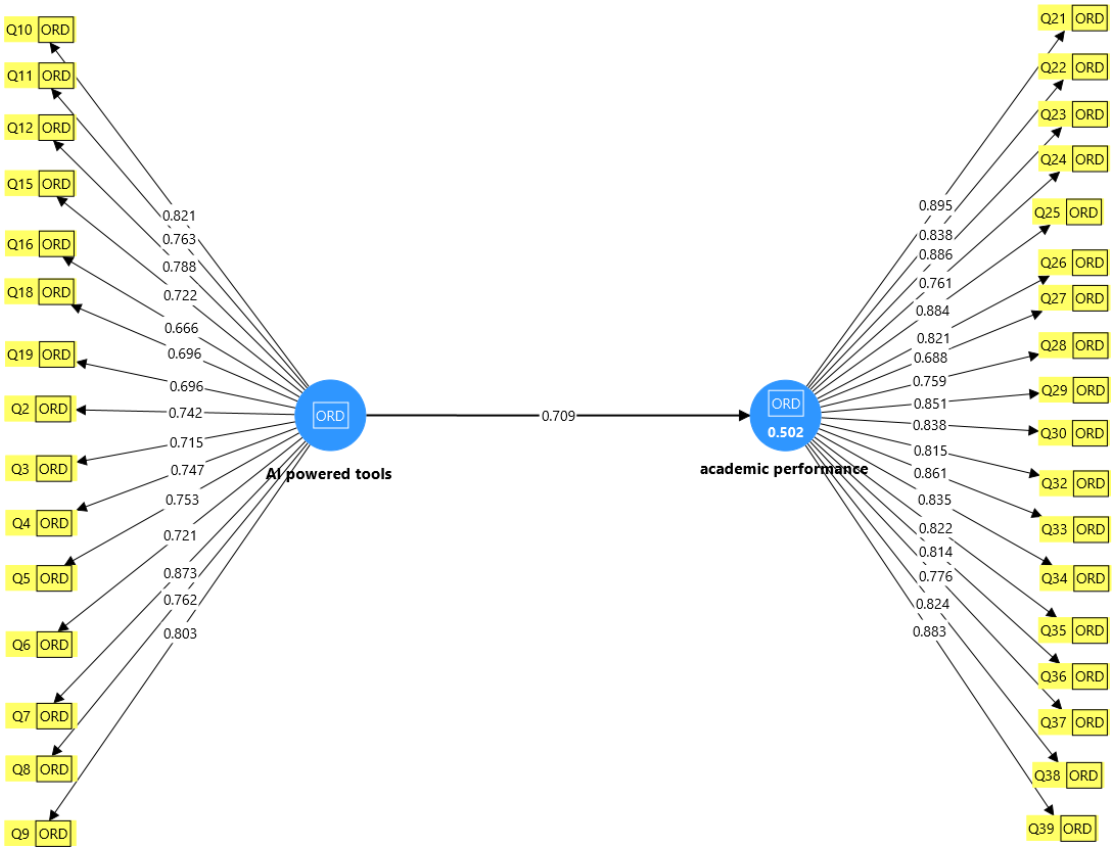

Fig. 1. Smart-PLS – regression analyses with R-square values

Assessment of the Measurement Model

Received: *02-06-2026 -* ***Accepted:*** *29-07-2026 -* ***Published:*** *06-08-2026*

The evaluation of the reflective measurement model is detailed in (Table 4), encompassing the reliability assessment of the indicators through Cronbach's alpha (CA) and Composite Reliability (CR), alongside the validity assessment via the Average Variance Extracted (AVE) value and R-squared (R^2).

Table 4. Assessment of the Measurement Model

Construct	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)	R^2
AI-powered tools	0.945	0.950	0.567	0.502
academic performance	0.972	0.974	0.683	

According to the findings presented, the subsequent conclusions can be inferred from (Table 4): A construct is deemed to exhibit substantial reliability if it satisfies the conditions CA>0.7 and CR>0.7 [42,43]. Consequently, as indicated in (Table 4), every construct demonstrates an acceptable reliability coefficient. The Average Variance Extracted (AVE) must exceed 0.5 for a construct to be classified as valid. This criterion is met, as all constructs have AVE values exceeding 0.5. The coefficient of determination, denoted as R^2, serves as an indicator of the predictive efficacy of the model, and the spectrum of R2 values must adhere to (1,0) [44,45,46]. According to (Table 4), the resulting model (independent variable) explains 50% of the variance (R^2) in academic performance. According to [47], the independent variables exerted a substantial influence on the dependent variables when R^2=0.26, a moderate influence when R^2=0.13, and a minimal influence when R^2=0.02. In the present investigation, the independent variable demonstrated a considerable effect on the dependent variable. Specifically, 50% of the variance in academic performance is accounted for by the independent variable in the current research, while the remaining 50% is attributable to variables that were not examined within this study.

Table 5. Hypothesis Testing

Hypothesis	Correlation	Beta	P- Val	Status
There is a significant impact of AI-powered tools on academic performance.	AI-Powered Tools > Academic Performance	0.709	(0.000)	accepted

Hypothesis Testing

In order to evaluate the proposed hypotheses, the interrelationships among various elements (variables) were rigorously examined through the application of path coefficients (refer to Figure 1).

To ascertain the statistical significance of the path coefficient (regression analyses) relationships, the p-value was determined to be (0.000), and the Beta coefficient was calculated at (0.709) (refer to Table 5). The findings depicted in (Figure 1 and Table 5) elucidate the structural modeling assessments, thereby presenting the results of the hypotheses: There exists a statistically significant positive correlation between academic performance and AI-powered tools, a conclusion substantiated by the parameters {B=0.709, P=0.000}.

Conclusion of the study

In conclusion, this study assessed the factor (AI-powered tools) influencing academic performance; the participants in this study were from the Faculty of Education at Ajilat city. The PLS-SEM model was estimated using 175 students; the study revealed that the AI-powered tools factor has a strong effect on the academic performance variable, according to R2 (50%) and Beta (0.709). Also, evaluate the relationship's strength and significance through indicators like outer loadings, path coefficients, and Average Variance Extracted (AVE), as explained by CA (0.945), (0.972), and AVE (0.567) and (0.683). The opinions provided by the respondents (students) can be used to improve academic performance by improving AI-powered tools in education and ensuring that they are used to their full potential in enhancing students' learning outcomes. Also, improving academic performance in education will increase students' knowledge by conducting more workshops and training programs, improving infrastructure and facilities, and balancing technology usage.

References

1- Alemán de la Garza L, Gómez Zermeño M, Mochizuki Y, Bruillard E, Anichini A, Antal P, et al. Rethinking Pedagogy. Exploring the Potential of Digital Technology in Achieving Quality Education. New Delhi, India: UNESCO MGIEP; 2019.
2- Bahja M, Kuhail MA, Hammad R. Embracing technological change in higher education. In: IntechOpen eBooks. 2022. doi: 10.5772/intechopen.100431.
3- Salama R, Hinton T. Online higher education: current landscape and future trends. J Furth High Educ. 2023;47(7):913–24. doi: 10.1080/0309877x.2023.2200136.
4- Chaudhary AA, Arif S, Calimlim RF, Khan SZ, Sadia A. The impact of AI-powered educational tools on student engagement and learning outcomes at higher education level. Int J Contemp Iss Soc Sci. 2024;3:2842–52.
5- Kamalov F, Santandreu Calonge D, Gurrib I. New era of artificial intelligence in education: towards a sustainable multifaceted revolution. Sustainability (Switzerland). 2023;15(16):12451. doi: 10.3390/su151612451.
6- Bhutoria A. Personalized education and artificial intelligence in United States, China, and India: a systematic review using a human-in-the-loop model. Comput Educ Artif Intell. 2022;3:100068. doi: 10.1016/j.caeai.2022.100068.

Received: *02-06-2026 -* ***Accepted:*** *29-07-2026 -* ***Published:*** *06-08-2026*

7- Pedró F, Subosa M, Rivas A, Valverde P. Artificial Intelligence in Education: Challenges and Opportunities for Sustainable Development. Paris: UNESCO; 2019.
8- De La Higuera C. A report about education, training teachers and learning artificial intelligence: Overview of key issues. 2019 [cited 2024 Sep 10]. Available from: http://cdlh7.free.fr/UNESCO/Teaching_AI-cdlh.pdf.
9- Alam A. Possibilities and apprehensions in the landscape of artificial intelligence in education. In: 2021 International Conference on Computational Intelligence and Computing Applications (ICCICA). Nagpur, India; 2021. p. 1-8. doi: 10.1109/ICCICA52458.2021.9697272.
10- Eggert K. How artificial intelligence will shape universities of tomorrow. In: 2021 International Conference. HTWG Konstanz University of Applied Sciences, Germany; 2021. p. 50.
11- George B, Wooden O. Managing the strategic transformation of higher education through artificial intelligence. Adm Sci. 2023;13(9):196. doi: 10.3390/admsci13090196.
12- Gupta R, Bhatia S. Artificial intelligence: A boon to the education industry. Int J Comput Appl. 2019;177(33):18-21.
13- Kadaruddin K. Empowering education through generative AI: innovative instructional strategies for tomorrow's learners. Int J Bus Law Educ. 2023;4(2):618-25.
14- Christopoulos A, Kajasilta H, Salakoski T, Laakso MJ. Limits and virtues of educational technology in elementary school mathematics. J Educ Technol Syst. 2020;49(1):59-81. doi: 10.1177/0047239520908838.
15- Qushem UB, Christopoulos A, Oyelere SS, Ogata H, Laakso MJ. Multimodal technologies in precision education: providing new opportunities or adding more challenges? Educ Sci. 2021;11(7):338. doi: 10.3390/educsci11070338.
16- Adair A. Teaching and learning with AI: how artificial intelligence is transforming the future of education. XRDS. 2023;29(3):7-9.
17- Chen L, Chen P, Lin Z. Artificial intelligence in education: a review. IEEE Access. 2020;8:75264–78. doi: 10.1109/access.2020.2988510.
18- Seo K, Tang J, Roll I, Fels S, Yoon D. The impact of artificial intelligence on learner–instructor interaction in online learning. Int J Educ Technol High Educ. 2021;18:54. doi: 10.1186/s41239-021-00292-9.
19- Kamalov F, Santandreu Calonge D, Gurrib I. New era of artificial intelligence in education: towards a sustainable multifaceted revolution. Sustainability (Switzerland). 2023;15(16):12451. doi: 10.3390/su151612451.
20- Dwivedi YK, Kshetri N, Hughes L, Slade EL, Jeyaraj A, Kar AK, et al. So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. International Journal of Information Management, 2023.
21- Nakshine VS, Thute P, Khatib MN, Sarkar B. Increased screen time as a cause of declining physical, psychological health, and sleep patterns: a literary review. Cureus. 2022;14(10):e30051. doi: 10.7759/cureus.30051.
22- Shahzad MF, Xu S, Lim WM, Yang X, Khan QR. Artificial intelligence and social media on academic performance and mental well-being: student perceptions of positive impact in the age of smart learning. Heliyon. 2024;10(10):e29523. doi: 10.1016/j.heliyon.2024.e29523.
23- Chan CKY, Hu W. Students' voices on generative AI: perceptions, benefits, and challenges in higher education. Int J Educ Technol High Educ. 2023;20:43. doi: 10.1186/s41239-023-00411-8.
24- Fetzer JH. What is Artificial Intelligence? In: Artificial Intelligence: Its Scope and Limits. Dordrecht: Springer; 1990. (Studies in Cognitive Systems; vol 4). doi: 10.1007/978-94-009-1900-6_1.
25- McCarthy J. What is artificial intelligence. 2007 [cited 2024 Sep 10]. Available from: http://jmc.stanford.edu/artificial-intelligence/what-is-ai/index.html.
26- Ertel W. Introduction to artificial intelligence. 2nd ed. Springer; 2018. doi: 10.1007/978-3-319-58487-4.
27- Loeckx J. Blurring boundaries in education: context and impact of MOOCs. Int Rev Res Open Distrib Learn. 2016;17(3):92–121. doi: 10.19173/irrodl.v17i3.2395.
28- Seldon A, Abidoye O. The Fourth Education Revolution. London, UK: University of Buckingham Press; 2018.
29- Zhai X, Chu X, Chai CS, Jong MSY, Istenic A, Spector M, et al. A review of artificial intelligence (AI) in education from 2010 to 2020. Complexity. 2021;2021:1-18. doi: 10.1155/2021/8812542.
30- Zhang K, Aslan AB. AI technologies for education: recent research & future directions. Comput Educ Artif Intell. 2021;2:100025. doi: 10.1016/j.caeai.2021.100025.
31- du Boulay B. Artificial intelligence as an effective classroom assistant. IEEE Intell Syst. 2016;31(6):76–81. doi: 10.1109/mis.2016.93.
32- Lacity M, Willcocks LP. Robotic Process Automation and Risk Mitigation: The Definitive Guide. Ashford, UK: SB Publishing; 2017.
33- Flogie A, Aberšek B. Transdisciplinary approach of science, technology, engineering and mathematics education. J Balt Sci Educ. 2015;14(6):779–90. doi: 10.33225/jbse/15.14.779.
34- Ijaz K, Bogdanovych A, Trescak T. Virtual worlds vs books and videos in history education. Interact Learn Environ. 2017;25(7):904-29. doi: 10.1080/10494820.2016.1225099.
35- Luckin R, Luckin W, Griffiths M, Forcier LB. Intelligence Unleashed: An argument for AI in Education. London: Pearson Education; 2016.
36- Zawacki-Richter O, Marín VI, Bond M, Gouverneur F. Systematic review of research on artificial intelligence applications in higher education–where are the educators? Int J Educ Technol High Educ. 2019;16(1):1-27.
37- Baker T, Smith L, Anissa N. Exploring the Future of Artificial Intelligence in Schools and Colleges. NESTA; 2019 [cited 2024 Sep 10]. Available from: https://media.nesta.org.uk/documents/Future_of_AI_and_education_v5_WEB.pdf.
38- Chen L, Chen P, Lin Z. Artificial intelligence in education: a review. IEEE Access. 2020;8:75264–78. doi: 10.1109/access.2020.2988510.
39- Kulik JA, Fletcher JD. Effectiveness of intelligent tutoring systems: a meta-analytic review. Rev Educ Res. 2016;86(1):42-78.
40- Micabalo ADC, et al. The impact of AI-powered study tools on the academic performance and the motivation of higher education students. 2024 [cited 2024 Sep 10]. Available from: https://www.researchgate.net/publication/386045165.
41- Alkawsi G, Ali N, Baashar Y. The moderating role of personal innovativeness and users experience in accepting the smart meter technology. Appl Sci. 2021;11(8):3297. doi: 10.3390/app11083297.

Received*: 02-06-2026 -* ***Accepted****: 29-07-2026 -* ***Published****: 06-08-2026*

42- Kannan V. Just in time, total quality management, and supply chain management: understanding their linkages and impact on business performance. Omega. 2005;33(2):153-62.
43- Nunnally JC, Bernstein IH, Berge JMT. Psychometric Theory. Vol. 226. New York, NY: McGraw-Hill; 1967.
44- Hair JF, Risher JJ, Sarstedt M, Ringle CM. When to use and how to report the results of PLS-SEM. Eur Bus Rev. 2019;31(1):2-24.
45- Shmueli G. To explain or to predict? Stat Sci. 2010;25(3):289-310.
46- Shmueli G, Koppius OR. Predictive analytics in information systems research. MIS Q. 2011;35(3):553-72.
47- Cohen J. Statistical Power Analysis for the Behavioral Sciences. Vol. 2. Hilsdale, MI: Lawrence Earlbaum Associates; 1988.

Received*: 02-06-2026 -* ***Accepted****: 29-07-2026 -* ***Published****: 06-08-2026*