



# The Role of AI Technology in Enhancing Learning Outcomes of University Students: A Case Study of Ghana Communication Technology University (GCTU)

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## ABSTRACT

Using artificial intelligence (AI) in higher education has made learning more enjoyable by allowing personal instruction and adaptive learning. However, studies on its deployment in higher education in Ghana remain limited. This study sought to understand how the use of AI technology influences student engagement and performance at the Ghana Communication Technology University (GCTU). Data was obtained by using a descriptive survey design from 185 students through structured questionnaires. The researchers performed a Pearson correlation analysis and linear regression to determine the impact of AI technology integration on student academic aptitude. The study revealed that there is a positive correlation between the integration of AI tech and student engagement, meaning students are more engaged in their studies when AI-driven learning methods are employed. Nevertheless, while integration with AI was able to boost academic performance, the effect was relatively weak, suggesting that the presence of AI on its own does not make such a significant difference to academic success. This study recommends faculty training, AI literacy courses for students, policy frameworks towards AI's adoption in education. Optimising AI integration in these areas can result in improved student engagement and academic performance while addressing issues of overreliance and ethical questions present in the case of GCTU and other similar institutions. The research will contribute empirical evidence to inform strategic decision-making on educational technology investments by providing insights into the relationship between the use of AI technology and learning outcomes at GCTU.

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## INTRODUCTION

Rapidly, artificial intelligence (AI) technologies have reshaped the landscape of higher education all around the world, offering new approaches to learning and teaching.<sup>1</sup> As educational institutions in Ghana, with its relatively developed educational infrastructure, begin to adopt digital transformation

<sup>1</sup> Olaf Zawacki-Richter et al., "Systematic Review of Research on Artificial Intelligence Applications in Higher Education—Where Are the Educators?," *International Journal of Educational Technology in Higher Education* 16, no. 1 (2019): 1–27.

into their systems, the integration of the use of AI-based educational technologies presents great promise in improving student's learning outcomes. Ghana Communication Technology University (GCTU), as a leading technology-focused institution, stands at the forefront of this educational revolution in West Africa.

The relationship between education quality in general and technology integration has been researched extensively in the last decade. Research by Consoli et al. shows that it is the quality of technology integration in the classroom that drives students' behavioural engagement and digital competencies rather than the quantity and frequency of technology use.<sup>2</sup> Also, more recent studies have exhibited the capability of AI-driven educational tools that provide personalised learning experiences, adapt to the learning needs of students and provide real-time feedback.<sup>3</sup> This personalisation has been linked to better learning outcomes in higher education settings across various disciplines.<sup>4</sup>

As a reaction to a number of problems in Ghanaian higher education, a study by Buabeng-Andoh in the Ghanaian context asserts the increasing Ghanaian adoption of educational technologies in Ghana's tertiary institutions could help address some of the prevailing challenges within Ghanaian higher education.<sup>5</sup> Gyamfi posited that the mere availability of technology doesn't automatically translate into better educational outcomes; thus, technology is to be incorporated into pedagogical frameworks for it to be helpful.<sup>6</sup> Among the new technologies incorporated into GCTU's courses is the use of AI-powered learning technologies. Comprehensively, these initiatives are in line with Ghana's broader educational policy objectives in the use of technology to enhance education quality and accessibility.<sup>7</sup> Despite investing in infrastructure, little empirical research has been done to find out how these technologies influence student engagement and academic performance, particularly in the institutional context in which GCTU operates.

Student engagement is a critical factor in academic success as it is measured by the level of interest, attention, and curiosity students show when learning.<sup>8</sup> Research has linked increased student technology use with increased student engagement and self-directed learning, which could have an indirect effect on academic performance.<sup>9</sup> Ko et al. and Rajabalee et al. established strong correlations between student engagement and positive learning outcomes.<sup>10</sup> According to Henrie et al., using digital tools can significantly increase student engagement as they provide more interactive and collaborative learning experiences in technology-enhanced learning environments.<sup>11</sup> According to Zheng et al.'s

<sup>2</sup> Tessa Consoli et al., "Quality of Technology Integration Matters: Positive Associations with Students' Behavioral Engagement and Digital Competencies for Learning," *Education and Information Technologies*, 2024, 1–34.

<sup>3</sup> Wayne Holmes, Maya Bialik, and Charles Fadel, *Artificial Intelligence in Education Promises and Implications for Teaching and Learning* (Center for Curriculum Redesign, 2019); Olusegun Oladele Jegede, "Artificial Intelligence and English Language Learning: Exploring the Roles of AI-Driven Tools in Personalizing Learning and Providing Instant Feedback," *Universal Library of Languages and Literatures* 1, no. 2 (2024); E. G. Grace, P. Vidhyavathi, and P. Malathi, "A Study on AI in Education: Opportunities and Challenges for Personalised Learning," *Industrial Engineering Journal* 52, no. 5 (2023): 750–59.

<sup>4</sup> Zawacki-Richter et al., "Systematic Review of Research on Artificial Intelligence Applications in Higher Education—Where Are the Educators?"

<sup>5</sup> Charles Buabeng-Andoh, "ICT Implementation and Practices: Factors Influencing Students' Pedagogical Use of ICT in Ghanaian Secondary Schools," *International Journal of Information and Communication Technology Education (IJICTE)* 11,no.2(2015):1–13.

<sup>6</sup> Stephen Adu Gyamfi, "Informal Tools in Formal Context: Adoption of Web 2.0 Technologies among Geography Student Teachers in Ghana," *International Journal of Education and Development Using ICT* 13, no. 3 (2017).

<sup>7</sup> Ghana Ministry of Education, *Education Strategic Plan 2018-2030*. (Accra: Government of Ghana, 2020).

<sup>8</sup> Md. Sahadat Hossen Sajib, "Determining Factors and Correlation of Factors Influential for Student Engagement," in *15th International Conference on Computing Communication and Networking Technologies (ICCCNT)* (IEEE, 2024), 1–6, <https://doi.org/10.1109/ICCCNT61001.2024.10724770>.

<sup>9</sup> Tabassum Rashid and Hanan Muhammad Asghar, "Technology Use, Self-Directed Learning, Student Engagement and Academic Performance: Examining the Interrelations," *Computers in Human Behavior* 63 (October 2016): 604–12, <https://doi.org/10.1016/j.chb.2016.05.084>.

<sup>10</sup> Jang Wan Ko et al., "The Structural Relationship Between Student Engagement and Learning Outcomes in Korea," *The Asia-Pacific Education Researcher* 25, no. 1 (February 10, 2016): 147–57, <https://doi.org/10.1007/s40299-015-0245-2>; Banoor Younsa Rajabalee, Mohammad Issack Santally, and Frank Rennie, "A Study of the Relationship between Students' Engagement and Their Academic Performances in an E-Learning Environment," *E-Learning and Digital Media* 17, no. 1 (January 17, 2020): 1–20, <https://doi.org/10.1177/2042753019882567>.

<sup>11</sup> Curtis R. Henrie, Lisa R. Halverson, and Charles R. Graham, "Measuring Student Engagement in Technology-Mediated Learning: A Review," *Computers & Education* 90 (December 2015): 36–53, <https://doi.org/10.1016/j.compedu.2015.09.005>.

meta-analysis, technology-enhanced environments generally have a positive effect on student achievement.<sup>12</sup>

However, Castillo-Merino and Serradell-López observed that those effects are mediated through factors such as institutional support, faculty competence and student readiness.<sup>13</sup>

Despite the growing literature on the intersection of AI and education globally, there is a dearth of context-specific work that investigates how AI technology affects learning outcomes in Ghanaian higher education institutions, specifically in technology-based universities such as GCTU. In general, studies on how Ghanaian education applies technology have been explored by Manu et al. and Obiri-Yeboah et al., but specifically, there is no quantitative study on how the use of AI technology is related to student engagement and academic performance.<sup>14</sup> This study seeks to fill this gap by providing empirical evidence from GCTU and how this can be exploited in the Ghana context, which has a specific socio-educational environment to improve by using AI technology. Specifically, the study sought to;

1. To examine the relationship between AI technology integration and student engagement at GCTU.
2. To assess the impact of AI technology integration on student academic performance at GCTU.

The findings of this study have important implications for educational stakeholders in Ghana and other settings. The research will contribute empirical evidence to inform strategic decision-making on educational technology investments by providing insights into the relationship between the use of AI technology and learning outcomes at GCTU. The results will guide university administrators on how to deploy technology more effectively and achieve greater levels of student engagement and academic performance. It will be beneficial for the faculty members to understand how to bring AI tools into pedagogical approaches that are effective for them. More broadly, this research also contributes to a growing body of literature on the use of technology to support learning in African contexts and, in more specific terms, the AI knowledge gap in its application to technology use in Ghanaian higher education. The impact findings may compel policy formation at the institutional and national levels for how educational technologies should be integrated into Ghana's higher education system. Finally, this study could then catalyse change in terms of the use of AI in teaching and learning practices to better prepare students for the digital economy.

## LITERATURE REVIEW

### Relationship between AI technology integration and student engagement

Several studies have shown that AI-enabled educational tools can have a significant impact on increasing student engagement. For example, Ezeoguine & Eteng-Uket recently investigated the effect of AI tools on student engagement in higher education.<sup>15</sup> A descriptive survey design was employed using a diverse sample of university students in the study. Mean, one-way and two-way ANOVA were done to analyse the data. The result found that student engagement was extremely high due to the influence of AI tools, with a massive difference in student engagement levels among students influenced by AI tools. Kim et al. investigated whether an AI-based Intelligent Tutoring System (ITS) could enhance student engagement, observing a 25.13% increase in engagement among over 21,000 students who utilised an AI-based ITS.<sup>16</sup> In Cao et al., the development and use of AI chatbots as multi-

<sup>12</sup> Binbin Zheng et al., "Learning in One-to-One Laptop Environments," *Review of Educational Research* 86, no. 4 (December 10, 2016): 1052–84, <https://doi.org/10.3102/0034654316628645>.

<sup>13</sup> David Castillo-Merino and Enric Serradell-López, "An Analysis of the Determinants of Students' Performance in e-Learning," *Computers in Human Behavior* 30 (January 2014): 476–84, <https://doi.org/10.1016/j.chb.2013.06.020>.

<sup>14</sup> Joshua, Manu et al., "Education and Technology in Ghana: Understanding the Centrality of Technology Integration in the Classroom and Beyond," *American Journal of Educational Research* 12, no. 10 (2024): 402–12; Kwabena Obiri-Yeboah, Collins Fosu, and Roderick Kyere-Djan, "Exploring the Trend of ICT Adoption in Tertiary Institutions in Ghana: A Case Study at Kwame Nkrumah University of Science and Technology (KNUST)," in *Information and Knowledge Management*, vol. 3, 2013, 44–52.

<sup>15</sup> Eber Pearl Ezeoguine and Stella Eteng-Uket, "Artificial Intelligence Tools and Higher Education Student's Engagement," *Edukasiana: Jurnal Inovasi Pendidikan* 3, no. 3 (2024): 300–312.

<sup>16</sup> Byungchan Kim et al., "AI-Driven Interface Design for Intelligent Tutoring Systems Improves Student Engagement," *ArXiv Preprint*, 2020.

role pedagogical agents in computer science education were found to be more engaging and address students' psychological needs for competence, autonomy, and relatedness.<sup>17</sup> Nguyen et al. conducted research at a highly esteemed university in the United Arab Emirates, and their students revealed high engagement in classroom activities, experiencing AI tools as easy and useful, which in turn contributed to their engagement and concentration in the classroom.<sup>18</sup> The findings also highlighted how students' perceptions of AI acceptance aligned with their engagement in the learning environment.

### **Impact of AI technology integration on student academic performance**

Several studies have proven that educational tools based on AI significantly enhance students' academic achievement. For example, Baillifard et al. allowed students to engage with an AI tutor app (GPT-3) as part of a semester-long psychology project.<sup>19</sup> Students used the app to ask microlearning questions about course materials produced by the AI tutor. The AI tutor was able to provide personalised distributed retrieval practice by developing a dynamic neural network model of each student's grasp of key concepts. When comparing the AI tutor to the same course without the AI tutor, students' grades were dramatically higher. For students in the most active engagement group, their grades increased by 15 percentile points. Thomas et al. applied a hybrid human-AI tutoring model, utilising AI tools in three urban, low-income middle schools studied.<sup>20</sup> Proficiency and usage results show significant improvement in achievement differentials for lower and higher achievers in human-AI-based tutoring. Gao et al. also analyse the influence of Generative AI on the academic achievements of Chinese business students by examining its application in technology.<sup>21</sup> Results from Chinese business students using the Wenjuanxing platform suggest that the use of technology in teaching increases motivation, self-efficacy and beliefs about future education, and those business students subsequently perform better in their academic studies. It is also worth noting that a survey by Wecks et al. has yielded conflicting results. Specifically, they discovered that, of the test grades for students using generative AI, those who used generative AI tools like ChatGPT scored significantly lower (6.7 points) than those who didn't use generative AI.<sup>22</sup> In particular, the use of AI tools was negatively associated with student test results, particularly among the hyper-gifted, indicating that the use of AI tools may not always lead to positive learning outcomes.<sup>23</sup>

### **CONCEPTUAL FRAMEWORK**

Based on the empirical evidence, a conceptual framework showing the relationship between the variables is shown below in Figure 1. The independent variable is AI technology integration, and the dependent variables are students' engagement and academic performance.

<sup>17</sup> Cassie Chen Cao et al., "AI Chatbots as Multi-Role Pedagogical Agents: Transforming Engagement in CS Education," *ArXiv Preprint ArXiv:2308.03992*, 2023.

<sup>18</sup> L. Nguyen, T. Tran, and P. Dao, "Exploring the Dynamics of Power in Educational Institutions: A Case Study of Large Class Settings," *Journal of Educational Administration* 61, no. 3 (2023): 160–73.

<sup>19</sup> Ambrose Baillifard et al., "Implementing Learning Principles with a Personal AI Tutor: A Case Study," *ArXiv Preprint ArXiv:2309.13060*, 2023.

<sup>20</sup> Danielle R Thomas et al., "Improving Student Learning with Hybrid Human-AI Tutoring: A Three-Study Quasi-Experimental Investigation," in *Proceedings of the 14th Learning Analytics and Knowledge Conference*, 2024, 404–15.

<sup>21</sup> Ziyi Gao et al., "Enhancing Academic Performance of Business Students Using Generative AI: An Interactive-Constructive-Active-Passive (ICAP) Self-Determination Perspective," *The International Journal of Management Education* 22, no. 2 (2024): 100958.

<sup>22</sup> Janik Ole Wecks et al., "Generative AI Usage and Exam Performance," *ArXiv Preprint ArXiv:2404.19699*, 2024.

<sup>23</sup> Wecks et al., "Generative AI Usage and Exam Performance."

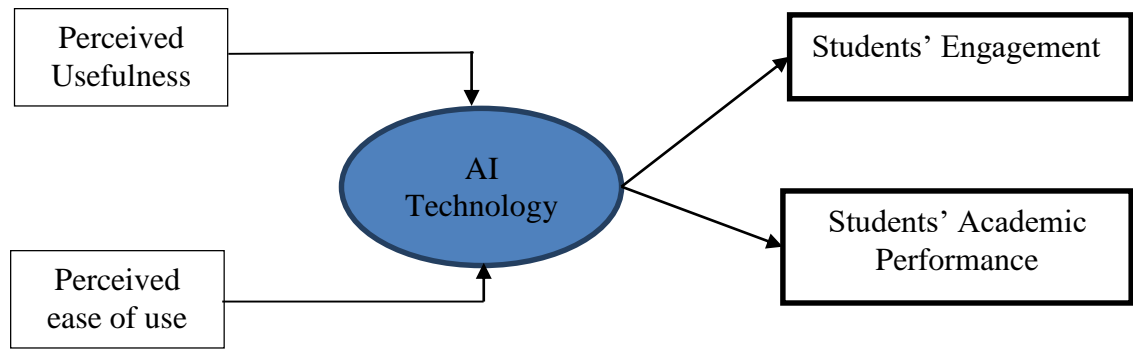


Figure 1: Conceptual Framework

## Hypothesis

H<sub>1</sub>: There is a significant relationship between AI Technology integration and students' engagement.

H<sub>2</sub>: AI Technology integration will have a significant impact on students' academic performance.

## THEORETICAL FRAMEWORK

The Technology Acceptance Model is a theoretical framework used to study the integration of AI technology at GCTU. According to TAM, technology adoption is described by two main determinants: perceived usefulness and Perceived ease of use.<sup>24</sup> Perceived usefulness in education is defined explicitly as situations in which individuals believe that AI tools will help them improve their academic performance. Perceived ease of use is defined as the ease with which students can interact with these technologies.<sup>25</sup> According to Scherer et al., TAM suggests engagement with AI educational tools is likely to rise when people perceive tangible benefits in their learning outcomes and encounter little to no usage barriers.<sup>26</sup> Abdullah and Ward argue that this acceptance accounts for the level and intensity of learning engagement and actual academic performance.<sup>27</sup> The model allows researchers to analyse factors that may facilitate or obstruct the uptake of AI at GCTU, such as institutional support, technical infrastructure or social perception of technology.<sup>28</sup> For the design of effective AI implementation strategies to improve high levels of student engagement and academic excellence, it is crucial to have a clear understanding of these dynamics. By applying TAM to GCTU's specific context, this study can identify how students' perceptions and attitudes towards AI technologies influence their learning experiences and result in the integration of educational technology within Ghanaian higher education.

## METHODOLOGY

### Research Design

The descriptive survey design was adopted for this study. The descriptive survey is based on collecting quantifiable data through structured questionnaires, interviews, or observations to describe the occurrence of the phenomenon without manipulating variables.<sup>29</sup> As Creswell points out, this research design enables not only the systematic collection of data on student engagement and academic performance following the integration of AI in the university context but also the identification of

<sup>24</sup> Fred D. Davis, "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* 13, no. 3 (September 1989): 319, <https://doi.org/10.2307/249008>.

<sup>25</sup> Viswanath Venkatesh and Fred D. Davis, "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies," *Management Science* 46, no. 2 (February 2000): 186–204, <https://doi.org/10.1287/mnsc.46.2.186.11926>.

<sup>26</sup> Fazilat Siddiq and Ronny Scherer, "Is There a Gender Gap? A Meta-Analysis of the Gender Differences in Students' ICT Literacy," *Educational Research Review* 27 (June 2019): 205–17, <https://doi.org/10.1016/j.edurev.2019.03.007>.

<sup>27</sup> Fazil Abdullah and Rupert Ward, "Developing a General Extended Technology Acceptance Model for E-Learning (GETAMEL) by Analysing Commonly Used External Factors," *Computers in Human Behavior* 56 (March 2016): 238–56, <https://doi.org/10.1016/j.chb.2015.11.036>.

<sup>28</sup> Timothy Teo, "Factors Influencing Teachers' Intention to Use Technology: Model Development and Test," *Computers & Education* 57, no. 4 (2011): 2432–40.

<sup>29</sup> Mark N. K Saunders, Philip Lewis, and Adrian Thornhill, *Research Methods for Business Students*, 8th ed. (New York: Pearson, 2019).

patterns and trends.<sup>30</sup> With the aid of this design, the researchers were able to empirically investigate the correlation between student outcomes and the use of AI in students' learning experiences at GCTU.<sup>31</sup> Also, the design flexibility enables the use of a large sample, allowing the results to be generalised.

### Population, Sample Technique and Size

The target population of this study consisted of Ghana Communication Technology University (GCTU) students who had encountered AI technology integration in their education. The study comprised approximately 5,000 undergraduate and postgraduate students, utilising a stratified random sampling approach to ensure proportionate representation by mode of research and educational levels.<sup>32</sup>

In calculating the sample size, Cochran's formula for a finite population was employed :  $n = \frac{N \cdot p \cdot q}{(e^2/Z^2 + p \cdot q/N)}$ . Using population  $N=5000$ , the proportion of students experiencing AI technology integration  $p=0.1541$ ,  $q=0.8459$ , the margin of error  $e=0.05$ , and  $Z=1.96$  (95% confidence level), then  $n \approx 170$  individuals equals the figure obtained.<sup>33</sup> For the quantitative survey, this was rounded up to 200 to account for potential non-response, as recommended by Pagell and Lusk.<sup>34</sup>

### Data Collection Procedure

A systematic approach to data collection was developed to examine GCTU's AI technology integration using quantitative methods. Structured questionnaires from validated instruments were used to collect the quantitative data. Adapted instruments from Van Schaik et al. were modified to fit the GCTU context for measuring AI technology integration.<sup>35</sup> The questionnaire items adapted to measure students' engagement and academic performance were selected from the existing literature to ensure consistency with the Technology Acceptance Model framework. An expert review by educational technology specialists and GCTU faculty members, who are all AI technology experts and familiar with local contextual educational settings, was conducted to establish the content validity of the instrument.

Pilot testing was conducted with a small sample ( $n = 20$ ) of GCTU students who were not part of the final study using these instruments. One way to confirm face validity was through cognitive interviews in which student's perceptions of questionnaire items were verbalised.<sup>36</sup> Internal consistency was established using Cronbach's alpha coefficients, which were calculated for the three scales. All of the scales presented reliability ( $\alpha = 0.87$  for the AI technology integration scale,  $\alpha = 0.82$  for the student engagement scale, and  $\alpha = 0.85$  for the academic performance self-assessment scale) above the recommended threshold of 0.70.<sup>37</sup> Surveys were electronically distributed over one academic semester via a secure online platform, Google Surveys, to protect confidentiality and anonymity. Ethical considerations were also factored in by obtaining informed consent from all participants before they participated in the study while they were informed about the study's objectives. Access to anonymised responses and data was strictly confidential and available only to the principal researcher. Confidentiality was guaranteed.

### Data Analysis

To ensure the dependability and accuracy of results, analysis was carried out using Statistical Package for the Social Sciences (SPSS). An examination of the relationship between the integration of AI technology, student engagement, and academic performance at the GCTU was conducted using the

<sup>30</sup> John W. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 4th ed. (Thousand Oaks, CA: Sage Publications, 2014).

<sup>31</sup> A. Bryman, *Social Research Methods* (Oxford University Press, 2016).

<sup>32</sup> F. J. Fowler, *Survey Research Methods*, 5th ed. (SAGE, 2014).

<sup>33</sup> W.G. Cochran, *Sampling Techniques*, 3rd ed. (New York: Wiley, 2011).

<sup>34</sup> Ruth A. Pagell and Edward J. Lusk, "Benchmarking Academic Business School Libraries Relative to Their Business School Rankings," *Journal of Business & Finance Librarianship* 7, no. 4 (June 2002): 3–33, [https://doi.org/10.1300/J109v07n04\\_02](https://doi.org/10.1300/J109v07n04_02).

<sup>35</sup> Paul Van Schaik, Josette A Bettany-Saltikov, and J G Warren, "Clinical Acceptance of a Low-Cost Portable System for Postural Assessment," *Behaviour & Information Technology* 21, no. 1 (2002): 47–57.

<sup>36</sup> Robert M Groves et al., *Survey Methodology* (John Wiley & Sons, 2011).

<sup>37</sup> Robert F. DeVellis and Christine T. Thorpe, *Scale Development: Theory and Applications* (Sage Publications, 2021).

SPSS tool that employed both descriptive and inferential statistics. Descriptive statistics were also used to summarise and present demographic data in a structured format by presenting the frequencies and percentages. Inferential statistics, particularly Pearson correlation analysis and linear regression analysis, were used to test hypotheses and explore the predictive power of AI technology integration in engaging students and improving academic performance. The coefficient of determination ( $R^2$ ) and p-values were used to measure the explanatory power of the model and to estimate the level of statistical significance, respectively.

## PRESENTATION OF RESULTS /FINDINGS

### Demographic Characteristics

A total of 185 responses were received from the respondents, representing 92.5%, which the researchers considered adequate for analysis, as more than 50.0% confirmed Mugenda and Mugenda's assertion.<sup>38</sup> The demographic characteristics of the respondents are presented in Table 1 below.

**Table 1: Demographic characteristics of respondents**

Variables		Frequency	Percentage
Gender	Male	92	49.7
	Female	93	50.3
Age	18-24	44	23.8
	25-29	41	22.2
	30-34	39	21.1
	35-39	35	18.9
	40 and above	26	14.1
Education	Undergraduate	83	44.9
	Graduate (Masters)	77	41.6
	Doctoral (PhD)	25	13.5
Mode of Study	Full-Time	74	40.0
	Part-Time	46	24.9
	Distance Learning	65	35.1

Source: Field Survey (2025)

The gender distribution based on the demographic characteristics of the respondents indicates that 49.7% of the total population of the respondents are male and 50.3% are female, almost equal distribution of both genders. Respondents are distributed in different age groups. Respondents aged 18-24 make up the largest age group at 23.8% of respondents. Following closely are those aged 25-29, comprising 22.2% of the sample. 21.1% of the respondents are students between the ages of 30 and 34, and 18.9% are 35 to 39 years old. The group aged 40 and above accounted for the smallest group, with 14.1% of the respondents. This distribution covers young students and more mature ones as well, spreading across the ages. The GCTU academic population is diverse according to the level of study of respondents. The largest group consists of 44.9% undergraduate students among 185 valid respondents. The sample has 41.6% of graduate students who are pursuing a master's degree, demonstrating the substantial presence of more advanced learners. 13.5% of the respondents represent doctoral (PhD) candidates, demonstrating that this study benefits from the input of students conducting advanced academic research. Among the respondents, 40.0% are full-time students, making up the largest group. Distance learning students follow closely with 35.1% of the sample, showing a substantial proportion of students engaged in remote or online education. Respondents who indicated they were part-time

<sup>38</sup> Olive Mwhiki Mugenda and Abel Gitau Mugenda, *Research Methods: Quantitative & Qualitative Approaches*, vol. 2 (Acts press Nairobi, 2003).

students make up 24.9%, which reflects a substantial group of individuals balancing study with other commitments.

### Relationship between AI technology integration and student engagement at GCTU.

To assess the relationship between AI technology integration and student engagement at GCTU, the data was subjected to hypothesis testing.

#### Hypothesis Testing

**H<sub>1</sub>:** There is a significant relationship between AI Technology integration and students' engagement.

To test the first hypothesis, a Pearson correlation analysis was conducted to determine whether a significant relationship exists between AI Technology integration and students' engagement. The results are shown in Table 2 below:

**Table 2: Pearson Correlation**

Variable	Mean	Standard Deviation	Pearson Correlation	p-value
AI Technology Integration	2.88	1.19		
Student Engagement	2.74	1.21	0.93	0.000

\*\* Correlation is significant at the 0.01 level (2-tailed)

As shown by the Pearson correlation coefficient ( $r = 0.93$ ) in Table 2, there is a strong positive relationship between Artificial Intelligence (AI) technology integration and student engagement. At the 95% confidence level, the p-value (0.000) supports that this relationship is statistically significant, and therefore, this relationship strongly correlates to high student engagement with AI technology integration at GCTU. Hence, since the hypothesis specifies that there is a significant relationship between AI technology integration and student engagement in GCTU, and the correlation analysis confirms the same, the null hypothesis (no relationship) is rejected.

### Impact of AI technology integration on student academic performance at GCTU

To assess the impact of AI technology integration on student academic performance at GCTU, the data was subjected to hypothesis testing.

#### Hypothesis Testing

**H<sub>2</sub>:** AI Technology integration will have a significant impact on students' academic performance.

To test the second hypothesis, a linear regression analysis was conducted to determine the impact of AI technology integration on student academic performance at GCTU. The results are shown in Tables 3 and 4 below:

#### Model Summary

The linear regression model was used to examine the relationship between students' academic performance and AI technology integration. An  $R^2$  value of 0.051 for the model suggests that the first 5.1% of the variation in academic performance is explained by AI integration. An adjusted  $R^2$  value of 0.046 indicates low explanatory power.

**Table 3: ANOVA**

Source	Sum of Squares	df	Mean Square	F-value	p-value
Model	6.281	1	6.281	9.785	0.002
Residual	117.478	183	0.642		
Total	123.759	184			

From Table 3 above, the ANOVA results indicate that the model, with an F value of 9.785 and a p-value of 0.002, is statistically significant, implying that AI integration explains variation in academic performance.

**Table 4: Coefficients**

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.476	0.156		15.855	0.000
	AI Integration	0.156	0.050	0.154	3.128	0.002
a. Dependent Variable: Academic Performance						

The regression coefficient of the AI integration is 0.156, with a standard error of 0.050. The t value is 3.128 ( $p=0.002$ ), which means there is a positive but statistically significant relationship. Since the p-value is less than 0.05, we cannot accept the null hypothesis (which says there is no relationship) and take the alternative, which states the integration of AI technology positively and significantly affects student academic performance at GCTU.

## DISCUSSION

The study conducted at GCTU shows that AI technology integration has a very strong positive relationship with student engagement. Thus, it can be seen that the application of AI integration provides a significant enhancement to the student engagement level, and the Pearson correlation coefficient ( $r=0.93$ ,  $p<0.001$ ) of student engagement with AI-integrated tools supports the hypothesis that the use of AI-powered tools can induce an interactive learning experience.

The findings confirm the empirical studies results found in the literature. For instance, in the field of higher education, Ezeoguine and Eteng-Uket proved that AI tools have positive effects on student engagement and recommended giving students the opportunity to use these tools in their learning process.<sup>39</sup> As Kim et al. indicated, student engagement within a student sample that used an AI-driven ITS demonstrated a 25.13% increase in engagement.<sup>40</sup> AI also helps engage students through individualised learning experiences. Besides, Nguyen et al. discovered that adopting AI has a positive association with student engagement in classroom activities, especially in highly interactive learning settings.<sup>41</sup> Additionally, the theoretical basis of the study, founded on the Technology Acceptance Model (TAM), explicates this relationship since GCTU students would discover the AI tools introduced to them as highly useful and easy to use.

Furthermore, the GCTU results indicate that AI learning tools personalise education such that students dynamically interact with course materials. This learning approach seems to have some appeal in terms of its adaptivity, which caters to the different learning preferences of students while giving instant feedback—the primary motivator that keeps students involved in learning endeavours. Moreover, as Cao et al. suggest, AI chatbots and virtual assistants offer students the competence, autonomy, and relatedness that they require, allowing for greater engagement.<sup>42</sup>

The study also showed that including AI technology in education had a positive but weak influence on student academic achievement at GCTU. However, the integration of AI technology with teaching was statistically significant to academic performance, as a positive coefficient of 0.156 ( $p=0.002$ ) was revealed from the results of regression analysis. This result parallels those of Baillifard et

<sup>39</sup> Ezeoguine and Eteng-Uket, “Artificial Intelligence Tools and Higher Education Student’s Engagement.”

<sup>40</sup> Kim et al., “AI-Driven Interface Design for Intelligent Tutoring Systems Improves Student Engagement.”

<sup>41</sup> Nguyen, Tran, and Dao, “Exploring the Dynamics of Power in Educational Institutions: A Case Study of Large Class Settings.”

<sup>42</sup> Cao et al., “AI Chatbots as Multi-Role Pedagogical Agents: Transforming Engagement in CS Education.”

al., who found that AI-personalised tutoring raised grades in a psychology course by 15 percentile points.<sup>43</sup> Moreover, Gao et al.'s research also finds that it boosts the motivation and self-efficacy of students, which in turn leads to the achievement of high performance.<sup>44</sup> The weak explanatory power in this study, however, indicates that AI tools are not enough to push academic success in GCTU unless faculty are engaged, the curriculum is aligned, and students have developed digital literacy.

Alternatively, some studies conversely warn of the adverse effects that will arise, such as Weeks et al. that point out that the unregulated use of AI will take the student's academic performance in the worst direction by making them lose their ability to think critically and make their own choices by resorting to AI-generated content.<sup>45</sup> Although AI technology holds promise to bolster academic achievement, the study points out that effective implementation strategies are necessary to reap the benefits at GCTU, such as guidance from faculty, assessment reform and students' responsible use of AI.

## RECOMMENDATIONS

Based on the findings of the study, the following are recommended:

1. For the GCTU, the integration of comprehensive AI technology in all the faculties should be focused on tools that help enhance student interaction and opportunities for students to learn collaboratively with each other.
2. To enable AI tools to be incorporated in the classroom in ways that increase pedagogical effectiveness, faculty development programs can and ought to include building AI literacy and competence among instructors.
3. Continuous assessment of the effectiveness of the integration of AI into the university curriculum should be implemented in the form of analysis of feedback from the students and continuously tracking metrics related to their engagement and performance.
4. Developing context-specific AI applications for Ghanaian students based on their unique needs and aligning with the Ghanaian local education goals should be an option that GCTU should look into.
5. These findings should be considered by the Ministry of Education when developing national policies on educational technology integration, especially in Ghana's higher education sector.

## CONCLUSION

This study focused on how AI technology could enhance student engagement and ultimately boost academic performance at the Ghana Communication Technology University. The findings reveal that AI technology integration in education is strongly positively correlated with student engagement. In other words, such students who interact with AI-based educational tools have higher student engagement levels in the learning process than regular students. When such students interact with AI-based educational tools, they have higher levels of student engagement in the learning process than traditional students. While academic performance and AI technology had a significant relationship, the amount of variance explained by AI technology explained a relatively low degree of variance, indicating that while AI impacts student academic achievement, it is just one of many factors affecting student performance. The perceived usefulness and ease of use of AI technologies are found to be positively related to their subsequent adoption and effectiveness in educational settings, which is in line with the Technology Acceptance Model framework. However, despite these challenges, overreliance on AI, the digital literacy gap, and faculty engagement, the use of AI at GCTU can be valuable. Yet, it must be done so carefully. The research highlights the implications of higher education on adopting structured AI or failing to do so that AI does not become a replacement for critical thinking as well as independent learning.

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<sup>43</sup> Baillifard et al., "Implementing Learning Principles with a Personal AI Tutor: A Case Study."

<sup>44</sup> Gao et al., "Enhancing Academic Performance of Business Students Using Generative AI: An Interactive-Constructive-Active-Passive (ICAP) Self-Determination Perspective."

<sup>45</sup> Weeks et al., "Generative AI Usage and Exam Performance."

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