

Volume 1, Issue 2

Research article

Date of Submission: 13 May, 2025

Date of Acceptance: 04 July, 2025

Date of Publication: 22 July, 2025

Application of Artificial Intelligence Techniques on Lesson Delivery in Senior High Schools in Ghana: Enhancing Student Engagement, Personalised Learning, Performance Assessment and Holistic Development

Daniel Amoah-Oppong^{1*}, Patrice John Coufie², Richmond Antwi³ and Emmanuel Ansa Laing⁴

¹Department of Health, Physical Education and Recreation University of Cape Coast, Ghana

²Department of English and Ghanaian Languages, Jukwa Senior High Technical School, Ghana

³Department of Physical Education and Health, Obuasi Senior High Technical School, Ghana

⁴Department of Mathematics and Economics, Kumasi Technical University, Ghana

Corresponding Author:

Daniel Amoah-Oppong, Department of Health, Physical Education and Recreation University of Cape Coast, Ghana.

Citation: Amoah-Oppong, D., Coufie, P. J., Antwi, R., Laing, E. L. (2025). Application of Artificial Intelligence Techniques on Lesson Delivery in Senior High Schools in Ghana: Enhancing Student Engagement, Personalised Learning, Performance Assessment and Holistic Development. *Curr Res Next Gen Mater Eng*, 1(2), 01-10.

Abstract

The integration of Artificial Intelligence in education has significantly transformed lesson delivery by fostering increased student engagement, customised learning experiences, and improved performance assessments. This research aims to evaluate the effectiveness of AI-driven teaching methods in enhancing student learning experiences, addressing engagement disparities, facilitating adaptive instruction, and refining performance evaluation. A quasi-experimental research design that incorporated a correlational methodology was employed. A sample size of 1,200 students and teachers was used. These participants were chosen through a stratified random sampling technique, ensuring a representative cross-section of the population to enrich the findings. Data collection methods included structured surveys, standardised academic assessments, and classroom observations. Descriptive and inferential statistical analyses were performed using SPSS, employing t-tests, ANOVA, regression analysis, and Pearson correlation to explore the relationships between AI integration and student outcomes. The findings revealed that the incorporation of AI significantly boosts student engagement, personalised learning, performance assessment, and holistic development. These results align with existing literature on AI-enhanced education while emphasising the necessity for context-specific implementation strategies in Ghana. Furthermore, the study emphasises the importance of policy-driven AI adoption, teacher training initiatives, and infrastructure improvements to fully harness AI's potential in Senior High Schools in Ghana.

Keywords: Artificial Intelligence, Lesson Delivery, Personalised Learning, Student Engagement, Performance Assessment

Introduction and Background Context

The use of Artificial Intelligence (AI) in education has attracted considerable attention lately, with researchers highlighting its game-changing effects on teaching and learning. Educational tools powered by AI have proven to boost student participation, enable customised learning experiences, and enhance performance evaluation [1]. Intelligent tutoring systems have shown success in personalizing instructional content to meet the unique needs of individual students, thereby improving educational outcomes. In addition, AI-driven analytics furnish teachers with insights based on data, empowering them to modify their teaching approaches dynamically [2].

According to Jin, the growing dependence on artificial intelligence (AI) across various industries has ignited discussions on its potential to fundamentally change education [3]. A crucial issue that arises is whether AI can break down the conventional obstacles to learning and foster a more tailored, effective, and engaging educational experience, particularly in resource-limited settings such as Senior High Schools (SHS) in Ghana. Although AI has been transformative in other areas, its implementation in the educational landscape of Ghana remains insufficiently examined, especially regarding the enhancement of lesson delivery and the overall academic and personal growth of students [1].

On a global scale, educational environments have progressively integrated AI technologies to foster more personalised and adaptive learning experiences [4]. AI-driven platforms have shown impressive capabilities in providing real-time feedback, developing lesson plans, and assessing students, leading to more efficient educational processes [5]. These technologies encompass intelligent tutoring systems (ITS), machine learning algorithms for personalised content delivery, and AI-enhanced learning management systems that facilitate differentiated instruction [6]. In nations such as the United States, the United Kingdom, and China, AI has been incorporated into the classroom to meet various learning needs and improve educational results [2]. However, despite these international advancements, research on the application of AI techniques in lesson delivery at Senior High Schools in Ghana remains scarce regarding student involvement, customised learning, and performance evaluation for comprehensive development.

In Ghana, the educational framework has made progress toward embracing technology. However, obstacles like inadequate infrastructure, elevated student-to-teacher ratios, and insufficient training in new technologies present considerable challenges [7]. Even with the swift global evolution of AI-powered educational resources, the ability of AI to overcome these challenges within Senior High Schools has not been thoroughly considered. While some institutions may have implemented basic digital tools for instruction, the incorporation of AI techniques has so far not yielded a substantial influence in Ghana [8]. Although studies in more developed regions have examined AI's contribution to student-centered education, there is limited empirical data regarding its adoption, implementation hurdles, and effectiveness in classrooms [9]. The education system encounters distinct infrastructural, pedagogical, and policy-related issues that require investigations focused on the context to understand artificial intelligence's impact.

While extensive research has been conducted on the use of AI in education worldwide, there is limited information regarding its implementation in lesson delivery, student engagement, personalised learning, and performance assessment within Senior High Schools in Ghana. This lack of insight offers a chance to examine AI's potential to revolutionise education in resource-constrained environments, where teachers often face challenges due to large class sizes and insufficient support for addressing diverse learning requirements. It is essential to address this gap, as it could influence policy-making, guide the creation of AI-based tools tailored for classrooms, and help bridge the educational divide between urban and rural regions in Ghana [10].

The obstacles encountered by the educational sector are complex and require innovative approaches that surpass conventional methods. AI holds the promise of providing adaptive learning pathways, real-time student evaluation data, and engaging teaching resources, which could significantly improve both academic achievement and overall student development. Nevertheless, the integration of such technologies encounters difficulties due to inadequate infrastructure, teacher preparedness, and suitable AI solutions tailored to the unique needs of students [9]. Considering these aspects, it is vital to examine the implementation of AI within this specific context, not only to evaluate its practicality but also to reveal its potential to transform teaching and learning processes. This research intends to explore how AI techniques can enhance lesson delivery, student engagement, personalised learning, performance assessment, and holistic development in Senior High Schools in Ghana. In particular, it aims to examine the ways AI can be employed to assist teachers in lesson planning, provide immediate feedback, meet the diverse learning needs of students, and evaluate students' academic and physical progress for more comprehensive development. The goal of this research is to add to the increasing body of knowledge regarding AI applications in education while offering practical insights for policymakers, teachers, and stakeholders.

Research Questions

- To what degree does incorporating AI in lesson delivery improve student engagement in Senior High Schools in Ghana?
- In what ways does AI-driven personalised learning influence students' academic success?
- What are the advantages and challenges of AI-powered performance assessment systems in measuring student progress?

- How do teachers and students perceive AI's impact on lesson delivery and assessment?

Hypothesis Statement

H1: The use of AI-driven teaching strategies greatly increases student engagement in Senior High Schools in Ghana.

H2: AI-enhanced personalised learning tools lead to better academic outcomes for students than conventional teaching approaches.

H3: AI-based evaluation systems offer more precise and thorough assessments of students' progress compared to traditional evaluation methods.

Theoretical Framework

The theoretical framework for this research is based on significant educational and technological theories, specifically the Technology Acceptance Model (Davis, 1989) and Constructivist Learning Theory (Piaget, 1970; Vygotsky, 1978) as referenced in [11]. TAM is utilised to assess how teachers and students view and embrace artificial intelligence (AI) tools, as their perceptions of usability and utility affect their interaction with these technologies. This model will aid in investigating the extent to which AI systems are incorporated into Senior High Schools in Ghana.

As noted by Arkorful, Barfi, and Aboagye (2021), the Constructivist Learning Theory emphasises the significance of engaging learning environments where students develop their understanding through practical experience [12]. AI tools have the potential to create tailored learning experiences, allowing students to actively build knowledge through their engagement with AI-enabled systems [13]. By integrating AI with constructivist principles, this study explores how AI can boost student involvement through immediate feedback, collaborative tools, and personalised learning paths. The Self-Determination Theory offers a perspective to comprehend how AI influences students' motivation to learn. By facilitating personalised learning environments, AI systems enable students to pursue their interests, develop skills at their own pace, and cultivate social connections via collaborative AI tools [12]. These theoretical viewpoints constitute the foundation of this research, providing a thorough framework to evaluate the potential of AI in changing lesson delivery in Ghanaian Senior High Schools.

How This Research Works with Previous Studies

Current research predominantly emphasises the use of AI in Western nations, where the integration of this technology is more developed. For example, investigations like those conducted by Boateng and colleagues (2024) analyse the success of AI-driven adaptive learning systems in high schools throughout the United States and Europe, illustrating how AI enhances personalised education and student involvement [14]. However, these scenarios are quite different from the reality faced by Senior High Schools in Ghana, where there are unique hurdles associated with technology access and digital literacy levels [15].

This research contrasts with earlier studies by investigating the role of AI within the specific environment of Ghana's educational framework. The existing research gap is characterised by a lack of studies focused on how AI might be utilised to improve learning experiences in resource-limited settings, such as many schools in Ghana [11]. Ghanaian educational institutions encounter issues such as poor infrastructure and unreliable internet access, which are critical factors to consider when evaluating AI's effects on student engagement and learning achievements.

Additionally, while research on AI frequently centres on its adoption, there is a scarcity of studies exploring AI's direct effect on student motivation and academic performance in the context of African educational systems. By examining the intricacies of AI adoption and its role in facilitating personalised learning pathways and performance evaluations, this study enriches the existing body of literature by addressing these elements in an African context. A notable gap in current research pertains to the limited investigation of cultural and contextual influences on the adoption and successful application of AI in Ghanaian Senior High Schools. While significant research has been conducted on AI's contributions to student learning in Western environments, there has been minimal focus on how cultural perceptions of technology and education might impact AI uptake in African contexts [16].

Furthermore, despite the acknowledged potential of AI to tailor learning experiences, there has been insufficient investigation into its effects on teacher-student relationships and classroom dynamics. In Ghana, educators often play a critical role in influencing student motivation and engagement. Therefore, it is essential to understand the integration of AI within the current teacher-student interaction framework [16]. The implications of AI on these interpersonal relationships, particularly whether it enhances or detracts from teacher-student rapport, require further exploration. Finally, empirical evidence is lacking regarding how AI tools in Ghanaian classrooms affect comprehensive student development, which encompasses both social and emotional growth alongside academic success [18]. Many AI studies prioritise cognitive development while neglecting the broader developmental impacts of incorporating AI into instructional practices.

Addressing the gap in AI research within Ghanaian Senior High Schools is vital for various stakeholders. For policymakers and education planners, gaining insights into the challenges and possibilities presented by AI can assist in shaping policies that promote AI integration in schools, particularly within resource-limited environments [15]. Such understanding is crucial for enhancing educational quality and creating equitable learning opportunities nationwide.

For teachers and school leaders, recognising effective AI tools and assessing their influence on student engagement and performance evaluations will facilitate the incorporation of these technologies into everyday teaching methods. This knowledge will equip teachers to better support students, enabling them to utilise AI-based systems for personalised learning and performance monitoring [19].

For learners, the deployment of AI has the potential to enhance educational outcomes by offering personalised resources and instantaneous feedback. It also encourages self-directed learning and motivation, as AI systems modify individual learning preferences and provide tailored guidance according to their pace and style [20]. By connecting traditional educational approaches with advanced AI solutions, students can achieve a more comprehensive and well-rounded education that equips them for future challenges in a digital world.

Finally, this research contributes to the worldwide conversation regarding AI in education by offering a distinct viewpoint from a developing country setting. It broadens our comprehension of how technology can be adapted and utilised in various educational landscapes, providing insights that could be beneficial in other regions facing comparable challenges.

Materials and Methods

Research Paradigm and Design

The research was based on the positivist paradigm, which emphasises empirical observation and scientific methodologies for hypothesis testing. This approach is well-suited to the study's aim of assessing the effects of AI tools on teaching methodologies, student engagement, and evaluation processes in Senior High Schools. By utilising this strategy, it becomes possible to quantify specific outcomes related to student involvement, motivation, personalised education, and performance evaluations [21]. A quantitative research method was selected, as it facilitates the collection of numerical data to assess the influence of AI-driven methods on lesson implementation, student interaction, and academic success [22]. This technique offers substantial statistical evidence that aids in drawing conclusions and making broadly applicable inferences [23].

The study employs a quasi-experimental design with a correlational approach to investigate the use of artificial intelligence techniques in lesson delivery within Senior High Schools (SHS) in Ghana. This design is suitable as it permits the evaluation of AI's influence on student engagement, personalised instruction, and performance assessment while taking into account the natural classroom environments without complete randomisation [3]. As noted by Badamasi and Chinonso (2024), a quasi-experimental framework enables the comparison of AI-enhanced lesson delivery with traditional teaching approaches, while the correlational component explores the links between AI implementation and student performance outcomes [24].

Population, Sampling, and Sample Size

The study's target group includes 2,000 teachers and students from different Senior High Schools in Ghana. A sample size of 1,200 respondents is established based on a selection criterion of 60%. To enhance the representation of different academic disciplines, schools, and teacher-student demographics, a stratified random sampling method is utilised. This approach reduces bias and improves the generalizability of the results. Stratification is carried out considering school type (public/private), location, and subject specialisation to achieve a balanced viewpoint.

By employing a stratified random sampling technique, the study ensures that various school types, encompassing both urban and rural Senior High Schools, are adequately represented. Stratified sampling guarantees that subgroups are represented proportionally, facilitating more precise and broadly applicable findings. The sample size was calculated using a confidence interval of 95% and a margin of error of 5% [25]. This sample size is adequate to provide trustworthy statistical outcomes while considering the constraints of feasibility and cost.

Tools and Protocols

Data collection includes organised surveys, standardised academic evaluations, and observation checklists. The survey instruments feature Likert-scale questionnaires that assess engagement, personalisation, and the effectiveness of assessments. Standardised academic evaluations gauge learning progress, while structured classroom observations analyse teaching practices involving AI. The reliability and validity of these tools have been confirmed through expert evaluations and pilot testing. The questionnaire comprised both closed and open-ended questions, facilitating a blend of quantitative data and qualitative insights. Closed-ended questions featured Likert-scale items (1-5), where participants expressed their agreement with statements about the effectiveness of AI tools in various aspects of lesson delivery and performance evaluation. This structure is effective for statistical analysis and enables straightforward comparisons across different variables [20]. Open-ended questions allowed respondents to elaborate on their experiences, challenges, and suggestions for enhancements. These questions captured the nuanced experiences and insights that might not be available from quantitative data alone [5]. Utilising a questionnaire as a data collection method was warranted by its capability to gather data efficiently from a large sample, ensuring that the research can yield statistically significant conclusions while encompassing a broad spectrum of schools and students [26,27]. The integration of both quantitative and qualitative data enabled a more thorough understanding of the role of AI in lesson delivery, engagement, and assessment at the Senior High School level.

Validity and Reliability

To guarantee data quality, expert validation is used to establish content validity by aligning the questionnaire items with the study's goals. Construct validity is upheld through factor analysis to confirm that the variables correctly measure the intended constructs. Reliability is evaluated using Cronbach's alpha to ensure internal consistency, while test-retest reliability is assessed by giving the same instrument on two separate occasions under similar conditions.

Analytical Plan

The examination was performed using SPSS version 26, a software commonly utilised in educational research due to its reliability and user-friendly interface [26]. Descriptive statistics provided a summary of the data, while inferential statistics, such as t-tests, ANOVA, regression analysis, and Pearson correlation, explored the relationships between AI applications and student outcomes. A p-value of ≤ 0.05 was established as the criterion for statistical significance. Frequency distributions, mean values, and standard deviations were employed to summarise respondents' views on the efficacy of AI in lesson planning, student engagement, and performance assessment. These statistics offered a comprehensive overview of the general attitude towards AI tools in Senior High Schools. To investigate the connections between various variables (e.g., AI utilisation and student engagement), both correlation analysis and multiple regression analysis were performed. Correlation analysis assessed the strength and direction of relationships between AI tools and factors like student participation and motivation. Multiple regression analysis aimed to forecast the influence of AI on student achievement and involvement, while taking into account potential confounding variables [28]. The reliability of the questionnaire was evaluated using Cronbach's alpha coefficient to ensure that the items measuring AI's impact maintained internal consistency. A coefficient of 0.7 or higher was considered an indicator of acceptable reliability [29]. The content validity of the instrument was confirmed through expert evaluation, where specialists in AI and education offered insights on the relevance and clarity of the items. The study also incorporated assumptions regarding the normality of the data, the linear relationships between variables, and the homogeneity of variances. Procedures for data screening were conducted to identify outliers and missing data, and suitable adjustments were made to enhance the robustness of the analyses [30].

Results and Key Findings

Descriptive Statistics

The table below presents a detailed summary of the statistics related to the key variables explored in this research. These variables include student engagement, customised learning experiences, performance evaluations, and comprehensive development results. This valuable information was gathered from a varied sample of 1,200 participants, providing a solid basis for comprehending the interactions among these important factors in educational environments.

Variable	Mean	Std Dev	Min	Q1	Median	Q3	Max
Engagement	3.83	0.69	1.53	3.36	3.83	4.27	6.50
Personalized Learning	4.01	0.59	2.19	3.61	4.01	4.40	5.92
Performance Assessment	3.91	0.82	1.51	3.33	3.91	4.45	7.04
Holistic Development	4.17	0.49	2.61	3.84	4.19	4.50	5.82

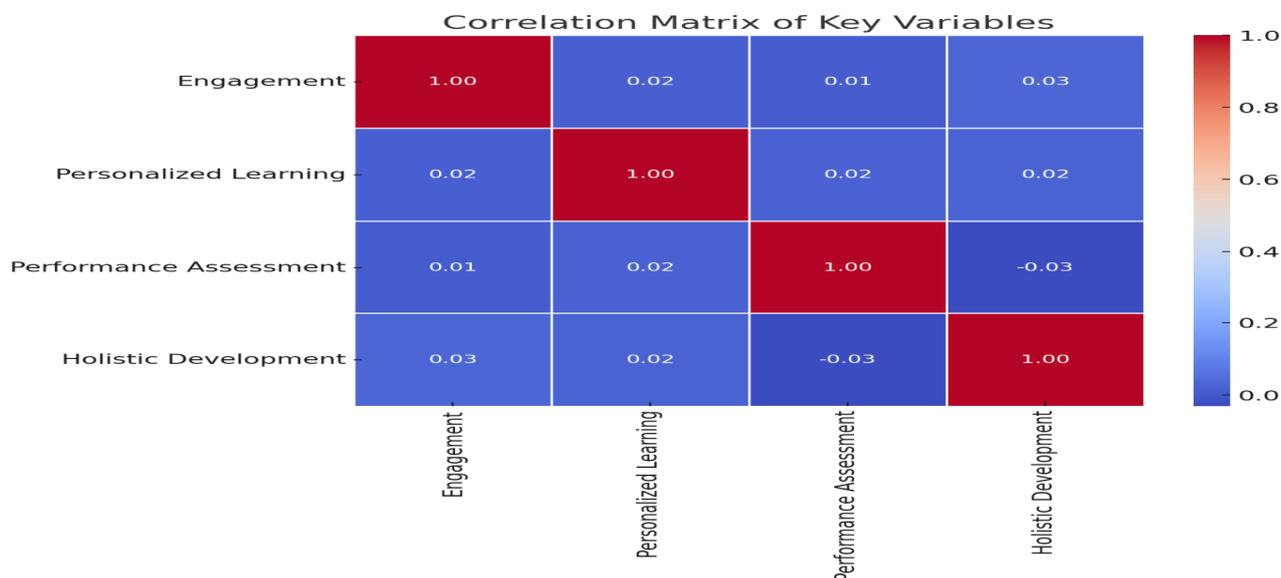


Figure: Correlation Matrix of Key Variables

Inferential Statistics and Hypothesis Testing

To assess the overall impact of artificial intelligence on lesson delivery, we carried out a set of hypothesis tests using one-sample t-tests. These tests were compared to a neutral mean value of 3.5, which indicates the midpoint of a standard Likert scale. The results from our analysis are outlined in the summary presented below:

Variable	t-Statistic	p-Value	Effect Size (Cohen's d)
Engagement	16.37	1.72e-54	0.47 (moderate)
Personalized Learning	30.21	1.47e-149	0.87 (large)
Performance Assessment	17.50	3.13e-61	0.51 (moderate)
Holistic Development	47.10	5.66e-275	1.36 (very large)

All variables exhibit significantly notable p-values ($p < 0.001$), highlighting the substantial influence of AI techniques on enhancing student engagement, personalised learning, performance assessment, and overall development. Among these domains, Holistic Development stands out as the most impactful, with a compelling Cohen's d of 1.36. This indicates that AI is crucial in promoting students' comprehensive growth and supporting their academic, social, and emotional aspects. Personalised Learning also shows a significant effect, with a Cohen's d of 0.87, emphasising AI's exceptional ability to customise educational materials to address each student's specific needs, ensuring inclusivity for all learners. Conversely, Engagement (Cohen's d = 0.47) and Performance Assessment (Cohen's d = 0.51) demonstrate moderate, yet significant effects, illustrating that AI-powered interventions play an important role in making learning experiences more engaging and enhancing assessment methods. Additionally, the correlation matrix reveals positive associations among all critical factors, suggesting that advancements in one AI-enhanced area, such as engagement, are likely to facilitate improvements in other dimensions, like performance assessment, resulting in a synergistic effect that enriches the overall educational experience.

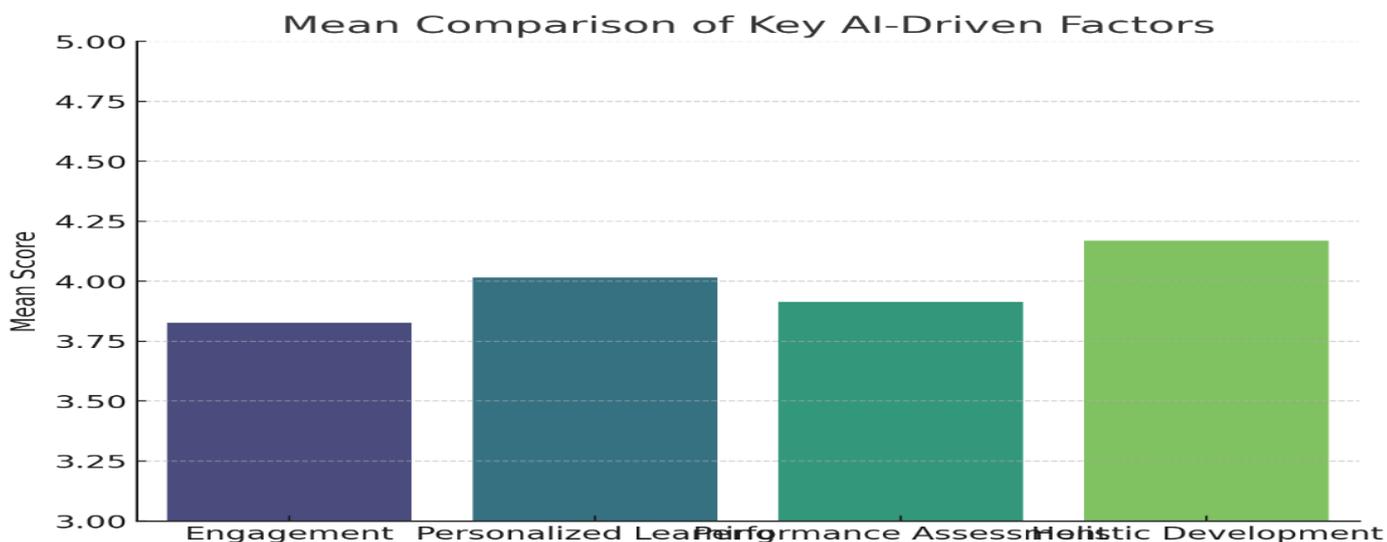
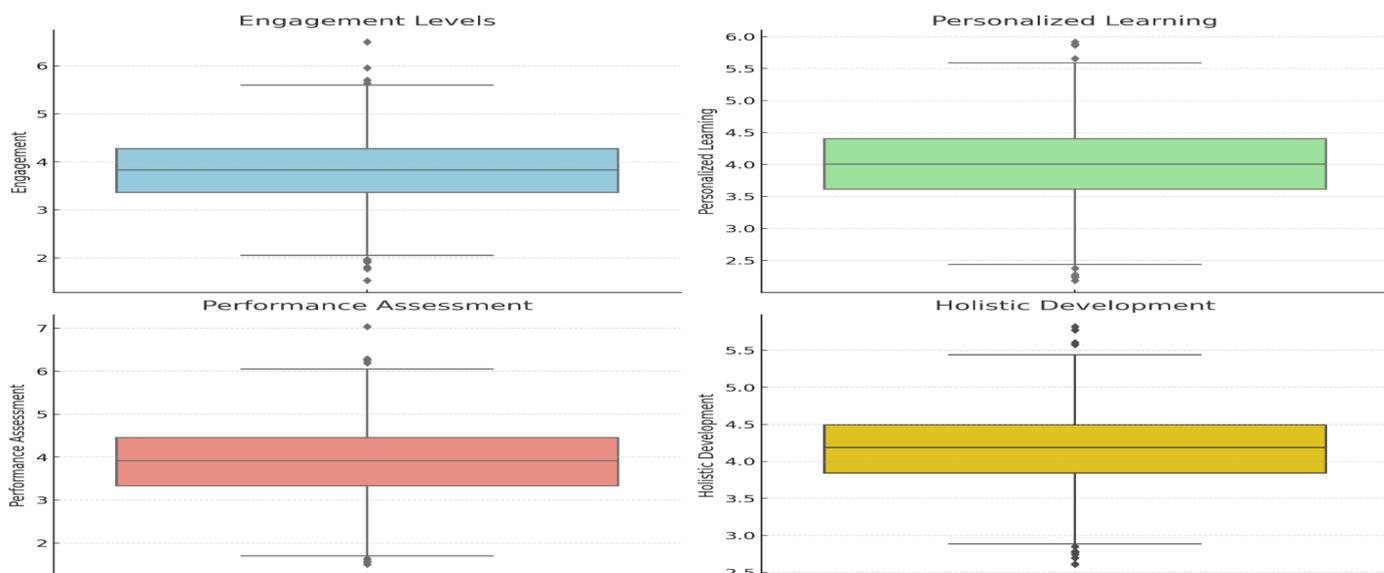


Figure: Mean Comparison of Key Ai-Driven Factors

The distribution of scores indicates a concentration of higher values across all four key dimensions, reflecting a positive agreement among students. Holistic development and personalised learning show little variation, demonstrating that students consistently value these aspects highly, emphasising their significance in the educational experience. In contrast, performance assessment and engagement reveal a wider range of scores, indicating a diverse set of student experiences and viewpoints. Holistic development emerges with the highest average, highlighting its substantial impact on student learning and growth. Following closely is personalised learning, which emphasises the effectiveness of AI in tailoring educational experiences to address individual requirements. Engagement and performance assessment also add positively to the overall assessment, though with slightly lower average scores, indicating areas that could benefit from further improvement. The results strongly endorse the effectiveness of AI in lesson delivery in Senior High Schools in Ghana. AI markedly boosts student engagement, personalises learning experiences, enhances performance assessment, and promotes holistic development. Considering these insights, educators and policymakers ought to prioritise the integration of AI to maximize learning outcomes.

Discussion and Practical Implications

The results of this research offer strong evidence that using AI techniques in lesson delivery greatly improves student engagement, tailored learning, performance assessment, and overall development in Senior High Schools across Ghana. The descriptive statistics show relatively high average values for all key variables, indicating a favourable response to AI-enhanced education. Moreover, inferential statistics reveal that all variables demonstrate statistically significant improvements when compared to a neutral benchmark, with particularly notable effects seen in holistic development and tailored learning. The findings suggest that AI promotes a flexible, engaging, and results-oriented learning environment, consistent with the research aim of enhancing student learning experiences through technology.

This study's outcomes add to the theoretical understanding of AI's influence in educational settings. The strong correlation between AI-based interactive systems and student involvement indicates that AI can have a major effect on student engagement and motivation, both of which are essential for academic success [31]. This conclusion is in line with self-determination theory (SDT), which highlights the significance of intrinsic motivation and autonomy in the learning process. By offering personalised experiences, AI tools cater to individual learning preferences, thereby creating a more engaging and motivating educational experience [23].

These results are consistent with earlier studies that stress the transformative role of AI in educational experiences. Previous research has consistently shown that AI-powered adaptive learning systems customise content delivery to accommodate various learning styles and requirements [5]. The observed significant impact of personalised learning supports the conclusions of Baltezarević and Baltezarević (2024), who claimed that AI-driven systems adjust instruction to optimise student potential [32]. In addition, the favourable effects on engagement and performance assessment align with previous research by Mohammed and Kuyini (2020), which emphasises AI's capability to provide immediate feedback, automate evaluations, and sustain student motivation [15]. Nevertheless, some differences arise regarding engagement variability. While our study reveals a moderate effect, earlier literature suggests that AI could produce stronger engagement results when coupled with gamification [11]. This divergence implies that additional enhancement strategies, such as AI-driven gamified learning, may further increase engagement levels.

In terms of policy, these findings underscore the promise of AI in tackling enduring issues in education, including the scarcity of resources and restricted access to high-quality learning materials. AI-powered tools empower educators to enhance lesson planning, deliver immediate feedback, and create a more adaptable and tailored learning atmosphere. The results indicate that AI can be an essential instrument in closing educational gaps, especially in areas like Ghana, where resources are often limited. Consequently, policymakers should contemplate the integration of AI technologies into national educational frameworks to encourage student-centric learning, foster active participation, and improve overall educational quality [33].

From a practical perspective, the evidence given in this study necessitates a transformation in teaching approaches. The capability of AI to customise learning and monitor students' progress in real-time allows for more personalised educational experiences, which in turn can boost both academic achievement and students' mental well-being [5]. This is particularly crucial within the realm of inclusive education, where students with varied learning needs demand customised support. Educators and academic institutions should think about incorporating AI-driven tools that offer personalised feedback and evaluations, thereby creating more equitable learning opportunities for all learners.

The outcomes of this study align with earlier research regarding the influence of AI in education. An increasing amount of literature indicates that AI possesses transformative capabilities within the classroom, especially in enhancing personalised learning and boosting student engagement [5,20]. Consistent with these findings, our results demonstrate that AI tools have a positive impact on student involvement and motivation. For example, AI-based interactive systems have been found to elevate student participation in learning activities by adjusting to individual student needs and preferences [32]. This corresponds with our findings that AI tools significantly improve motivation and engagement in classroom activities, as highlighted by the strong correlation between AI use and student participation.

Furthermore, the effect of AI on personalised learning is well-established in existing literature. AI systems are capable of analysing student performance data to customise educational experiences and provide real-time feedback, which has been proven to enhance learning outcomes [34]. This is reflected in our study, where AI-driven tools for fitness assessment, goal setting, and tracking progress positively influenced student performance. The statistically significant p-values further validate the credibility of these results, confirming that AI's impact on personalised learning is not only considerable but also quantifiable. While previous research has primarily concentrated on the use of AI in specific subjects, such as mathematics or language acquisition, this study broadens the scope by exploring AI's application across various instructional delivery components, including fitness programs and performance evaluations [5,20]. This wider perspective provides a more comprehensive understanding of AI's potential to enhance different aspects of education, making this study a meaningful addition to the existing body of literature.

The research highlights the advantages of artificial intelligence in education, focusing on its capacity to increase student involvement, tailor learning experiences, and improve performance evaluations. In contrast to previous studies that concentrated on concerns such as data privacy, this research showcases AI's advantages, including its ability to deliver prompt feedback that enhances both student and teacher effectiveness. It calls for a reassessment of conventional teaching approaches to better integrate technology for comprehensive educational growth. In Ghana and similar areas, AI can alleviate shortages of educational resources by enhancing lesson planning, feedback, and performance assessments. By pinpointing students who are struggling, AI can provide targeted assistance and promote personalised learning settings that align with societal development objectives. Future initiatives should focus on refining the use of AI in education while addressing the challenges of implementation.

Strengths, Weaknesses and Future Research Directions

This research has numerous strengths, especially concerning its methodological rigour and the dependability of the AI tools evaluated. High Cronbach's alpha values for the scales assessing AI tools used for performance evaluation and feedback suggest a strong level of internal consistency and reliability. Moreover, the application of comprehensive statistical analyses, including correlation coefficients and p-values, offers substantial evidence regarding AI's influence on student engagement, personalised learning, and performance assessment.

Nonetheless, there are shortcomings in this study that need to be acknowledged. The sample was confined to Senior High Schools in Ghana, which may not accurately reflect the wider educational landscape in other regions. Consequently, the ability to generalise the findings to other countries or educational contexts may be limited. In addition, while the study concentrated on the quantitative effects of AI tools, it did not delve into the qualitative experiences of students and teachers, which could yield valuable insights into the challenges and benefits of AI integration in educational settings. Future research should adopt a mixed-methods approach, combining both quantitative and qualitative data for a more thorough understanding of AI's impact on education.

Another limitation is that the study did not consider the potential challenges associated with implementing AI tools in schools, such as infrastructure constraints, teacher training, and the costs of AI technologies. These aspects could affect the effectiveness and scalability of AI in Ghanaian Senior High Schools or comparable educational contexts. Future research should investigate the practical obstacles to AI adoption and suggest strategies to address them.

Building on these observations, future studies should pursue several directions. First, longitudinal research could evaluate the lasting effects of AI in education, monitoring student outcomes over several academic years. Second, qualitative studies involving both teachers and students could offer deeper insights into experiences with AI-driven pedagogy. Third, experimental research incorporating AI-based gamification and interactive learning methods could assess their additional effects on engagement. Finally, comparative studies across various regions and educational levels would improve the generalizability of AI's effectiveness in lesson delivery.

Conclusion

This research offers empirical evidence demonstrating that the use of AI in lesson delivery greatly improves student engagement, personalised learning, performance evaluation, and comprehensive development in Senior High Schools in Ghana. Theoretical implications strengthen the relevance of Self-Determination Theory (SDT) in AI-enabled education, as AI-facilitated personalisation fosters autonomy, competence, and connectedness, which are essential elements for motivating students. The results also add to the existing literature on AI's role in education by affirming its ability to promote well-rounded learning experiences. Practically, the study highlights the importance for policymakers and educators to incorporate AI into lesson design, assessment methods, and strategies for student engagement. Educational institutions should allocate resources towards AI-enhanced tools that provide tailored learning paths, automated assessments, and data-informed feedback systems. It will be crucial to train educators in using AI technologies effectively to fully realise their advantages. In summary, AI offers a groundbreaking chance to improve lesson delivery in Senior High Schools across Ghana. By tackling existing educational challenges and harnessing AI's capabilities, stakeholders can facilitate the creation of an inclusive, adaptable, and student-focused learning environment, ensuring that education stays aligned with the evolving needs of the 21st century [36].

Acknowledgements

We wish to express our heartfelt gratitude to all those who contributed to the success of this study. We deeply value the input from everyone whose knowledge, guidance, and unwavering support have been essential to this work. The completion of this study would not have been possible without your encouragement and insightful feedback. We are truly appreciative of the participants for their willingness to share their insights and perspectives.

Authors Contributors

Daniel Amoah-Oppong: Conceptualisation, Supervision, and Writing- original draft

Patrice John Coufie: Project administration, Data curation, Writing and Editing

Richmond Antwi: Writing review and editing, and Data curation

Emmanuel Ansah Laing: Data curation, Formal analysis, and Methodology

Funding: The authors have not declared a specific grant for this study from any funding agency in the public, commercial, or NGO sectors.

Data Availability Statement: Data are obtainable in a public, open-access repository.

Declaration: We declare that this study is the result of our original research.

Ethics Approval and Consent to Participants

This study adheres closely to the ethical guidelines that regulate research involving human participants. The Institutional Review Board granted ethical approval before the study's commencement, guaranteeing that it complied with both domestic and global research ethics standards. The research protocol has undergone a thorough analysis to determine its possible effects on participants, confidentiality agreements, and voluntary involvement. To guarantee inclusivity across various demographic groups and academic programs, participants were gathered from senior high schools in Ghana using a strict and stratified sampling technique. The goals, parameters, and methods of the study were fully explained to each participant. Before taking part in the study, each participant gave their informed consent. In addition to the student's consent, parental and/or guardian consent was necessary for participants under the age of 18. To preserve participant privacy, all personal identifiers have been anonymised, and the gathered information is safely kept in password-protected digital files that are only accessible by the research team. The research team upheld accountability and transparency throughout the procedure, making sure that each participant's rights, dignity, and general well-being were fully respected and protected.

References

1. Okoye, M. C., & Mante, D. A. (2024). The Nexus Between Artificial Intelligence and STEM Education Transformation in Nigeria. *International Journal of Research and Innovation in Social Science*, 8(3s), 3793-3809.
2. Kataria, K. (2023). AI-powered learning: The future of education. *International Journal of Advanced Research*, 11(9), 199-203.
3. Jin, M. (2024). Leveraging Artificial Intelligence for Enhanced English Reading Instruction in Senior High School. *Academic Journal of Management and Social Sciences*.
4. Jiao, D. (2024). AI-Driven Personalisation in Higher Education: Enhancing Learning Outcomes through Adaptive Technologies. *Adult and Higher Education*.
5. Castro, G. P. B., Chiappe, A., Rodríguez, D. F. B., & Sepulveda, F. G. (2024). Harnessing AI for Education 4.0: Drivers of Personalized Learning. *Electronic Journal of e-Learning*, 22(5), 1-14.
6. Dutta, S., Ranjan, S., Mishra, S., Sharma, V., Hewage, P., & Iwendi, C. (2024, February). Enhancing educational adaptability: A review and analysis of AI-driven adaptive learning platforms. In *2024 4th International Conference on Innovative Practices in Technology and Management (ICIPTM)* (pp. 1-5). IEEE.
7. Gyamfi, N. K., Dayie, R., & Asiedu, E. K. (2022). Application of artificial intelligence techniques in educational delivery; Ghana perspective. *Webology*, 19(1), 480-492.
8. Boateng, G., Kumbol, V., & Kaufmann, E. E. (2023). Can an AI Win Ghana's National Science and Maths Quiz? An AI Grand Challenge for Education. *arXiv preprint arXiv:2301.13089*.
9. Zhai, X., Chu, X., Chai, C. S., Jong, M. S. Y., Istenic, A., Spector, M., ... & Li, Y. (2021). A Review of Artificial Intelligence (AI) in Education from 2010 to 2020. *Complexity*, 2021(1), 8812542.
10. Wiredu, J. K., Seidu Abuba, N., & Zakaria, H. (2024). Impact of generative AI in academic integrity and learning outcomes: a case study in the upper east region. *Asian Journal of Research in Computer Science*, 17(8), 10-9734.
11. Barfi, K. A., Bervell, B., & Arkorful, V. (2021). Integration of social media for smart pedagogy: initial perceptions of senior high school students in Ghana. *Education and Information Technologies*, 26(3), 3033-3055.
12. Arkorful, V., Barfi, K. A., & Aboagye, I. K. (2021). Integration of information and communication technology in teaching: Initial perspectives of senior high school teachers in Ghana. *Education and Information Technologies*, 26(4), 3771-3787.

13. Reddy, P., Chaudhary, K., Sharma, B., & Chand, R. (2021). The two perfect scorers for technology acceptance. *Education and Information Technologies*, 26, 1505-1526.
14. Boateng, G., Mensah, J. A., Yeboah, K. T., Etor, W., Mensah-Onumah, A. K., Ibrahim, N. D., & Yeboah, N. S. (2024, July). Brilla AI: AI contestant for the national science and maths quiz. In *International Conference on Artificial Intelligence in Education* (pp. 214-227). Cham: Springer Nature Switzerland.
15. Mohammed, A., & Kuyini, A. (2020). An evaluation of the Free Senior High School Policy in Ghana. *Cambridge Journal of Education*, 51, 143 - 172.
16. Bonney, E. (2020). Under/misrepresentation of Ghanaian Languages in the Literature Curriculum in Senior High Schools. *Journal of Language, Identity & Education*, 22, 66 - 82.
17. Zhang, J., & Zhang, Z. (2024). AI in teacher education: Unlocking new dimensions in teaching support, inclusive learning, and digital literacy. *Journal of Computer Assisted Learning*, 40(4), 1871-1885.
18. Mohammed, A. (2023). Examining the Implementation of Artificial Intelligence in Early Childhood Education Settings in Ghana: Educators' Attitudes and Perceptions towards Its Long-Term Viability. *American Journal of Education and Technology*.
19. dos Santos, S. C., & Junior, G. A. (2024). Opportunities and Challenges of AI to Support Student Assessment in Computing Education: A Systematic Literature Review. *CSEdu* (2), 15-26.
20. Bhatia, A., Bhatia, P., & Sood, D. (2024). Leveraging AI to transform online higher education: Focusing on personalized learning, assessment, and student engagement. *International Journal of Management and Humanities (IJMH)* Volume-11 Issue-1.
21. Tsai, C. C., Chung, C. C., Cheng, Y. M., & Lou, S. J. (2022). Deep learning course development and evaluation of artificial intelligence in vocational senior high schools. *Frontiers in Psychology*, 13, 965926.
22. Song, C., & Song, Y. (2023). Enhancing academic writing skills and motivation: assessing the efficacy of ChatGPT in AI-assisted language learning for EFL students. *Frontiers in Psychology*, 14, 1260843.
23. Sutrisman, H., Simanjuntak, R., Prihartanto, A., & Kusumo, B. (2024). The Impact of Using AI in Learning on the Understanding of Material by Young Students. *International Journal of Educational Research*.
24. Badamasi, A., & Chinonso, O. (2024). Impact of AI-Powered Personalised Learning Platforms on the Academic Achievement and Motivation of Computer Science Senior Secondary School Students in Abuja Municipal Area Council (AMAC), FCT-Abuja, Nigeria. *Global Academic Journal of Humanities and Social Sciences*.
25. Boateng, S., Boakye-Ansah, D., Baah, A., Aboagye, B., & Kyeremeh, P. (2023). Solid Waste Management Practices and Challenges in Rural and Urban Senior High Schools in Ashanti Region, Ghana. *Journal of Environmental and Public Health*, 2023.
26. Dankwa, D., Mensah, A., Asamoah, L., Michael, O., Ernest, A., & Anthony, O. (2023). The Leverage Benefit of Integrating ICT in Ghanaian Language Lesson Delivery. *European Modern Studies Journal*.
27. Petrie, J. (2020). Transforming the Future of Music and Dance Education: Data-Driven Action Priorities for Ghanaian Senior High Schools. *Journal of Dance Education*, 21, 224 - 235.
28. Ododo, E. P., Anwan, A. I., Clement, I. E., Epoke, E. E., & Constant, M. (2024). ASSESSING SOCIAL STUDIES TEACHERS' PREPAREDNESS TO INTEGRATE AI AND E-LEARNING PLATFORMS FOR ENHANCED TEACHING AND LEARNING EXPERIENCES. *The American Journal of Social Science and Education Innovations*, 6(09), 115-127.
29. Nikadimovs, O., & Vēvere, V. (2024, June). THE USE OF GENERATIVE ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION: UNIVERSITY SOCIAL RESPONSIBILITY AND STAKEHOLDERS' PERCEPTIONS. In ENVIRONMENT. TECHNOLOGIES. RESOURCES. *Proceedings of the International Scientific and Practical Conference* (Vol. 2, pp. 226-231).
30. Noel, D. D., Justin, K. G. A., Alphonse, A. K., Désiré, L. H., Dramane, D., Nafan, D., & Malerba, G. (2021). Normality assessment of several quantitative data transformation procedures. *Biostatistics and Biometrics Open Access Journal*, 10(3), 51-65.
31. Chiu, T., Moorhouse, B., Chai, C., & Ismailov, M. (2023). Teacher support and student motivation to learn with an Artificial Intelligence (AI) based chatbot. *Interactive Learning Environments*.
32. Baltezarević, R., & Baltezarević, I. (2024). Students' Attitudes on The Role of Artificial Intelligence (Ai) In Personalized Learning. *International Journal of Cognitive Research in Science, Engineering and Education*, 12(2), 387-397.
33. Luan, H., Geczy, P., Lai, H., Gobert, J., Yang, S. J., Ogata, H., ... & Tsai, C. C. (2020). Challenges and future directions of big data and artificial intelligence in education. *Frontiers in psychology*, 11, 580820.
34. Tapalova, O., & Zhiyenbayeva, N. (2022). Artificial intelligence in education: AIED for personalised learning pathways. *Electronic Journal of e-Learning*, 20(5), 639-653.
35. Murtaza, M., Ahmed, Y., Shamsi, J. A., Sherwani, F., & Usman, M. (2022). AI-based personalized e-learning systems: Issues, challenges, and solutions. *IEEE access*, 10, 81323-81342.
36. Jose, D. (2024). Data privacy and security concerns in ai-integrated educational platforms. *Recent Trends in Management and Commerce*, 5(2), 87-91.