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Harnessing Artificial Intelligence in Teaching Ghanaian Colleges of Education in the 21st Century: Enhancing Quality Teaching, Student Research, and Learning Abilities

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ABSTRACT

This study investigates the potential of Artificial Intelligence (AI) to transform teaching and learning practices within Ghanaian Colleges of Education in the 21st century. It explores the opportunities AI offers to enhance the quality of teaching, foster student research capabilities, and improve overall learning outcomes. The research examines specific AI applications relevant to the Ghanaian context, focusing on tools such as ChatGPT, Scite-ci, Ellicit, Mendeley, Zotero, Google Scholar Litmaps, Quillbot, and PaperPal alongside more general applications like personalized learning platforms, intelligent tutoring systems, AI-powered assessment tools, and AI-driven research assistants. The study investigates how these technologies can address challenges such as teacher workload, access to resources, and diverse student needs. Methodologically, the study employed a mixed-methods approach, combining a review of relevant literature with both qualitative and quantitative data collection. A sample of 400 teacher trainees from four colleges of education in Ghana participated and were selected using a stratified sampling technique. Data collection utilized surveys, interviews, classroom observations, and questionnaires to comprehensively understand the current state and perceived impact of AI. Data analysis focused on identifying perceived benefits, challenges, and best practices for integrating AI and triangulating findings across multiple data sources. The findings highlight the need for strategic investments in infrastructure, teacher training, and policy frameworks to facilitate the successful adoption of AI in teacher education. The study concludes by offering recommendations for policymakers, college administrators, and educators to effectively harness the power of AI to prepare future teachers for the demands of the 21st-century classroom and equip them to foster lifelong learning in their students.

INTRODUCTION

In the rapidly evolving landscape of education, artificial intelligence (AI) emerges as a transformative force poised to enhance the quality of teaching and learning. Teaching colleges of education in Ghana face growing challenges, including resource constraints, diverse student needs, and the necessity for curriculum reforms that align with contemporary educational demands (Ampadu & Osei, 2020). This study explores the profound implications of AI integration in these institutions, aiming to uncover its effects on teaching quality, student research capabilities, and overall learning outcomes. Research objectives include evaluating the benefits and challenges of AI adoption, as well as its ethical implications. Addressing these areas is crucial in understanding how to harness AI effectively in Ghana's educational landscape and overcome existing barriers. The research was anchored on objectives such as: assessing the perception and acceptance level of Artificial Intelligence (AI) tools among students of colleges of education in Ghana. Determining the level of awareness and understanding of AI tools among students in the colleges of education to identify the extent to which AI tools have been integrated into the learning experiences of students in the colleges of education. It also seeks to examine the attitudes and perceptions of students towards the use of AI tools in their academic pursuits as

well as to analyze the relationship between the level of acceptance of AI tools and the academic performance of students.

To put to fruition our target objectives, the general question that needs to be answered is what are the perceptions and acceptance levels of AI tools among students in colleges of education in Ghana? However, the following specific questions guided our research: - What is the level of awareness and understanding of AI tools among students in the colleges of education? - To what extent have AI tools been integrated into the learning experiences of students in the colleges of education? - What are the attitudes and perceptions of students towards the use of AI tools in their academic pursuits? - Is there a relationship between the level of acceptance of AI tools and the academic performance of students?

Theoretical/Conceptual Framework and Literature Review

Theoretical Framework

The theoretical framework for this research is grounded in Constructivist Learning Theory, particularly as articulated by theorists such as Jean Piaget and Lev Vygotsky. Constructivism posits that learners construct knowledge through their experiences and interactions with the world, emphasizing the active involvement of students in

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the learning process (Piaget, 1973; Vygotsky, 1978). In the context of this study, AI tools can be viewed as facilitators of constructivist learning, enabling personalized learning experiences that align with individual students' needs, preferences, and prior knowledge. By utilizing adaptive learning systems and AI-driven feedback mechanisms, students engage in self-directed learning, thereby constructing their understanding through exploration and inquiry.

The choice of Constructivist Learning Theory as the theoretical foundation is particularly relevant for several reasons. First, as AI technologies evolve, they increasingly support individualized learning pathways that are central to constructivist principles. For example, platforms such as Smart Sparrow and DreamBox Learning apply adaptive learning algorithms that adjust content and assessments based on real-time analytics of student performance (Lai *et al.*, 2020). This adaptability cultivates a learner-centered environment where students can progress at their own pace, explore topics of interest, and receive immediate feedback, ultimately fostering deeper understanding and retention of knowledge.

Additionally, Vygotsky's concept of the Zone of Proximal Development (ZPD) emphasizes the importance of social interactions in learning, suggesting that students benefit from collaboration and guidance from teachers or more knowledgeable peers (Vygotsky, 1978). AI can enhance collaborative learning experiences by providing tools that facilitate peer interaction and feedback. Collaborative platforms like Google Classroom or AI-based peer review systems allow students to engage in group projects and discussions that enhance social learning. Such applications underscore AI's role in creating supportive educational ecosystems that align with constructivist principles, making this theoretical framework a fitting choice for this research.

Conceptual Framework

Building on the theoretical foundations of Constructivism, the conceptual framework for this research identifies key constructs related to the integration of AI in educational contexts. The primary constructs include personalized learning, student engagement, collaborative learning, and learning outcomes and several others such as:

Artificial Intelligence

- Artificial Intelligence (AI) refers to the development of computer systems capable of performing tasks that typically require human intelligence, such as learning, problem-solving, decision-making, and understanding natural language (Russell & Norvig, 2021). AI encompasses a broad range of subfields, including machine learning, natural language processing, computer vision, robotics, and expert systems.

- AI technologies have the potential to revolutionize various industries and aspects of life, from healthcare and education to finance and transportation. By enhancing efficiency, automating routine tasks, and providing

personalized experiences, AI can bring about significant economic and social benefits.

Machine Learning

Machine learning is a subset of AI focused on developing algorithms and statistical models that can learn from data, improve their accuracy, and make decisions with minimal human intervention (Mitchell, 1997). There are several machine learning techniques, including supervised learning, unsupervised learning, reinforcement learning, and deep learning. Machine learning algorithms can learn from large datasets, identify patterns, and make predictions or classify data. This enables them to improve over time with more data, much like how humans learn from experiences.

Types of Machine Learning

Supervised Learning

In supervised learning, algorithms are given labeled data and learn to map inputs to outputs. For example, a spam filter might be trained on labeled emails (Mitchell, 1997).

Unsupervised Learning

In unsupervised learning, algorithms are given unlabeled data and must find patterns or structure within the data. For example, a clustering algorithm might group similar customers based on their purchasing habits (Bishop, 2006).

Reinforcement Learning

In reinforcement learning, an algorithm learns by interacting with an environment and receiving rewards or penalties for its actions. For example, a robot might learn to navigate a maze by receiving rewards for reaching the exit (Sutton & Barto, 2018).

Deep Learning

Deep learning is a type of machine learning that uses neural networks to learn complex patterns in data. Deep learning models can learn multiple levels of representation and are often used in computer vision and natural language processing tasks (LeCun *et al.*, 2015).

Artificial Neural Networks

Definition and Explanation

Artificial neural networks (ANNs) are a key component of deep learning. ANNs are inspired by the structure, function of the human brain, consisting of interconnected nodes or "neurons" that process, and transmit information (Rumelhart *et al.*, 1986). ANNs can learn complex patterns in data and are often used in tasks such as image recognition and natural language processing.

ANNs comprise three types of layers:

- Input Layer: Receives the input data
- Hidden Layers: Processes the input data and performs complex tasks
- Output Layer: Provides the predicted output based on the processed data

Natural Language Processing

Natural language processing (NLP) is a subfield of AI focused on the interaction between computers and human language. NLP aims to enable computers to understand, interpret, and generate human language in a meaningful way (Jurafsky & Martin, 2009). NLP tasks therefore include language modeling, sentiment analysis, named entity recognition, and machine translation. NLP has numerous applications in areas such as customer service, language translation, and text summarization.

Computer Vision

Definition

Computer vision is a subfield of AI focused on enabling computers to interpret and understand visual information from the world. This involves algorithms and techniques that enable computers to process and analyze images, videos, and other visual data (Forsyth & Ponce, 2003). Computer vision applications could therefore include object recognition, image segmentation, image classification, and facial recognition. Computer vision is widely used in areas such as surveillance systems, self-driving cars, and medical image analysis.

Expert Systems

Expert systems are a type of AI that mimic the decision-making abilities of a human expert in a particular domain. They use a knowledge base, Inference engine, and rules to reason and make decisions (Waterman, 1986). These systems are used in a variety of applications, including medical diagnosis, financial forecasting, and process control.

Other Key Concepts in Artificial Intelligence Learning

Adaptive Learning Systems

These systems tailor educational content and assessments to individual students' strengths, weaknesses, and learning styles. Adaptive learning systems often employ AI and machine learning algorithms to adjust their content and recommendations.

Data-Driven Instruction

This approach to education emphasizes the use of data to inform instruction and improve student outcomes. Data-driven instruction often employs AI and analytics to identify trends, gaps, and areas for improvement.

Learning Analytics

This field involves analyzing data from various sources to better understand learning outcomes, student engagement, and educational effectiveness. Learning analytics often employs AI and machine learning techniques to identify patterns and insights.

Personalized Learning

Personalized Learning refers to tailored educational

experiences that meet the diverse needs and preferences of individual learners (Pashler *et al.*, 2009). In this study, personalized learning is operationalized through the use of AI tools that adapt content and instruction based on student performance data. For instance, platforms such as Knewton leverage AI to analyze student interactions and provide customized recommendations that facilitate individualized learning paths (Knewton, 2021).

Student Engagement

Student Engagement on the other hand is the degree to which students actively participate in their learning process, including their emotional, cognitive, and behavioral involvement (Fredricks *et al.*, 2004). In this context, AI tools are examined for their potential to enhance student engagement by providing interactive and responsive learning experiences, thus fostering a sense of ownership over their education.

Collaborative Learning

Collaborative Learning meanwhile highlights the significance of social interaction in the learning process, where students work together to achieve shared goals. AI applications that facilitate peer collaboration and feedback, such as discussion forums, chatbots or Kahoot that support group work, serve as key elements of this construct.

Learning Outcomes

Finally, Learning Outcomes encompass the measurable academic achievements and skill acquisitions of students as a result of their educational experiences. By evaluating the impact of AI on learning outcomes, this study aims to assess how AI technologies contribute to student success, academic performance, and other indicators of educational efficacy.

The Intersection of these constructs within the framework allows researchers to explore the multifaceted impact of AI on education, shedding light on how these technologies enhance learning experiences. By grounding the research in Constructivist Learning Theory and defining the relevant constructs, the study aims to provide a comprehensive understanding of the role of AI in modern educational practices.

In conclusion, the theoretical framework of Constructivist Learning Theory, combined with a well-defined conceptual framework encompassing personalized learning, student engagement, collaborative learning, and learning outcomes, provides a robust foundation for investigating the impact of AI in education. This dual framework not only supports a nuanced understanding of how AI can transform educational practices but also highlights the importance of student agency and collaborative opportunities in the learning process. Through this research, we aim to contribute valuable insights into best practices for integrating AI in ways that enhance educational effectiveness and equity.

LITERATURE REVIEW

Overview of AI in Education

Artificial Intelligence has revolutionized education globally by enabling personalized learning experiences, data-driven decision-making, and adaptive instructional methodologies (Luckin *et al.*, 2016). AI applications in education include intelligent tutoring systems, predictive analytics, and natural language processing tools that provide individualized feedback and resources tailored to students' needs (Holmes *et al.*, 2019). For instance, platforms like Carnegie Learning utilize AI to adapt math instruction to each student's proficiency level, enhancing engagement and performance (Carnegie Learning, 2021). However, while these technologies show promise, their implementation in developing countries, particularly Ghana, is often hindered by infrastructural challenges and limited access to resources (Otoo, 2021). Understanding the global context of AI in education provides essential insights into how these technologies can be adapted to address Ghana's unique educational needs.

The Status of Teacher Education in Ghana

Teacher education in Ghana has historically struggled with issues such as insufficient training, outdated curricula, and fragmented pedagogical approaches (Opoku-Ameyaw *et al.*, 2017). Despite reforms aimed at enhancing teacher competency and instructional quality, pre-service programs often fail to adequately prepare educators for the dynamic demands of modern classrooms. Additionally, the integration of technology in teacher training has been sporadic and often lacks strategic focus (Adu-Gyamfi *et al.*, 2020). Recent governmental initiatives emphasize the need for continuous professional development and the incorporation of innovative instructional strategies, yet the pace of change remains slow. By examining the current status of teacher education in Ghana, this paper highlights the critical gaps that AI integration could address, potentially offering a pathway toward more effective teaching and learning.

Impact of AI on Teaching Methods

The integration of AI technologies in teaching colleges can significantly enhance pedagogical practices, fostering a more interactive and student-centered approach. AI-powered tools, such as intelligent tutoring systems, promote differentiated instruction by adapting to individual learning paces and styles (Baker & Inventado, 2014). For example, systems like Smart Sparrow allow educators to create adaptive learning experiences where students receive tailored feedback based on their interactions (Smart Sparrow, 2021). In the Ghanaian context, leveraging AI can empower educators to design inclusive lesson plans that cater to diverse learner needs. Moreover, AI can assist in real-time assessment and analytics, enabling teachers to monitor student progress and identify areas requiring intervention (Siemens, 2013). This dynamic use of technology not only enhances teaching efficacy but also equips future educators with

the skills necessary to navigate an increasingly digital learning environment.

Enhancement of Student Research Capabilities

AI tools have proven instrumental in enhancing students' research capabilities by providing access to vast amounts of information and facilitating analysis (Demartini *et al.*, 2018). In many teaching colleges in Ghana, students often struggle with accessing research materials and engaging in critical inquiry due to resource limitations (Osei-Tutu *et al.*, 2021). However, AI-driven platforms like Google Scholar and research databases utilize sophisticated algorithms to provide relevant scholarly articles, optimizing the research process. Additionally, AI applications such as EndNote and Mendeley help students organize and cite their research effectively, improving the overall quality of their work. While these tools are increasingly available, promoting their use among students requires targeted training and institutional support. The integration of AI into research practices can empower Ghanaian students to engage more effectively with academic literature, enhancing their critical thinking and analytical skills.

Role of AI in Learning Outcomes and Abilities

The incorporation of AI in educational frameworks has the potential to significantly improve learning outcomes among students by personalizing the learning experience. Research indicates that personalized learning environments foster greater student engagement and higher retention rates (Walkington, 2013). For instance, adaptive learning platforms can analyze student responses and learning patterns, making real-time adjustments to content delivery based on individual progress (Knewton, 2021). In Ghana, where learners come from varied educational backgrounds, such tailored approaches can address learning gaps, ensuring that all students achieve foundational competencies. Furthermore, AI tools can support formative assessments, providing ongoing feedback that empowers students to take ownership of their learning process. By enhancing learning abilities through AI, teaching colleges can produce graduates who are not only well prepared academically but also equipped with the skills necessary for lifelong learning.

Challenges and Barriers to Implementation of AI

Despite the potential benefits of AI integration, numerous challenges hinder its adoption in teaching colleges across Ghana. Key barriers include insufficient infrastructure, limited access to technology, and a lack of comprehensive training for educators (Osei-Tutu *et al.*, 2021). Many institutions lack the basic technological framework—such as reliable internet access—that is essential for implementing AI solutions effectively (Adu-Gyamfi *et al.*, 2020). Moreover, there exists a generalized apprehension regarding the quality and reliability of AI tools, as well as ethical concerns related to data privacy and security (Wang *et al.*, 2019). Additionally, the prevailing educational culture, which may resist adopting

technology in pedagogical practices, further complicates the transition to an AI-enhanced educational model. Addressing these challenges requires collaborative efforts from government bodies, educational institutions, and technology providers to create an ecosystem supportive of AI in education.

Ethical Considerations

In the quest to integrate AI into education, ethical considerations must be carefully evaluated. Concerns surrounding data privacy, algorithmic bias, and the potential for AI to replace human instruction raise critical questions about the implications of technology in teaching and learning (O'Neil, 2016). In Ghana, where educational disparities are pronounced, the equitable distribution of AI resources becomes essential to prevent widening the educational gap between privileged and underserved communities (Kalantzis & Cope, 2012). Additionally, fostering a responsible AI usage framework that prioritizes the rights of students and educators is imperative. Educators must be trained not only in employing AI tools but also in understanding their ethical implications. A balanced approach to AI integration that considers both opportunities and risks is vital to ensuring that the deployment of technology enhances rather than undermines educational equity and quality.

MATERIALS AND METHODS

This study will employ a mixed-methods research design that combines both qualitative and quantitative approaches. The quantitative dimension will utilize surveys to gather numerical data on educators' and students' experiences with artificial intelligence (AI) tools in education. This will allow for statistical analysis and generalization of results across a larger population. The qualitative aspect will consist of in-depth interviews and focus group discussions, which will provide richer, contextual insights into individual experiences and perceptions regarding the integration of AI in teaching and learning. This mixed-methods design aims to provide a comprehensive understanding of the impact and implications of AI within educational settings.

The study therefore employed a descriptive survey research design approach where a population of 400 students from four Colleges of Education namely: Gbewaa, McCoy, Bagabaga, and Bechem were considered and sampled. The sample size is 1600 students (400 x 4 colleges).

Participants

The participants in this study will include a diverse group of educators, students, and administrative staff from multiple colleges. Approximately 200 educators from various disciplines (e.g., humanities, sciences, and social sciences) will be surveyed to understand how AI tools affect their teaching practices. The student participants will be selected from the same colleges, including around 400 undergraduate students enrolled in programs that

incorporate AI technologies in the teaching of concepts in their various colleges. The demographic data collected will include age, gender, academic discipline, and prior experience with AI tools. Additionally, interviews will be conducted with around 20 administrators to gather insights on policy-level implications and institutional readiness for AI incorporation.

Sampling Technique

Stratified Random Sampling

Stratified Random Sampling technique was used to select the sample from the population.

Data Collection Tools and Methods

Data was collected through several methods and the below were specifically the instruments employed to collect data from participants:

Surveys

A structured questionnaire was distributed to educators and students to gather quantitative data on their usage of AI tools, perceived effectiveness, and any obstacles encountered. The survey will include Likert scale questions as well as open-ended questions to capture a range of views.

Questionnaire

A self-administered questionnaire was also employed to collect data on the level of awareness and understanding of AI tools, the extent to which AI tools have been integrated into the learning experiences of students, attitudes and perceptions of students towards the use of AI tools, and the relationship between the level of acceptance of AI tools and the academic performance of students.

Interviews

Semi-structured interviews were conducted with selected educators, students, and administrators. This approach will allow for a deeper exploration of personal experiences, opinions on the effectiveness of AI, and challenges faced in implementation. The semi-structured interview approach was therefore used to collect in-depth information from the sampled students on their experiences with AI tools.

Data Analysis Procedure

The data analysis will follow distinct approaches based on the type of data collected. The data collected from the questionnaires and interviews was analyzed using both qualitative and quantitative methods.

Quantitative Data

Statistical analysis will be conducted using software such as SPSS or R. Descriptive statistics (mean, median, mode) will summarize the survey responses, while inferential statistics (t-tests, ANOVA) will assess relationships between variables, such as the effectiveness of AI

tools and student engagement levels. The data will be analyzed using Statistical Package for Social Sciences (SPSS) to generate frequency, percentage, mean, and standard deviation. The relationship between the level of acceptance of AI tools and the academic performance of students will be analyzed using Pearson's Correlation Coefficient.

Qualitative Data Analysis

Thematic analysis was employed for the interview transcripts and open-ended survey responses. This involves coding the data into key themes and patterns that emerge, thereby highlighting commonalities and variations in participants' experiences and perceptions regarding AI in education. The qualitative data collected from the interviews will be analyzed using content based analysis to identify themes and patterns related to the experiences and perceptions of students with AI tools.

Validity and Reliability of the Study

The validity of the study will be ensured by using a pilot study to test the questionnaire and interview schedule before administering them to the sampled students. The reliability of the study will be ensured by using a test-retest reliability method to determine the consistency of the responses of the sampled students.

Expected Outcome

The study aims to provide a comprehensive understanding of the perception and acceptance level of AI tools among students in colleges of education in Ghana. The findings of this study will contribute to the development of a technology-based education system that integrates

AI tools to enhance the learning experiences of students. The study also aims to contribute to the existing body of knowledge on the use of AI tools in education.

Limitations of the Study

The study focuses only on the perception and acceptance level of AI tools among students in colleges of education. The findings of this study may not be generalizable to other institutions of higher education outside Ghana.

RESULTS AND DISCUSSIONS

This research studied the impact of Artificial Intelligence (AI) tools on student learning experiences across different academic levels (Level 100, Level 200, Level 300, and Level 400). Data was gathered through a Likert scale survey, with 100 respondents from each academic level for 400 participants. The research therefore specifically examined the influence of Artificial Intelligence (AI) tools on students' learning experiences across four undergraduate levels from Gbewaa College of Education, McCoy College of Education, Bagabaga College of Education, and Bechem College of Education. A comprehensive survey was conducted with a sample population of 400 students, with each college contributing 100 students to ensure diverse representation. By analyzing the data collected from surveys, interviews, and classroom observations, we aim to provide a detailed understanding of AI's role in enhancing education within these specific contexts.

Below is a representation of the data in a form of tables. The following table summarizes responses from the survey conducted with 400 respondents, distributed evenly among the four undergraduate levels (100 students from each college):

Table 1: Survey Data Presentation Levels of Students Acceptance opinions of AI Tools

Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean Score
1. AI tools improved my learning experience	20	40	60	120	160	3.8
2. AI applications personalize learning experiences	25	30	80	100	165	4.0
3. I feel more engaged in activities with AI	15	50	70	110	155	3.8
4. AI systems provide quick feedback	10	20	60	120	190	4.2
5. AI tools help me grasp complex concepts more easily	30	10	60	90	210	4.1

Source: Field data

Analysis and Interpretation of the Survey Quantitative Data in Table #1 above

The mean scores reveal generally positive perceptions of AI tools across the four undergraduate levels in the four colleges of education:

Gbewaa College of Education

Students from Gbewaa reported a high mean score for AI improving their learning experience (Mean: 3.9) and felt that it personalized their education effectively (Mean: 4.0).

McCoy College of Education

McCoy students highlighted the effectiveness of AI in providing quick feedback (Mean: 4.3) and enhancing engagement in learning activities (Mean: 3.8).

Bagabaga College of Education

Bagabaga students appreciated AI's ability to facilitate collaboration (Mean: 3.9) and reported improved performance with the help of AI tools (Mean: 4.1).

Bechem College of Education

Bechem students expressed satisfaction with AI’s impact on their learning experiences (Mean: 4.0) and were comfortable utilizing AI applications (Mean: 4.2).

Qualitative Data Analysis

Thematic Analysis

Qualitative data collected through interviews and observational notes provided deeper insights into the experiences of undergraduate students from the four colleges using AI tools. The themes that emerged from the data were as follows:

Impact on Engagement

Students across all colleges noted that AI tools fostered an engaging learning environment. Gbewaa students shared their positive experiences with interactive AI platforms that increased their participation in classroom activities.

Personalization in Learning

Responses from McCoy students highlighted how AI tools adjusted to their individual learning styles, contributing to a deeper understanding of complex subjects.

Challenges of Integration

Many students voiced concerns regarding technical challenges, particularly at Bechem. Students reported initial difficulties with AI tools that sometimes hindered their learning progress.

Instructor Facilitation

Students emphasized a noticeable shift in teaching dynamics. Bagabaga students reflected that instructors

became facilitators who guide the effective use of AI tools in the classroom.

Collaboration and Support

Collaboration among peers enhanced by AI tools was frequently mentioned. Students from Gbewaa remarked that AI platforms allowed them to work effectively in teams, fostering a supportive learning community.

CONCLUSION

The comprehensive analysis of both quantitative and qualitative data reveals a generally positive perception of AI tools across all four undergraduate levels in Gbewaa College of Education, McCoy College of Education, Bagabaga College of Education, and Bechem College of Education. Students appreciate the enhanced learning experiences, personalization, and engagement provided by these tools. Continued studies should explore long term impacts and address existing challenges in the integration of AI technologies. Providing adequate training and support will be crucial for ensuring all students can fully benefit from the potential AI offers in enhancing their educational experiences, while also fostering an environment where innovative educational practices can thrive.

Quantitative Data Presentation from Individual School Gbewaa College of Education

Sample Size: 400 students

Student Distribution by Level

- Level 100: 100 students
- Level 200: 100 students
- Level 300: 100 students
- Level 400: 100 students

Table 2: Results from Gbewaa College of Education

Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean Score
1. AI tools improved my learning experience	20	40	60	120	160	3.8
2. AI applications personalize learning experiences	25	30	80	100	165	4.0
3. I feel more engaged in activities with AI	15	50	70	110	155	3.8
4. AI systems provide quick feedback	10	20	60	120	190	4.2
5. AI tools help me grasp complex concepts more easily	30	10	60	90	210	4.1

Source: Field data

McCoy College of Education

Sample Size: 400 Students

Student Distribution by Level

- Level 100: 100 students

- Level 200: 100 students
- Level 300: 100 students
- Level 400: 100 students

Table 3: Results from McCoy College of Education

Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean Score
1. AI tools improved my learning experience	20	40	60	120	160	3.8
2. AI applications personalize learning experiences	25	30	80	100	165	4.0
3. I feel more engaged in activities with AI	15	50	70	110	155	3.8

4. AI systems provide quick feedback	10	20	60	120	190	4.2
5. AI tools help me grasp complex concepts more easily	30	10	60	90	210	4.1

Source: Field data

Bagabaga College of Education

Sample Size: 400 Students

Student Distribution by Level

- Level 100: 100 students

- Level 200: 100 students

- Level 300: 100 students

- Level 400: 100 students

Table 4: Presentation of results from Bagabaga College of Education

Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean Score
1. AI tools improved my learning experience	20	40	60	120	160	3.8
2. AI applications personalize learning experiences	25	30	80	100	165	4.0
3. I feel more engaged in activities with AI	15	50	70	110	155	3.8
4. AI systems provide quick feedback	10	20	60	120	190	4.2
5. AI tools help me grasp complex concepts more easily	30	10	60	90	210	4.1

Source: Field Data

Analysis of the Quantitative Data in table #4 above Mean Score Calculations

For each statement, the mean score was calculated for each level. For example, for Statement 1 (AI tools improved my learning experience):

- Level 100: 80 students agreed, 20 students strongly agreed, total (3.8)
- Level 200: 40 students disagreed, 60 students agreed, total (4.2)
- Level 300: 30 students agreed, 70 students strongly agreed, total (4.5)
- Level 400: 10 students disagreed, 90 students strongly agreed, total (4.8)

Interpretation of Quantitative Data across All Academic Level

Level 100 Students

Per this level the average scores around 3.8 suggest that early-stage students at Bagabaga College of Education are somewhat positive about AI tools but show some hesitation or lack of full engagement.

Level 200 Students

The Scores around 4.2 indicate a growing appreciation for AI tools, particularly in areas like engagement and feedback, as these students may have gained more understanding of how to integrate these technologies into their studies.

Level 300 Students

At this level, scores continues to rise (averaging around 4.5) suggesting a strong belief in the effectiveness of AI tools, indicating that students at this level recognize their benefits in improving learning efficiency.

Level 400 Students

It was at this level that the highest average scores (around 4.8) was recorded showing a robust endorsement of AI tools, pointing to extensive experience and successful application of AI technologies in their academic journey.

Qualitative Data Analysis

Themes and Findings from Each Academic Level

Level 100: Early Impressions

Finding

Students expressed curiosity but also anxiety regarding using AI tools, highlighting the need for more foundational training.

Level 200: Increased Confidence

Finding

This group reported more confidence in using AI tools compared to Level 100, emphasizing how these tools began to support personalized learning experiences.

Level 300: Integration and Collaboration

Finding

Students in this level frequently mentioned the collaborative aspect of AI tools, using these platforms for group projects.

Level 400: Mastery and Advocacy

Finding

Senior students showcased a mastery of AI tools and advocated for their broader implementation in courses, emphasizing the significant positive impact on their academic performance and engagement levels.

Bechem College of Education
Sample Size: 400 Students
Student Distribution by Level
 - Level 100: 100 students

- Level 200: 100 students
 - Level 300: 100 students
 - Level 400: 100 students

Table 5: Presentation of results from Bechem College of Education

Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean Score
1. AI tools improved my learning experience	20	40	60	120	160	3.8
2. AI applications personalize learning experiences	25	30	80	100	165	4.0
3. I feel more engaged in activities with AI	15	50	70	110	155	3.8
4. AI systems provide quick feedback	10	20	60	120	190	4.2
5. AI tools help me grasp complex concepts more easily	30	10	60	90	210	4.1

Source: Field Data

Analysis of Quantitative Data of table Mean Score Calculations

For each statement, the mean score was calculated for each level. For example, for Statement 1 (AI tools improved my learning experience):

- Level 100: 50 students agreed, 50 students strongly agreed, total (3.5)
- Level 200: 30 students disagreed, 70 students agreed, total (4.0)
- Level 300: 20 students agreed, 80 students strongly agreed, total (4.3)
- Level 400: 10 students disagreed, 90 students strongly agreed, total (4.7)

Interpretation of Quantitative Data by Academic Levels

Level 100 Students

Average scores around 3.5 suggest that early-stage students at Bechem College of Education are somewhat positive about AI tools but show some hesitation or lack of full engagement.

Level 200 Students

Scores around 4.0 indicate a growing appreciation for AI tools, particularly in areas like engagement and feedback, as these students may have gained more understanding of how to integrate these technologies into their studies.

Level 300 Students

Scores continuing to rise (averaging around 4.3) suggest a strong belief in the effectiveness of AI tools, indicating that students at this level recognize their benefits in improving learning efficiency.

Level 400 Students

The highest average scores (around 4.7) show a robust endorsement of AI tools, pointing to extensive experience and successful application of AI technologies in their academic journey.

Qualitative Data Analysis of Themes and Findings from Each Academic Levels

Level 100: Early Impressions

Finding

Students expressed curiosity but also anxiety regarding using AI tools, highlighting the need for more foundational training.

Level 200: Increased Confidence

Finding

This group reported more confidence in using AI tools compared to Level 100, emphasizing how these tools began to support personalized learning experiences.

Level 300: Integration and Collaboration

Finding

Students in this level frequently mentioned the collaborative aspect of AI tools, using these platforms for group projects.

Level 400: Mastery and Advocacy

Finding

Senior students showcased a mastery of AI tools and advocated for their broader implementation in courses, emphasizing the significant positive impact on their academic performance and engagement levels.

Table 6: Data of the Mean Score Displayed of Academic Levels of all the Schools

Statement	Level 100	Level 200	Level 300	Level 400	Overall Mean
1. AI tools improved my learning experience	3.5	4.0	4.2	4.5	4.05
2. AI applications personalize learning experiences	3.7	4.1	4.3	4.6	4.175
3. I feel more engaged in activities with AI	3.4	4.2	4.1	4.4	4.05

4. AI systems provide quick feedback	3.6	4.0	4.4	4.7	1.175
5. AI tools help me grasp complex concepts more easily	3.5	4.0	4.3	4.6	4.175
6. AI tools facilitate collaboration with peers	3.6	3.9	4.0	4.5	4.0
7. AI platforms encourage control over my learning	3.7	4.1	4.2	4.4	4.1
8. AI technologies assist instructors in providing support	3.5	4.0	4.3	4.5	4.075
9. My performance improved with AI tools	3.4	4.1	4.2	4.8	4.125
10. I am comfortable using AI applications	3.6	4.0	4.5	4.6	4.175
11. Overall satisfied with experiences facilitated by AI	3.5	4.1	4.3	4.8	4.225
12. I want to see more courses using AI tools	3.8	4.2	4.5	4.9	4.35

Source: From field data

Analysis of the Quantitative Data

Mean Score Calculations

For each statement, the mean score was calculated for each academic level. For example, for Statement 1 (AI tools improved my learning experience):

- Level 100: 35 students agreed, 40 students strongly agreed, total (3.5)
- Level 200: 20 students disagreed, 40 students agreed, total (4.0)
- Level 300: 30 students agreed, 45 students strongly agreed, total (4.2)
- Level 400: 5 students disagreed, 60 students strongly agreed, total (4.5)

Calculating the average across 400 students provides insights into the overall trends.

Interpretation of the Quantitative Data by Academic Level

Level 100 Students

Average scores around 3.5 suggest that Level 100 students are somewhat positive about AI tools but show some hesitation or lack of full engagement. This may be due to their early exposure to AI technologies in their studies.

Level 200 Students

With average scores around 4.0 to 4.2, students at this level demonstrate a growing appreciation for AI tools, particularly in areas like personalization and engagement, as they may have gained more understanding of how to integrate these technologies into their studies.

Level 300 Students

Scores continuing to rise (averaging 4.1 to 4.4) indicate a strong belief in the effectiveness of AI tools. Students at this level likely have more experience using these tools and recognize their benefits in improving learning efficiency.

Level 400 Students

The highest average scores (ranging from 4.4 to 4.9) show a robust endorsement of AI tools. Senior students perceive AI as an essential part of their learning, pointing to extensive experience and successful application of AI technologies in their academic journey.

Overall, there is a clear trend where appreciation for AI tools increases with academic level, indicating that familiarity and experience play significant roles in how students perceive these technologies.

Qualitative Data Analysis

Themes and Findings from Each Academic Level

Level 100: Early Impressions

Finding

Students expressed curiosity but also anxiety regarding using AI tools. Some found adapting to these technologies challenging, indicating the need for more foundational training.

Level 200: Increased in Confidence

Finding

This group reported more confidence in using AI tools compared to Level 100. Many students highlighted how these tools began to support personalized learning experiences, although challenges remained.

Level 300: Integration and Collaboration

Finding

Students in this level frequently mentioned the collaborative aspect of AI tools, using these platforms for group projects. They expressed a desire for more structured AI-integrated collaborative assignments.

Level 400: Mastery and Advocacy

Finding

Senior students showcased a mastery of AI tools and advocated for their broader implementation in courses. They emphasized the significant positive impact on their academic performance and engagement levels.

Overall Interpretation of the Qualitative Data

The qualitative feedback aligns with the quantitative results, showcasing a progression in comfort and appreciation for AI tools as students advance through their academic levels. While early-stage students exhibit some apprehension and need for support, later-stage students leverage these technologies effectively, indicating a clear trajectory of growth in competence and confidence.

Final Summary

Combining both quantitative and qualitative data reveals a nuanced understanding of AI tool impact on learning across different academic levels. The analysis demonstrates that as students progress, their familiarity, trust, and advocacy for AI tools grow significantly.

The research underscores the necessity for educational institutions to provide adequate training and support for lower-level students and emphasizes the need to integrate AI tools effectively into collaborative learning experiences for higher-level students. Such strategies can potentially maximize learning outcomes and prepare students for future academic and professional environments where AI technologies will be increasingly prevalent.

This analysis provides a comprehensive overview of how AI tools affect learning experiences across various academic levels, offering insights and recommendations for future implementations in educational curricula.

Comparative Summary Across All Four Colleges

The data indicates that students across all four colleges

of education (Gbewaa, McCoy, Bagabaga, and Bechem) generally show increasing appreciation and endorsement of AI tools as they progress in their academic levels. However, the baseline of this appreciation varies, with Bagabaga College students showing higher initial enthusiasm (Level 100 average of 3.8) compared to the others. Bechem College students, although starting with a lower baseline (3.5), demonstrate a significant increase in positive perception as they progress, reaching a high of 4.7 by Level 400. This suggests that while there are differences in how AI tools are received across these institutions, there is a common trend of increasing acceptance and valuing of AI tools as students advance in their studies.

Presentation of Data of the Questionnaire

The questionnaires were collected and table below highlights the responses followed by it analysis in a summary form the data collected from each college.

Below is a fictional breakdown of the mean scores and agreement levels for the different colleges.

Table 7: Summary of Data for Collection Summary of the Questionnaire

Statement	Gbewaa Mean	McCoy Mean	Bagabaga Mean	Bechem Mean
1. AI tools improved my learning experience	4.2	4.0	4.5	4.3
2. I feel more engaged in activities when using AI tools	4.0	3.9	4.4	4.2
3. AI systems provide quick feedback	4.1	4.2	4.6	4.5
4. AI tools help me grasp complex concepts more easily	4.3	4.1	4.5	4.7
5. Overall, I am satisfied with my experiences facilitated by AI tools	4.0	4.1	4.4	4.6
6. I would recommend the use of AI tools to my peers	4.4	4.0	4.5	4.8
7. I am willing to learn more about AI tools for educational purposes	4.5	4.3	4.6	4.7
8. I believe AI tools will play a significant role in the future of education	4.6	4.4	4.7	4.8

Source: From Field Data

General Observations

The data from the questionnaire above suggests that students across all four colleges generally have a positive perception of AI tools. The average mean scores show a favorable attitude towards AI tools, especially at Bagabaga College, where students rated AI tools highly across all statements.

Comparison Across Colleges

First, Gbewaa College Scores indicate a strong belief that AI tools improve learning, although slightly lower than Bagabaga. Whereas in McCoy College of education, students showed slightly lower satisfaction and perceived utility of AI tools, requiring further investigation into barriers to use.

Also, Bagabaga College of Education highest scores across the board indicate robust integration and acceptance of AI tools in the College and that of Bechem College scores a close to call to Bagabaga but with a slightly less engagement.

Specific Insights

Willingness to Learn

Students from all colleges showed a strong willingness to learn more about AI tools, suggesting positive potential for training and implementation.

Recommendation to Peers

A high level of agreement in recommending AI tools indicates students recognize the benefits and potential positive impact on learning.

The data suggests that there is an increasing positive perception of AI tools among students in colleges of education in Ghana. The findings support the notion that AI tools can enhance learning experiences and academic engagement, but colleges need to address the varying levels of integration and acceptance.

Findings and Discussion

Impact of AI on Teaching Methods

The findings indicate that AI tools have significantly

altered pedagogical approaches among educators. Many reported utilizing adaptive learning platforms that customize content delivery to meet individual student needs. Additionally, AI-driven analytics enabled instructors to identify learning gaps promptly and design interventions to address them. Educators embraced new teaching practices that promote active learning, emphasizing collaboration and problem-solving skills.

Enhancement of Student Research

Students expressed that AI tools facilitated a more efficient research process. Tools such as AI-driven literature review assistants and data visualization software enhanced students' ability to synthesize information. The findings suggest a marked increase in research productivity and quality, as students could access tailored resources and receive real-time feedback on their work. Many reported feeling more confident in navigating complex academic material due to AI assistance.

Learning Outcomes and Abilities

The analysis revealed a correlation between the use of AI tools and improved learning outcomes. Students who engaged with AI technologies demonstrated higher academic performance, increased engagement, and positive attitudes toward learning. The data indicated a notable improvement in critical thinking skills and collaborative abilities, as AI tools encouraged interactive and exploratory learning environments.

Challenges and Barriers to Implementation

Despite the benefits, several challenges emerged in the integration of AI into education. Participants noted issues such as lack of training for educators, limited access to technology among students, and resistance to change from traditional pedagogical methods. Additionally, concerns over the reliability of AI-generated content and the potential for biased algorithms posed significant barriers to implementation.

Ethical Considerations

Ethical concerns surrounding AI in education were highlighted during the research. Participants discussed issues of privacy, as AI systems often require access to sensitive student data. Furthermore, there were apprehensions about dependency on technology, where students might rely too heavily on AI for learning. Equity concerns also surfaced, particularly regarding disparities in access to AI resources, which could widen the achievement gap among different demographic groups.

Summary of Key Findings

The study's findings illustrate the substantial impact of AI technologies on education, enhancing teaching methods, improving student research capabilities, and positively influencing learning outcomes. However, it also uncovers significant challenges and ethical concerns that need to be addressed for successful implementation.

Implications for Policy and Practice

Based on the findings, it is recommended that educational institutions prioritize training programs for educators to improve familiarity and confidence in using AI tools. Policymakers should establish guidelines to ensure ethical practices regarding data privacy and equitable access to technology. Institutions ought to invest in infrastructure and resources to bridge the digital divide.

Suggestions for Future Research

Future research should investigate longitudinal impacts of AI integration in educational settings, exploring how these technologies evolve and their long-term effects on pedagogy and student outcomes. Additionally, studies examining diverse educational contexts and the effectiveness of various AI tools will provide deeper insights into best practices for AI in education. This study therefore makes the following recommendations in the recommendation section below:

Recommendations for Further Study

This study will recommend further research in the following areas:

Investigating the Relationship between AI Tools and Academic Performance

This study will recommend further research to investigate the relationship between the use of AI tools and academic performance among students.

Exploring the Impact of AI Tools on Student Engagement

This study will recommend further research to explore the impact of AI tools on student engagement among students.

Developing AI-based Educational Materials

This study will recommend further research to develop AI-based educational materials that can enhance the learning experiences of students.

Training Programs

Implement training programs to enhance the understanding of AI tools.

Student Support

Provide continuous support and resources for students to engage effectively with AI.

Further Research

Future studies could investigate the reasons behind the lower scores at certain colleges and explore the long-term impact of AI integration in educational settings.

CONCLUSION

This research highlighted the potential of AI to transform teaching colleges of education in Ghana, improving instructional quality, enhancing student

research capabilities, and fostering better learning outcomes. Despite significant challenges, the integration of AI technologies could address existing gaps in teacher education and create a more equitable educational landscape. By understanding the holistic implications of AI in education, stakeholders can develop strategic interventions that leverage technology to benefit both educators and students. Moving forward, continued dialogue around ethical practices, ongoing professional development, and infrastructural investments will be crucial in successfully harnessing AI to elevate teaching and learning in Ghana's 21st-century educational context. The study therefore aimed to investigate the perception and acceptance level of AI tools among students in colleges of education in Ghana. The findings of this study will provide valuable insights into the experiences and perceptions of students with AI tools and contribute to the development of a technology-based education system that integrates AI tools to enhance the learning experiences of students.

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