Influence of Integrated Artificial Intelligence Models and Simulation Games Models on Students' Academic Achievement

RESEARCH ARTICLE

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ABSTRACT

This study addresses the critical need for innovative pedagogical tools by focusing on the development and evaluation of the COBEKS Artificial Intelligence Model (CAI), an integrated artificial intelligence model specifically designed to enhance structured learning and mitigate challenges associated with traditional methods in Nigerian secondary education. While acknowledging concerns about uncontrolled AI use, the COBEKS model emphasises guided, interactive learning experiences. A quasi-experimental, non-equivalent group design was employed, involving 500 SS2 students from four schools. These students were randomly assigned to two experimental groups and one control group. The groups were pre-tested using the COBEKS Achievement Test (CAT) and the Challenges and Prospects Inventory Questionnaire (CPIQ), which had reliability coefficients of 0.92 and 0.79, respectively, ensuring robust data collection. The intervention involved five 45-minute sessions covering topics such as Artificial Intelligence, Simulation Games, Kidnapping, Rape, Drug Abuse, and Cultism. The experimental groups were taught using CAI and SGM, while the control group received instruction via the conventional lecture method, allowing for direct comparison of pedagogical effectiveness. Data analysis involved means and standard deviations. Findings revealed that the CAI model was the most effective, demonstrating significantly higher academic gains, followed by the Simulation Games Model (SGM), both proving superior to the conventional lecture method in promoting student achievement and engagement. The study strongly recommends the systematic incorporation of CAI and SGM into the senior secondary school curriculum, grounded in their demonstrated ability to foster active learning and personalised instruction. Furthermore, it emphasises the urgent need for specialised training and dedicated funding for the development and effective implementation of these models, particularly to provide targeted support for low-achieving students. Given the empirically observed positive impact on student achievement, these innovative models offer a robust framework for educational reform and should be prioritised over contemporary teaching methods. Schools should strategically shift towards these models by integrating them into the curriculum, providing necessary resources for effective implementation, and conducting regular evaluations to ensure sustained enhancement of academic performance.

Research Design

Quasi-experimental, non-equivalent group design with 500 SS2 students from four schools

Key Models

COBEKS Artificial Intelligence Model (CAI) and Simulation Games Model (SGM)

Main Finding

CAI model most effective, followed by SGM, both superior to conventional lecture method

Keywords: Artificial Intelligence, COBEKS Artificial Intelligence Model, Simulation Game Model (SGM), Student Academic Achievement

INTRODUCTION

The relationship between the utilisation of artificial intelligence (AI) models and student academic achievement has garnered significant research interest. While AI's transformative potential in education is recognised, concerns exist about misuse, such as fostering academic laziness or plagiarism, if not thoughtfully integrated. This study emphasizes structured educational AI integration, differentiating it from uncontrolled AI use. Simulation Game Modelling (SGM) is one such structured approach, immersing students in interactive, real-world simulated scenarios. SGM encourages decision-making, problem-solving, and exploration. SGMs create dynamic learning environments where students apply theoretical concepts to practical situations, fostering experiential learning, collaboration, and critical thinking (Klopfer et al., 2009; Prensky, 2001). This approach moves beyond passive information reception, encouraging active participation and deeper understanding.

01

Business Class Application Example

Students participate in simulated stock market games, making investment decisions based on real-time market data, learning about risk management, portfolio diversification, and market trends.

02

History Class Application Example

SGM recreates historical events or eras where students assume roles of key figures, making decisions that affect the course of history, deepening understanding of historical complexities.

03

Science Class Application Example

Students engage in simulated lab experiments, manipulating variables and observing outcomes, enhancing understanding of the scientific method and data analysis.

04

Language Learning Application Example

SGM simulates trips to countries where target languages are spoken, requiring students to navigate various situations using the language, enhancing conversational skills and cultural understanding.

These applications provide robust justification for how Artificial Intelligence (AI) and Simulation Games Modelling (SGM) can be adapted to different educational contexts. The central premise is to create dynamic, interactive, and engaging learning environments where students apply theoretical concepts to practical situations. This approach fosters deeper understanding and equips students with valuable skills beyond the classroom (Shahzad et al., 2025). The integrated AI-simulation approach promotes active learning and minimizes opportunities for superficial engagement often associated with AI misuse, ensuring AI serves as a tool for cognitive enhancement rather than academic shortcuts.

Education in Nigeria has faced significant criticism for its inability to adequately prepare students for effective participation in society. This inadequacy has been attributed to several factors, including outdated teaching methodologies that prioritise rote memorisation over critical thinking and problem-solving. A growing concern, particularly in the digital age, is the potential for unregulated access to AI tools to exacerbate these issues, potentially fostering academic dishonesty and undermining genuine learning, although specific national statistics on AI misuse in Nigerian education are still emerging (Adepoju & Olatunji, 2022). Ige (2020) observed that "the level of achievement among Nigerian students is alarmingly below expectations," a trend that has persisted over the years. Ige further argues that the reliance on rote memorisation, rather than fostering critical thinking and problem-solving skills, has significantly contributed to the decline in student performance, a problem potentially compounded by the passive use of AI without proper pedagogical integration.

Further compounding this issue, the WAEC Chief Examiner's reports from 2018 to 2022 consistently highlight the poor performance of students in examinations, noting a "disheartening level of ignorance" among students regarding fundamental concepts (West African Examinations Council [WAEC], 2018-2022). This trend reflects not only the inefficacy of current educational practices but also the broader systemic issues within the Nigerian educational system, which could be mitigated by innovative, engaging, and structured learning interventions like those proposed in this study. Therefore, this study is necessitated by the identified gap in the effective and structured use of integrated Artificial Intelligence and Simulation Game Models by secondary school students towards improving teaching and learning of social and environmental concepts in the Nigerian context.

While Artificial Intelligence (AI) holds immense potential for educational enhancement, some scholars (Ododo & Orji, 2025; Vieriu & Petrea, 2025; Saraf, 2023; Marin, 2023) have also identified concerns regarding its misuse, leading to what they term "academic laziness" among students and potentially hampering academic performance. For instance, research by Ododo and Orji (2025) in Akwa Ibom State highlights instances where students misuse AI, which adversely impacts their academic outcomes. This misuse includes leveraging AI for examination misconduct, neglecting traditional study methods, and relying on AI for composing assignments without genuine engagement. The uncontrolled over-reliance on AI technologies, without proper guidance or integration into a structured learning framework, can indeed promote academic dishonesty, such as the effortless generation of essays and problem solutions. Furthermore, AI technologies, when used indiscriminately, may lack a comprehensive understanding of specific assignment contexts, potentially leading to erroneous or irrelevant outcomes for students. These factors collectively contribute to concerns about subpar academic performance when AI is not judiciously applied.

Uncontrolled AI Use: Negative Perspectives

- Academic dishonesty and misconduct
- Neglect of traditional learning methods
- Over-reliance, reducing critical thinking
- Contextual misunderstanding of assignments

Structured AI Integration: Positive Potential

- Personalised learning experiences
- Improved academic outcomes
- Enhanced student engagement
- Support for students with disabilities

This nuanced view is echoed by Vieriu and Petrea (2025), who found that while AI offers significant benefits, including personalised learning, improved academic outcomes, and enhanced student engagement in Romania, challenges such as over-reliance, diminished critical thinking skills, data privacy risks, and academic dishonesty were also identified. Their study underscores the necessity of a structured framework for AI integration, supported by clear ethical guidelines, to maximise benefits while mitigating these risks.

In contrast to concerns about misuse, several scholars (Alsolami, 2025; Shahzad et al., 2025) have identified structured applications of AI as a major driver for improving students' academic performance. For example, Shahzad et al. (2025) found that generative AI (ChatGPT-4) and social media, when integrated thoughtfully, positively influence young students' academic performance and psychological well-being in China. Similarly, Alsolami (2025) demonstrated that the utilisation of AI significantly improves the academic skills of school-aged students with mild intellectual disabilities in Saudi Arabia. This body of research indicates that the strategic utilisation of AI, particularly when integrated into pedagogical models, can substantially enhance students' academic achievement.

There thus appears to be an inconsistency in research findings regarding the overall link between AI use and student academic achievement, particularly when differentiating between uncontrolled, unguided use and purposeful, integrated application. This study aims to address this research gap by developing and testing an Integrated Artificial Intelligence Model alongside the Simulation Games Model (SGM). This approach offers a promising solution by harnessing AI's adaptive capabilities within a structured, experiential learning environment. The Integrated Artificial Intelligence Model represents a transformative approach to personalised learning, leveraging AI algorithms to dynamically adapt instructional content based on individual student needs, preferences, and learning styles. This integration, combined with the immersive, problem-solving nature of SGMs, is theorised to counteract issues like academic laziness and promote deeper engagement and critical thinking. By examining the influence of this integrated AI and Simulation Games Model (SGM) on students' academic achievement in selected senior secondary schools in Otukpo, this study seeks to provide empirical evidence for effective AI integration in education, moving beyond the challenges of unchecked AI use to harness its pedagogical potential.

Research Hypothesis

HO1: The integrated use of the COBEKS Artificial Intelligence Model (CAI) and Simulation Games Model (SGM) does not have significant influence on students' academic achievement in selected senior secondary schools in Otukpo.

LITERATURE REVIEW

Artificial Intelligence in Education

Artificial Intelligence (AI) holds transformative potential to address critical challenges in education, revolutionise teaching practices, and significantly advance Sustainable Development Goal 4 (SDG4) by providing inclusive and equitable quality education for all. However, the rapid pace of AI development has often outstripped corresponding policy discussions and regulatory frameworks, leading to potential risks and challenges. UNESCO (2023) critically emphasises that while it is imperative for countries to harness AI technologies to achieve the Education 2030 Agenda, this integration must occur within a robust framework founded on principles of inclusion and equity. Specifically, UNESCO advocates for a human-centred approach to AI, designed to reduce existing disparities in access to knowledge, research, and cultural diversity. This philosophy of "AI for all" seeks to ensure that technological advancements primarily benefit humanity, fostering innovation and knowledge sharing in a responsible manner. This approach stands in stark contrast to uncontrolled or unregulated AI use, which has been linked to issues like academic laziness and misconduct, as discussed by scholars such as Ododo & Orji (2025) and Saraf (2023) in contexts like Nigerian education, underscoring the critical need for structured integration to mitigate such risks.

How Structured AI Integration Can Boost Student Development and Make Teaching More Rewarding

When implemented thoughtfully and ethically, AI advancements possess the capacity to reshape education systems, making them inherently more inclusive and equitable. AI-driven tools, designed with pedagogical intent, can actively support the necessary transformation towards preparing students for a dynamic future. Zhao (2022) highlights how such structured AI tools can create highly personalised learning experiences, meticulously tailored to individual student needs, preferences, and learning styles, thereby significantly enhancing the overall learning process. Similarly, leading organisations like the LEGO Foundation and Teach for All view ethically integrated AI as a crucial driving force for inclusive learning, effectively preparing young people to navigate and thrive in a rapidly changing world. This careful integration addresses the concerns of academic misuse by embedding AI within a guided learning environment that promotes, rather than diminishes, critical engagement.

AI-Driven Personalisation

Create personalised learning experiences tailored to individual student needs, preferences, and learning styles, promoting deeper understanding and engagement through structured AI applications.

Teaching Enhancement

Ethically deployed AI tools enable teachers to focus on nurturing essential human skills like critical thinking, problem-solving, and emotional intelligence, shifting from rote instruction to guided facilitation.

Student Engagement

Interactive AI systems, designed for educational outcomes, promote deeper and more engaged learning experiences that extend beyond traditional methods, fostering active participation and intrinsic motivation.

How Ethically Integrated AI Tools Can Benefit Educators and Students

The strategic implementation of AI should inspire educators, students, parents, and policymakers to fundamentally rethink the skills necessary for navigating uncertainty, solving complex problems, and shaping meaningful futures. Education must cultivate agency, critical thinking, problem-solving, and well-being, with AI tools serving as powerful facilitators for teachers to achieve this vision. Vriti Saraf, CEO of K20 Educators, notes that when students are empowered to use AI constructively, reducing their sole reliance on teachers for basic knowledge acquisition, educators can then redirect their efforts towards developing higher-order skills that transcend mere memorisation (Saraf, 2023). This managed approach directly counters the risk of AI-induced academic laziness by structuring its use to enhance, not bypass, the learning process.

Beyond pedagogical enhancements, AI can significantly improve teacher productivity in administrative areas such as lesson planning, grading, providing constructive feedback, and streamlining communication with parents. In Lagos, Nigeria, educators are increasingly recognising how AI, when properly integrated, enhances their work, with Oluwaseun Kayode, founder of Schoolinka, observing that teachers in West Africa effectively use AI to assess literacy levels and personalise learning experiences in a controlled manner. Similarly, in Illinois, USA, Diego Marin, an 8th-grade math teacher, describes how tools like ChatGPT, when guided by educators, can function as a valuable one-on-one tutor for students, offering individualised support without fostering dependency (Marin, 2023). These examples underscore the positive potential of AI when applied within a structured and purposeful educational context, contrasting sharply with the negative outcomes associated with its unregulated misuse.

Simulation Games Model (SGM): A Framework for Active Learning

The term simulation originates from the Latin word Similis, which means like, to resemble, or to pretend to be. This concept is foundational to simulation-based learning, where real-life situations, past events, or organisational systems are recreated in a controlled environment to enhance teaching and learning. This model provides a robust theoretical basis for fostering active, experiential learning, allowing students to construct knowledge through direct engagement with complex scenarios rather than passive reception of information.

What are Simulation Methods?

According to Obeka (2009) and Emeke & Ugwuishiwu (2018), simulation methods involve the use of activities, models, or materials that replicate real-world experiences in a way that supports education. These methods are theoretically grounded in experiential learning and constructivism, helping students develop critical thinking, problem-solving, and decision-making skills by engaging them in lifelike scenarios where they must interact, analyse, and respond to different situations. This active engagement directly addresses the challenge of preparing students for uncertain futures by enabling them to practise applying theoretical knowledge in practical, consequence-rich environments.

What are Games in Education?

A game is a structured competition or contest based on skills and played according to set rules. In an educational context, games can be used to enhance learning by introducing challenges, rewards, and engagement strategies that motivate students to actively participate in problem-solving activities. This inherent motivational aspect helps overcome issues of student disengagement and apathy, fostering deeper learning and retention of complex concepts through enjoyable and purposeful interaction.

Steps in Developing Educational Simulation Games

Creating a simulation game for educational purposes requires a structured approach that ensures alignment with pedagogical goals and maximises learning outcomes. The following steps outline the process as detailed by Emeke & Ugwuishiwu (2018):

01

Define Learning Objectives

Identify key concepts, real-life processes, or scenarios that the simulation will represent, and clearly determine the specific educational goals and desired competencies for students to achieve.

02

Analyse Process Components

Break down the chosen real-world process into its essential elements, including relevant rules, variables, constraints, and the critical interactions that drive the scenario, ensuring fidelity to the real-world problem.

03

Determine Time Span

Decide whether the simulation will take place over minutes, hours, days, or weeks in simulated time, and define time acceleration settings to manage the pace and duration of the learning experience effectively.

04

Identify Individual Roles

Define distinct roles or characters that participants will assume, carefully considering their real-world counterparts and the various stakeholders involved, to provide diverse perspectives and responsibilities.

05

Define Objectives and Resources

Establish clear goals for each participant within their assigned roles and identify available resources such as information, tools, or in-game currency, which are crucial for decision-making and problem-solving.

06

Sequence of Actions

Structure the logical flow of events and explicitly include critical decision points where participants must choose between different actions, allowing for exploration of consequences and development of strategic thinking.

07

Assign Roles and Responsibilities

Allocate roles based on students' abilities and learning needs, ensuring each participant has clear functions and contributes meaningfully to the simulation, fostering collaboration and individual accountability.

08

Determine Final Form

Choose the most appropriate format for the simulation: physical role-playing, digital/computer-based games, or structured board games and card-based simulations, based on learning objectives and resource availability.

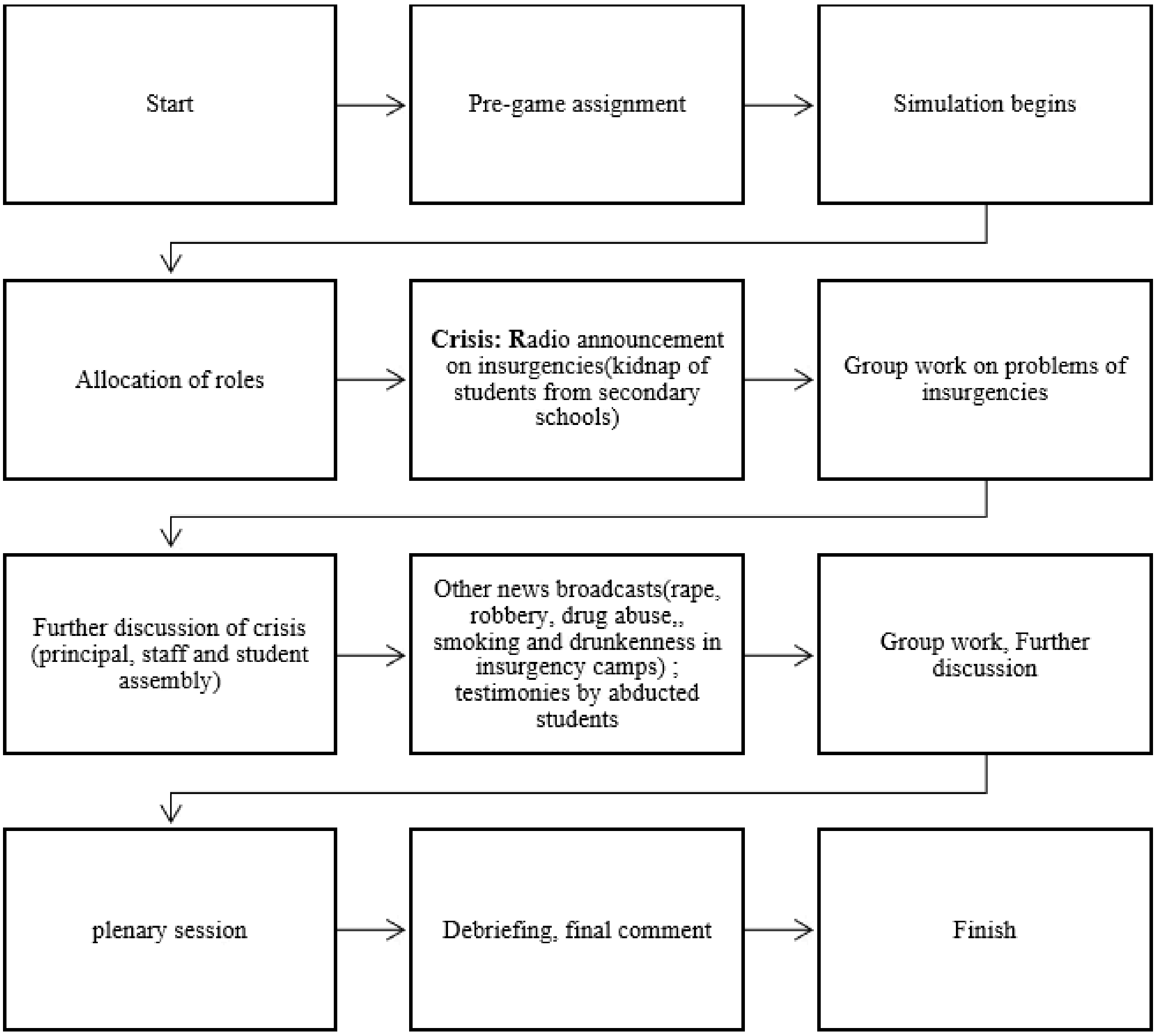

Figure 1: Simulation Game Model (SGM)

Source: Obeka, 2009; Emeke & Ugwuishiwu, 2018

UNDERPINNING THEORY

The two theories underpinning this study, crucial for understanding the adoption and effectiveness of an integrated AI-simulation approach in education, are the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT).

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), introduced by Davis (1989), is a widely recognised framework for predicting how users adopt and accept technology. It builds on Ajzen and Fishbein's Theory of Reasoned Action (TRA) by focusing on two core factors: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). These factors influence a user's Behavioural Intention (BI) to use a technology, which ultimately predicts Actual System Use. In the context of educational technology, particularly AI-powered simulation games, TAM provides a foundational understanding of learner willingness to engage with such innovative tools.

Perceived Usefulness (PU) refers to the extent to which a user believes a technology will improve their job performance or, in an educational setting, enhance their learning outcomes and skill development. If students perceive an AI-simulation game as helpful in achieving their academic goals more effectively, they are more likely to adopt it. For example, students might embrace an AI-driven simulation if they think it will streamline their learning process or deepen their understanding of complex concepts.

Perceived Ease of Use (PEOU) denotes the degree to which a user believes a technology is easy to use. The simpler an AI-simulation game is to operate and navigate, the higher the likelihood of adoption among students and educators. For instance, an educational software application with an intuitive interface and minimal technical hurdles is more likely to be accepted and regularly utilised in the classroom.

Core Components

Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) are key factors influencing technology adoption and behavioural intention.

Model Evolution

TAM2 included social influences and cognitive factors. TAM3 added computer self-efficacy, anxiety, and perceived enjoyment factors, reflecting the growing complexity of user-technology interactions.

Applications

Applied across industries to predict adoption of information systems, mobile apps, e-learning platforms, and enterprise software, making it highly relevant for educational AI solutions.

Unified Theory of Acceptance and Use of Technology (UTAUT)

Driven by e-commerce expansion and rapid digital technology advancements (AI, big data, cloud computing, robotics), organisations and educational institutions increasingly adopt new technologies (Verhoef et al., 2021). While Information Communication Technology (ICT) innovations transform sector operations, communication, and processes, a persistent challenge remains in ensuring their effective utilisation.

Market research shows less than 30% of organisations achieve expected returns on new technologies; success rates are even lower for those unable to sustain short-term gains (De la Boutetière, Montagner & Reich, 2018). This gap between adoption and sustained utilisation is a critical research focus, especially in education, where initial acceptance often doesn't translate to effective pedagogical integration or improved learning outcomes.

To address limitations of earlier models, Venkatesh et al. (2003) developed the Unified Theory of Acceptance and Use of Technology (UTAUT) by synthesizing constructs from eight prominent technology acceptance models. They reviewed theories from social, management, and behavioural psychology to create a comprehensive framework. UTAUT is salient for this study because it robustly examines the acceptance and use of complex integrated systems like AI-powered simulation games, considering determinants beyond usefulness and ease of use, such as performance expectancy, effort expectancy, social influence, and facilitating conditions. This comprehensive approach is essential for successfully integrating and sustaining advanced educational technologies.

METHODOLOGY

Development of an Integrated Artificial Intelligence Model (COBEKS Artificial Intelligence)

The COBEKS Artificial Intelligence (CAI) Model addresses critical secondary education challenges like lack of personalised learning, low student engagement, and limited access to quality resources. Inspired by constructivist learning theories, the model leverages generative AI to provide adaptive, interactive, and personalised learning. Unlike generalised AI tools that can lead to academic shortcuts, the CAI Model is designed for structured educational integration, focusing on guided learning and skill development. Its unique selling point is combining conversational AI, coding assistance, and personalised learning into a single platform, actively mitigating misuse risks by emphasising learning processes over mere answer generation.

Technical Framework & API Integration

The CAI Model operates as a multi-agent system, with each AI playing a specific role, engineered with built-in safeguards to promote academic integrity and responsible technology use:

Figure 2 visually represents the architectural overview of the COBEKS Artificial Intelligence Model, detailing its multi-agent system and API integrations.

1. Meta AI

Provides real-time responses and generates contextual learning materials, not direct answers for assessments. Uses NLP to analyse student queries and engagement levels, guiding them towards understanding rather than providing unearned solutions. Addresses limitations through optimised API calls and caching mechanisms, ensuring consistent and controlled educational output.

2. ChatGPT (OpenAI)

Acts as a conversational tutor, guiding students through dialogue-based learning. It is programmed to adapt explanations based on student responses using reinforcement learning techniques, focusing on conceptual mastery and problem-solving skills. Handles API rate limits through queuing systems, ensuring availability while promoting a deliberate pace of interaction to prevent over-reliance or rapid "answer-seeking" behaviours.

3. Microsoft Copilot

Assists students in coding tasks, debugging, and computational thinking by suggesting structured solutions and guiding them through the logic. This function is geared towards skill development and understanding programming concepts, rather than merely providing executable code. Enhances collaborative learning by suggesting structured solutions and integrating with Azure AI Services, facilitating a deeper understanding of coding principles.

The three agents communicate through a centralised middleware layer, ensuring data consistency and seamless interaction. This architecture also allows for centralised monitoring of user interactions to identify and address patterns that deviate from intended educational use, reinforcing the model's integrity.

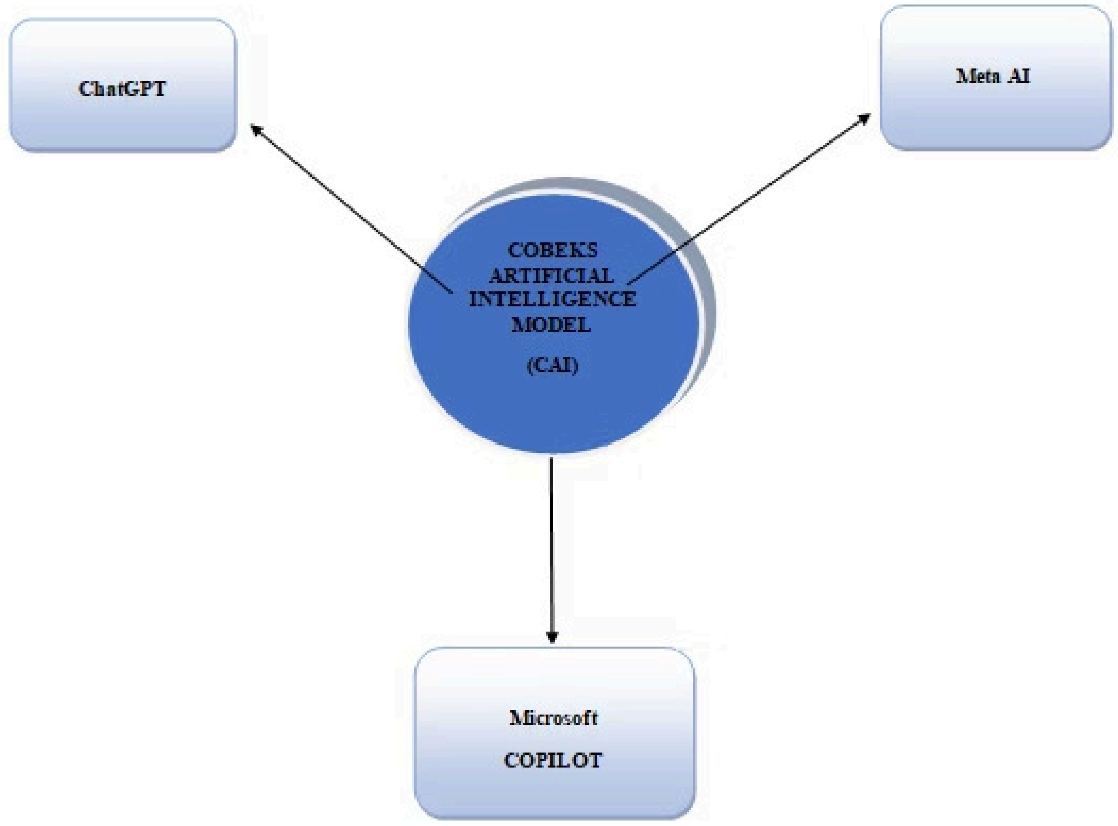

Figure 2: COBEKS Artificial Intelligence Model (CAI)
Source: Researcher's Field Survey, 2024

Population of the Study

The study's population comprises 15,000 Secondary School Students across 50 public and private institutions (government-run, mission, and community-based schools) in Otukpo (NBS, 2024).

Sample and Sampling Techniques

Sample

Five Senior Secondary Schools in Otukpo were selected: St. Francis College, Jesus College, St. Ann's College, St. Paul's Secondary School, and Wesley High School.

Sampling Technique

These schools were purposively selected due to prevalent socio-environmental problems: kidnapping, rape, drug abuse, and cultism. From each sampled school, intact SS2 classes were used for the research. Since the experiment required two experimental groups and one control group, three SS2 streams were drawn. If a school had more than three SS2 streams, three were selected via simple random sampling. The total sample of SS2 students amounted to 500.

Instrument for Data Collection

The instrument developed by the researcher for the purpose of this study is:

COBEKS Achievement Test (CAT)

The Achievement Test focused on the SS2 curriculum content on socio-environmental problems, including kidnapping, rape, drug abuse, and cultism. Questions were set to cover the content units of the six topics selected for the study. The CAT will be a 50-item, multiple-choice objective test based on the units of study in the SS2 curriculum, as outlined earlier. The items measure only objectives in the cognitive domain of Bloom's (1956) Taxonomy of Educational Objectives. A table of specifications built by the researcher was used in generating CAT items (see Table 1), which guided the construction of this instrument. The detailed table of specifications ensures representation of each content area in the unit of study.

Table 1: Table of Specifications

Objective/ content	Weight	Knowledge	Comprehension	Application	Total
	%	40 %	40 %	20%	100%
Artificial Intelligence Definition of Concepts	10	2	2	1	5
Simulation Games Definition of Concepts	10	2	2	1	5
Kidnapping	20	4	4	2	10
Raping	20	4	4	2	10
Drug abuse	20	4	4	2	10
Cultism	20	4	4	2	10
Total	100	20	20	10	50

Validation of Instrument

Validation of the instrument (test items) took the form of content validation and face validation. Content validation was conducted to ensure that the test blueprint was strictly adhered to. An item analysis was performed, and item difficulty levels between 0.30 and 0.70 were used; item discrimination index was also calculated.

As for face validation of the test, this was done by presenting the items to specialists in the subject areas of Computer Science and Measurement and Evaluation. Their criticisms and observations were incorporated into the modified test items. Some of the structured objective questions were modified based on their advice and corrections.

Control of Extraneous Variables

Certain measures were adopted to control undue influence from some extraneous variables. These measures include the following:

1. **Experimental Bias**

   The researcher did not conduct the actual teaching for both experimental and control groups himself. The teachers trained by the researcher for the research exercise handled the teaching.

2. **Teacher Variables**

   There was a training program for all the teachers co-opted to assist the researcher. During the training program, the validated instruments were given to the teachers and discussed.

3. **Hawthorne Effect**

   To minimise student apprehension, the researcher and the teachers became temporary staff members of the schools where the research exercises were carried out.

4. **School Variables**

   To minimise the influence of school variables, the sampled schools were drawn from the same neighbourhood (Otukpo) with similar environmental conditions.

5. **Experimental Precaution**

   To maintain experimental precaution, the test was administered to all SS2 classes in the sampled schools at the same time by the teachers.

6. **AI Misuse Control**

   To prevent potential misuse of generative AI tools for academic dishonesty during the study, strict protocols were implemented. Students were required to complete the COBEKS Achievement Test (CAT) under supervised conditions, in controlled environments where personal electronic devices were prohibited. Furthermore, teachers were trained to identify potential AI-generated content in student responses, and the CAI model itself was configured with safeguards to log interactions and flag unusually sophisticated or off-topic queries that might indicate an attempt to bypass learning objectives rather than engage with them.

Pilot Testing

Pilot testing assessed the two instruments' appropriateness, determined optimal timing, and identified potential administration issues, including those related to AI component misuse or misinterpretation. The trial data also served to estimate the instruments' internal consistency reliability.

Reliability of Instruments

Utilising pilot test data, instrument reliability was assessed. The COBEKS Achievement Test (CAT), dichotomously scored, showed high internal consistency with a Kuder-Richardson K-R20 coefficient of 0.92. Cronbach's Alpha was applied to the Problems and Prospects Inventory questionnaire, yielding a reliability coefficient of 0.79. These coefficients confirm the instruments' dependability for valid data collection.

Trial Test

A trial test with ninety (90) SS2A, SS2B, and SS2C students confirmed the appropriateness and practical administration of both instruments. This trial determined optimal timing: the COBEKS Achievement Test (CAT) required approximately 45 minutes, while the Challenges and Prospects Inventory Questionnaire (CPIQ) took 25-30 minutes, with all participants finishing within 30 minutes. These insights refined the instruments and administration protocols, and the data was subsequently used for internal consistency reliability estimation.

Method of Data Collection

A pre-test, using the COBEKS Achievement Test (CAT), established baseline academic performance. Following intervention with the COBEKS Artificial Intelligence Model (CAI) and Simulation Games Model (SGM), a post-test with the same validated instruments was administered. Measures were implemented during CAI and SGM administration to ensure structured, ethical educational integration, preventing AI misuse. Pre- and post-test scores were compared to determine achievement gains. Qualitative insights were also gathered via interviews and questionnaires from students and staff for comprehensive understanding.

Method of Data Analysis

Objective 1: Assess the influence of the COBEKS Artificial Intelligence Model (CAI) and Simulation Games Model (SGM) on students' academic performance:

A Quasi-Experimental Design with both pre-test and post-test measurements was employed for this objective. This approach involved meticulously measuring students' academic performance before and after the implementation of the CAI and SGM. The CAI was specifically designed to provide adaptive learning experiences, while the SGM offered immersive problem-solving scenarios, both structured to foster deeper understanding and active engagement rather than passive knowledge acquisition. Safeguards, such as real-time instructor monitoring and built-in progress tracking within the CAI, were integral to ensuring that students engaged with the AI in a pedagogically sound manner, mitigating risks of over-reliance or misuse. The difference in scores between the pre-test and post-test was subsequently analysed using a paired t-test or analysis of variance (ANOVA), depending on the specific group comparisons, to determine if there was a statistically significant difference in academic performance. The practical significance of these statistical findings, such as the magnitude of mean score differences, will be further interpreted to explain what these improvements mean in terms of tangible educational gains and student learning outcomes.

RESULTS AND DISCUSSION

This section presents the statistical analyses and interpretation of the findings related to the influence of the COBEKS Artificial Intelligence Model (CAI) and Simulation Games Model (SGM) on students' academic performance. The findings address the research hypotheses and provide evidence for the effectiveness of the intervention models, clearly distinguishing structured AI integration from potential issues of unguided AI use discussed elsewhere in this paper. Each claim is supported by the statistical data presented.

Hypothesis One:

The use of the COBEKS Artificial Intelligence Model (CAI) and Simulation Games Model (SGM) does not significantly influence students' academic performance in Selected Senior Secondary Schools, Otukpo.

Table 2: Analysis of Covariance (ANCOVA) of overall students' achievement score

Source Of Variation	Sum Of Squares	Df	Mean Squares	F-Value	Sig.	Interpretation
Covariates	45203.95	1	45203.95	7994.24	.00	
Pretest	45203.95	1	45203.95	7994.24	.00	
Main effects	4217.37	2	2108.68	327.92	.00	
Methods (use of models)	4217.37	2	2108.68	372.92	.00	
Explained	49421.32	3	16473.77	2913.36	.00	
Residual	2759.43	488	5.65			
Total	52180.75	491	106.27			

Significant at $P<0.05$

The results presented in Table 2 indicate a highly significant effect of the different teaching models on students' achievement. The calculated F-value for the effect of treatment on Students' Achievement (F=372.92) was found to be statistically significant at the probability level of 0.00 ($p < 0.05$). This robust statistical significance suggests that the intervention methods–COBEKS Artificial Intelligence Model (CAI), Simulation Games Model (SGM), and Conventional Lecture Model (CLM)–produced distinctly different outcomes in student academic performance. Therefore, the null hypothesis, which states that the use of CAI and SGM does not significantly influence students' academic performance, is rejected. This finding underscores the importance of carefully designed educational models, especially those integrating technology like AI, in improving learning outcomes. Given this significant main effect, a Multiple Classification Analysis was performed to further elucidate the specific differences between the groups, as presented in Table 3.

Table 3: Multiple Classification Analysis of Free Groups for Achievement Scores

GRAND MEAN= 54.25							
Variable +category	N	**Unadjusted**		**Adjusted for independents**		**Adjusted for independence+covariates**	
Method (Model)		Devin	Eta	Devin	Beta	Devin	Beta
1-COBECKS Artificial Intelligence (CAI)	169	8.34				4.29	
II Simulation game model (SGM)	166	-3.70				-2.71	
III Lecture (control)	165	-4.81				-1.65	
		-58					.3
MULTIPLE R-Squared							.94
Multiple R							.97

Building upon the ANCOVA results, the Multiple Classification Analysis in Table 3, with a grand mean of 54.25, reveals specific performance differences among the groups after adjusting for covariates. The adjusted mean for the COBEKS Artificial Intelligence Model (CAI) group is 54.25 + 4.29 = 58.54. For the Simulation Games Model (SGM) group, the adjusted mean is 54.25 - 2.71 = 51.54. Finally, the Conventional Lecture Model (CLM) (control) group's adjusted mean is 54.25 - 1.65 = 52.60.

This detailed analysis demonstrates a clear hierarchy of academic performance: students taught with the COBEKS Artificial Intelligence Model (CAI) achieved the highest adjusted mean score (58.54), significantly outperforming both the Conventional Lecture Model (CLM) group (52.60) and the Simulation Games Model (SGM) group (51.54). The CLM group, in turn, performed better than the SGM group. In practical educational terms, this means that the structured integration of AI, as embodied by the CAI model, is not merely statistically effective but also translates into a tangible improvement in student learning outcomes compared to traditional methods and even alternative innovative approaches like SGM. This reinforces the argument that when AI is purposefully designed and integrated into curricula as a pedagogical tool, it actively enhances learning rather than contributing to "academic laziness" often associated with unmanaged AI use.

To precisely determine where these significant differences lie among the various groups and further validate these findings, the Scheffé Test of Multiple Comparisons was subsequently conducted. The results of this post-hoc analysis are presented in Table 4.

Table 4: Scheffé Post-Hoc Pairwise Multiple Comparison Test of the Treatment Group for Achievement

	Means	COBEKS Art.Int Group 1 Exp,	Simulation Games Model Group 11 Exp 2	Conventional Lecture Model (CLM) Group III Control
COBEKS Artificial Intelligence Model (CAI) Exp 1	62.60			
Simulation Games Model (SGM) Exp 2	50.55			
Conventional Lecture Model (CLM) Model (CLM) Control CC)	49.44			

Significant difference at the 0.05 level

When the Scheffé post-hoc pairwise multiple comparison test was conducted on the mean achievement scores of the three groups, it was observed that a significant difference ($P<0.05$) exists between COBEKS Artificial Intelligence Model (CAI) Exp. 1 and Simulation Games Model (SGM) Exp. 2, and between COBEKS Artificial Intelligence Model (CAI) and Conventional Lecture Model (CLM) (control group).

This implies that the CAI experimental group (Exp. 1) scored significantly higher than both the SGM experimental group (Exp. 2) and the conventional lecture (control) group. The implication of this result is that the COBEKS Artificial Intelligence Model (CAI) demonstrated superiority over the other instructional models. Specifically, students engaged with the CAI model achieved a mean score approximately 6 points higher than those taught with the Conventional Lecture Model and 7 points higher than those in the Simulation Games Model. This substantial difference is not merely statistically significant but also represents a practically meaningful improvement in student academic performance, indicating a greater mastery of content and potentially higher educational attainment for students utilising the CAI approach compared to traditional methods.

58.54

CAI Model Mean

Highest-performing group with the COBEKS AI model

51.54

SGM Model Mean

Second-highest with the Simulation Games Model

52.60

Control Group Mean

Conventional lecture method baseline

CONCLUSION AND RECOMMENDATIONS

This study rigorously examined the influence of the COBEKS Artificial Intelligence Model (CAI) and the Simulation Games Model (SGM) on students' academic achievement. The findings definitively show that both CAI and SGM have a significant positive effect on students' academic achievement, as evidenced by the mean achievement scores in the experimental groups. Specifically, the Scheffé post-hoc analysis revealed that the CAI model led to significantly higher achievement compared to both the SGM and the Conventional Lecture Model (CLM). This indicates that while both innovative models are effective, the CAI model demonstrates superior efficacy, particularly in motivating and engaging students, leading to demonstrably better learning outcomes. This superiority can be attributed to CAI's adaptive learning pathways and immediate feedback mechanisms, which align with constructivist learning theories, fostering deeper understanding and personalised learning experiences, unlike the passive reception often associated with traditional methods or the less structured engagement of general AI tools. Therefore, this research confirms that structured educational AI integration, specifically through models like CAI, and well-designed simulation games are powerful drivers of enhanced academic achievement, offering a robust alternative to conventional teaching.

Given the observed and statistically significant positive impact on student achievement, particularly with the COBEKS Artificial Intelligence Model and the Simulation Games Model, these structured and evidence-based models should be prioritised over contemporary teaching methods that lack such empirical support. It is crucial to distinguish these controlled, education-focused AI integrations from the generalised, unregulated AI usage that has been linked to academic misconduct; the former is designed to enhance learning, while the latter can undermine it if not managed. Schools should strategically and gradually transition towards these innovative models by incorporating them into the curriculum, ensuring adequate teacher training and providing the necessary technological infrastructure and resources for effective, safeguarded implementation. Continuous evaluation, incorporating both quantitative and qualitative measures, should be an integral part of this transition to monitor effectiveness, ensure alignment with pedagogical goals, and make necessary adjustments to maximise academic performance and mitigate potential misuse.

01

Curriculum Integration

Incorporate CAI and SGM into senior secondary school curriculum as primary instructional methods, carefully replacing conventional lecture approaches with structured, pedagogical designs to maximise learning benefits.

02

Teacher Training & Safeguards

Provide specialised training for educators on the effective implementation and pedagogical use of AI-based and simulation game teaching models, emphasising best practices and ethical considerations to prevent misuse and foster responsible integration.

03

Resource Allocation

Secure necessary funding, technological infrastructure, and ongoing support for the development, deployment, and maintenance of these innovative instructional models, ensuring equitable access and functionality across all educational settings.

04

Continuous Evaluation & Refinement

Implement robust and regular assessment protocols to monitor the effectiveness of these models in enhancing academic performance, gathering data for continuous improvement, and addressing any emerging limitations or challenges.

Despite the promising findings, this study acknowledges certain limitations. The research was conducted within a specific educational context in Nigeria, and the generalisability of these findings to other cultural or educational environments may vary. Future research could explore the long-term impacts of CAI and SGM on higher-order thinking skills and student retention. Furthermore, a deeper investigation into specific instructional design elements within CAI that contribute most to student motivation and achievement would be beneficial for refining educational AI models. This work aligns with constructivist theories by emphasising active learning and personalised feedback, and further supports the notion that technology, when thoughtfully integrated, can significantly transform educational practices.

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CONFLICTS OF INTEREST

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