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IMPACT OF AI ON STUDENTS' PERFORMANCE IN ECONOMICS IN KADUNA METROPOLIS SECONDARY SCHOOLS

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ABSTRACT

This study investigated the effect of Artificial Intelligence (AI) tools on the academic performance of Senior Secondary School students in Economics in selected schools within Kaduna Metropolis, Kaduna State, Nigeria. Adopting a descriptive correlational survey design, data were collected from five hundred (500) Senior Secondary School Economics students, drawn from a purposively selected set of public and private schools within the metropolis (identities withheld in line with the confidentiality undertakings given to participating institutions), using a structured questionnaire that measured demographic characteristics, access to and frequency of AI tool use, perceptions of the positive effects and challenges of AI tools, and academic performance in Economics expressed as a percentage score. Data were analysed using descriptive statistics, Pearson product-moment correlation, independent-samples t-tests, one-way analysis of variance (ANOVA), and multiple linear regression.

The results showed that 83.6% of respondents had access to AI tools, with ChatGPT being the dominant tool used (50.6%). Students held moderately positive perceptions of the benefits of AI tools (overall mean = 3.01 out of 5.00) and moderate levels of concern about associated challenges (overall mean = 3.01 out of 5.00). A strong, positive, and statistically significant correlation was found between students' perceived positive effect of AI tools and their academic performance in Economics ($r = 0.590$, $p < .001$), while the correlation between perceived challenges and performance, though significant, was weak ($r = 0.121$, $p = .007$). Academic performance differed significantly by sex, favouring females ($p = .026$), and rose monotonically across categories of AI use frequency, from Never (M = 41.23%) to Very Often (M = 69.58%), $F(4, 495) = 97.52$, $p < .001$, but did not differ significantly between public and private school students ($p = .118$). A regression model combining both perception variables explained 35.0% of the variance in academic performance, with perceived positive effect as the dominant predictor.

The study concludes that AI tools exert a substantively positive effect on students' academic performance in Economics, particularly with frequent and purposeful use, although moderate levels of concern about over-dependence and information accuracy indicate that these risks require deliberate pedagogical attention. It is recommended that Economics teachers structurally integrate AI tools into instruction, that schools develop clear

guidelines for their use, and that AI literacy and information-verification skills be explicitly taught alongside subject content.

Keywords: *Artificial intelligence; ChatGPT; academic performance; Economics education; Senior Secondary School; Nigeria.*

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1. INTRODUCTION

The twenty-first century has witnessed an unprecedented transformation in the way knowledge is created, accessed, and transmitted, largely propelled by rapid advances in digital and computational technologies. Among these innovations, Artificial Intelligence (AI) has emerged as one of the most disruptive forces reshaping teaching and learning across all levels of education. Artificial Intelligence refers to the branch of computer science concerned with building systems capable of performing tasks that ordinarily require human intelligence, such as reasoning, problem-solving, natural language understanding, and adaptive learning (Akgun & Greenhow, 2022). In education, AI has moved from a theoretical possibility to a lived classroom reality, with tools such as ChatGPT, Google Gemini, Microsoft Copilot, and QuillBot now routinely consulted by students for explanations, practice questions, essay drafting, and examination preparation.

The entry of generative AI tools into mainstream use has been particularly rapid in secondary education. Cardona, Rodriguez, and Ishmael (2023) observe that AI-powered platforms have moved from the periphery of classroom practice to the centre of how many students study, revise, and complete assignments, often with little formal guidance from schools on how the tools should be used. Kohnke, Moorhouse, and Zou (2023) similarly note that AI chatbots can generate explanations, summarise complex materials, and provide near-instantaneous feedback, functions that were previously the exclusive preserve of human tutors. For subjects that many students perceive as abstract and demanding, such as Economics, this capacity to simplify and personalise content is potentially transformative.

Economics is a core social science subject in the Senior Secondary School curriculum that equips learners with an understanding of how individuals, firms, and governments allocate scarce resources among competing wants. Despite its practical relevance to everyday decision-making, Economics is frequently associated with graphical analysis, quantitative reasoning, and abstract theoretical constructs that many students find challenging (Samo, Shah, & Ramsha, 2025). Persistently, examination reports from bodies such as the West African Examinations Council (2023) have highlighted recurring weaknesses among candidates in areas such as the interpretation of economic diagrams, application of theory to real-life scenarios, and computation of statistical indices, underscoring a long-standing performance gap in the subject.

It is against this backdrop that AI tools are increasingly being explored as a potential remedy for the difficulties students encounter in Economics. Proponents argue that AI tools can help learners break down complex theories into simpler language, provide worked solutions to numerical problems, generate practice questions, and offer instant clarification outside school hours (Dong, Tang, & Wang, 2025; Wu & Zhang, 2025). A meta-analysis by Dong et al. (2025) synthesising studies on generative AI use in education reported an overall positive effect on academic achievement, suggesting that, under the right conditions, these tools can meaningfully support learning outcomes across subject areas.

However, the growing reliance on AI tools has equally attracted considerable scholarly concern. Critics warn that unregulated and excessive use of AI may promote intellectual dependency, reduce personal effort, and erode the very critical-thinking and problem-solving skills that Economics, as a discipline, seeks to cultivate (Oates & Johnson, 2025). Furthermore, the tendency of generative AI systems to occasionally produce plausible but inaccurate information, a phenomenon often referred to as hallucination, raises questions about the reliability of AI-generated content, particularly where students lack the background knowledge required to verify such information independently (Akgun & Greenhow, 2022).

1.1 Statement of the Problem

Despite the introduction of numerous instructional interventions, remedial classes, and curriculum reviews, the academic performance of Senior Secondary School students in Economics has remained a source of concern to educators, parents, and examination bodies alike. Yearly Chief Examiners' reports continue to note that a substantial proportion of candidates struggle with the application of economic theories to practical situations, the correct use of economic terminologies, and the accurate interpretation of statistical and graphical data (West African Examinations Council, 2023).

At the same time, students have, largely on their own initiative, begun to adopt AI tools such as ChatGPT and Google Gemini as informal study companions, often without any structured framework guiding their use, and without teachers or school authorities being fully aware of the extent or nature of this usage. While a growing body of international literature suggests that AI tools can enhance understanding, improve study efficiency, and support examination preparation (Alneyadi & Wardat, 2023; Salifu, Arthur, Arkorful, Nortey, & Osei-Yaw, 2024), other studies warn that unsupervised and excessive use of these same tools may foster over-dependence, diminish independent reasoning, and expose students to inaccurate or misleading information (Oates & Johnson, 2025; Ünal, Kaya, Uzun, & Erdem, 2026).

The central problem, therefore, is that there exists limited context-specific empirical evidence on how the actual pattern and frequency of AI tool use among Senior Secondary School Economics students relates to their measured academic performance. Without such evidence, school administrators and policymakers are left to formulate guidelines on AI use in the classroom based on anecdote and speculation rather than data. It is this gap that the present study seeks to fill by examining, with a sample of five hundred Senior Secondary School students, the relationship between the perceived positive effects of AI tools, the perceived challenges associated with their use, and students' academic performance in Economics.

1.2 Purpose and Objectives of the Study

The general purpose of this study is to examine the effect of Artificial Intelligence tools on the academic performance of Senior Secondary School students in Economics. Specifically, the study sought to:

1. determine the level of access to and frequency of use of AI tools among Senior Secondary School Economics students;
2. assess students' perceptions of the positive effects of AI tools on their understanding and performance in Economics;
3. assess students' perceptions of the challenges associated with the use of AI tools in the study of Economics;
4. examine the relationship between students' perceived positive effect of AI tools and their academic performance in Economics;
5. examine the relationship between students' perceived challenges of AI tool use and their academic performance in Economics; and
6. determine whether academic performance in Economics differs significantly according to students' sex, school type, and frequency of AI tool use.

1.3 Research Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance:

H01: There is no statistically significant relationship between students' perceived positive effect of AI tools and their academic performance in Economics.

H02: There is no statistically significant relationship between students' perceived challenges of AI tool use and their academic performance in Economics.

H03: There is no statistically significant difference in the academic performance in Economics of male and female students.

H04: There is no statistically significant difference in the academic performance in Economics of students in public and private schools.

H05: There is no statistically significant difference in the academic performance in Economics of students across the different categories of AI tool use frequency.

1.4 Significance and Scope of the Study

The findings of this study are of value to several categories of stakeholders in the education sector. For students, the study provides evidence-based insight into how the manner in which they engage with AI tools relates to their academic outcomes, potentially encouraging more purposeful and reflective use of such technologies. For Economics teachers, the findings offer empirical guidance on how AI tools might be constructively integrated into classroom instruction, assignments, and revision activities, while remaining

alert to challenges such as over-dependence and misinformation. School administrators, curriculum planners, and policymakers within the Ministry of Education and examination bodies stand to benefit from context-specific data that can inform institutional and policy guidelines on the acceptable and productive use of AI tools within the school environment.

The study is delimited to Senior Secondary School students offering Economics in selected public and private Senior Secondary Schools within Kaduna Metropolis, Kaduna State, focusing on students' self-reported access to and frequency of use of AI tools, their perceptions of the positive effects and challenges of such tools, and the relationship of these variables with their academic performance in Economics, as measured by a percentage performance score. The study draws on a sample of five hundred (500) respondents selected from schools spanning SS1 to SS3 within the metropolis; the specific schools are not named, for reasons explained in Section 3.2. It does not extend to an experimental evaluation of specific AI platforms, nor does it examine subjects other than Economics, nor schools outside Kaduna Metropolis; its findings should therefore be interpreted within the context of self-reported perceptions and correlational, rather than strictly causal, relationships, and with due caution regarding generalisation beyond the study area.

2. LITERATURE REVIEW

2.1 Conceptual Framework

2.1.1 The Concept of Artificial Intelligence

Artificial Intelligence has been defined in various ways across the literature, but a common thread running through most definitions is the capacity of machines to simulate cognitive functions typically associated with the human mind, such as learning, reasoning, perception, and language use (Akgun & Greenhow, 2022). In the context of education, the term Artificial Intelligence in Education (AIED) is often used to describe the application of these computational capabilities to teaching, learning, assessment, and administrative processes within educational institutions.

Generative AI tools, a subset of AI applications that have become especially prominent since the public release of ChatGPT in late 2022, are distinguished by their ability to produce original text, explanations, and content in response to natural-language prompts (Kohnke, Moorhouse, & Zou, 2023). Unlike earlier computer-assisted learning software, which typically followed rigid, pre-programmed pathways, generative AI tools can adapt their responses to the specific phrasing and context of a learner's query, creating an experience that many students describe as conversational and personalised (Salifu et al., 2024).

Zhai et al. (2021), reviewing a decade of research on AI in education, identify three broad areas in which AI has been applied in classrooms: as a learning tool for the student (for example, intelligent tutoring systems and chatbots), as a facilitating tool for the teacher (for example, automated grading and analytics), and as a policy or administrative tool for institutions (for example, learning-management systems with predictive capabilities). The present study is concerned primarily with the first of these, namely the use of AI as a direct learning tool by students, with a specific focus on the popular generative chatbots (ChatGPT, Google Gemini, Microsoft Copilot) and writing-support tools (QuillBot) that senior secondary school students commonly encounter.

2.1.2 Artificial Intelligence Tools in Education

The application of AI tools within classroom contexts spans a wide spectrum of functions. At the most basic level, AI chatbots can answer factual questions and provide simplified explanations of concepts that students find difficult to grasp from textbooks or classroom instruction alone (Alneyadi & Wardat, 2023). Beyond simple question-answering, these tools can generate step-by-step solutions to numerical problems, produce practice questions for examination revision, summarise lengthy texts, and even simulate dialogue that allows a student to test their understanding of a topic through interactive questioning (Rokhayani, Rukmini, Hartono, & Mujiyanto, 2022).

Chan and Hu (2023), examining students' voices on generative AI in higher education, found that learners frequently valued AI tools for the immediacy of feedback they provided, an attribute that traditional classroom settings, constrained by large class sizes and limited teacher time, often struggle to match. Similarly, Pertiwi, Kulsum, and Hanifah (2024) reported that AI-based learning methods were associated with improved motivation and academic achievement, attributing this to the personalised pacing and repeated exposure to material that AI tools make possible.

In the specific context of Economics education, AI tools have been noted for their potential to demystify graphical and quantitative content that many students find intimidating. Salifu et al. (2024), studying economics students' use of ChatGPT in a Ghanaian higher education institution, found that hedonic

motivation, that is, the enjoyment students derived from interacting with the tool, was the strongest predictor of their behavioural intention to use it, suggesting that the appeal of AI tools among economics learners is driven as much by engagement and enjoyment as by narrowly instrumental academic considerations.

2.1.3 Academic Performance and Economics as a Senior Secondary School Subject

Academic performance refers to the extent to which a student has attained defined learning objectives, typically measured through test scores, assignment grades, or examination results (Rajeswari & Madhusudan, 2022). In the context of Senior Secondary Economics, academic performance is most commonly operationalised through continuous assessment scores and end-of-term or end-of-session examination results, often expressed as a percentage. A wide range of factors have historically been identified as influencing students' academic performance in Economics, including the quality of classroom instruction, the availability of instructional materials, students' study habits, socio-economic background, and, more recently, the extent and manner of their engagement with digital learning technologies (Samo, Shah, & Ramsha, 2025).

Economics occupies a distinctive position within the Senior Secondary School curriculum. As a social science, it draws on elements of mathematics, statistics, and abstract theoretical reasoning to explain phenomena such as demand and supply, market structures, national income, and international trade. This hybrid character means that students must simultaneously master conceptual definitions, interpret graphical representations, and perform quantitative computations, a combination that has historically posed difficulties for many candidates (West African Examinations Council, 2023). Given these long-standing challenges, tools that can offer on-demand, simplified, and repeatable explanations, of the kind that generative AI platforms provide, are of particular interest to Economics educators and learners. At the same time, the discipline's heavy reliance on the correct application of theory to context makes it especially vulnerable to the risks associated with AI-generated inaccuracies, since a plausible-sounding but flawed explanation of, for example, price elasticity or the multiplier effect could reinforce rather than correct a student's misunderstanding if not properly verified.

2.2 Theoretical Framework

This study is anchored on the Technology Acceptance Model (TAM), originally propounded by Davis (1989). TAM was developed to explain and predict the extent to which individuals accept and make use of a given technology, and it identifies two central constructs, perceived usefulness and perceived ease of use, as the principal determinants of a person's attitude toward, and eventual use of, a technological system (Davis, 1989). Perceived usefulness refers to the degree to which a person believes that using a particular technology would enhance their performance of a task, while perceived ease of use refers to the degree to which a person believes that using the technology would be free of undue effort.

TAM is well suited to the present study because it offers a coherent lens through which to understand why Senior Secondary School students choose to adopt AI tools for the study of Economics, and how their beliefs about the usefulness of these tools translate into actual patterns of use and, potentially, into academic outcomes. Venkatesh, Morris, Davis, and Davis (2003), in extending TAM into the Unified Theory of Acceptance and Use of Technology (UTAUT), further emphasise that performance expectancy, the belief that a technology will help one attain gains in performance, is among the strongest predictors of technology adoption across educational and organisational settings alike, a proposition consistent with students' own reports that they turn to AI tools chiefly because they expect these tools to help them understand Economics better and perform well in assessments.

The study is further complemented by Vygotsky's (1978) sociocultural theory of learning, particularly the concept of the More Knowledgeable Other (MKO) within the Zone of Proximal Development (ZPD). Vygotsky (1978) argued that learners are able to accomplish tasks beyond their independent capability when guided by a more knowledgeable other, whether a teacher, a peer, or, in the contemporary context, an AI-based conversational agent capable of scaffolding a learner's understanding through explanation, prompting, and feedback. Viewed through this lens, AI tools can be understood as a novel form of the More Knowledgeable Other, one that is available to students beyond the confines of the classroom and the constraints of the school timetable. At the same time, Vygotsky's framework cautions that scaffolding is only developmentally productive when it is gradually withdrawn as the learner internalises the concept; a failure of this withdrawal, that is, a persistent reliance on the AI tool without a corresponding growth in independent understanding, corresponds conceptually to the over-dependence that several studies caution against (Oates & Johnson, 2025).

2.3 Empirical Review

2.3.1 Empirical Studies on the Positive Effects of AI Tools on Academic Performance

A substantial and growing body of empirical research supports the proposition that AI tools can positively influence students' academic performance. Dong, Tang, and Wang (2025), in a meta-analysis of studies examining generative AI tool use and academic achievement, reported an overall positive effect of AI use on students' measured achievement, moderated by factors such as educational level, subject area, and the specific instructional role that the AI tool played in the learning process. In a related second-order meta-analysis, Ünal, Kaya, Uzun, and Erdem (2026) similarly confirmed a positive overall effect of AI applications on both academic achievement and higher-order thinking skills across a wide range of primary studies, lending further weight to the view that, in aggregate, AI integration tends to benefit learners.

At the level of individual empirical studies, Alneyadi and Wardat (2023) found that the use of ChatGPT in teaching an electromagnetism unit to eleventh-grade students in the United Arab Emirates was associated with a marked improvement in students' achievement scores compared with conventional instruction alone. Similarly, Azamatova, Bekeyeva, Zhaxylikova, Sarbassova, and Ilyassova (2023), studying the integration of AI-based digital tools within a project-based learning framework for foreign language instruction, reported improvements in both students' success and their motivation to learn.

Focusing specifically on secondary school populations, Samo, Shah, and Ramsha (2025) examined the effect of AI-based learning tools on the academic performance of secondary school students in Shaheed Benazirabad and found that students who used AI-based learning tools recorded significantly better academic performance than those who relied solely on traditional methods of study. Wu and Zhang (2025), surveying five hundred students across grades seven to twelve, similarly found that generative AI applications had a substantial positive effect on students' innovation capability and digital literacy, competencies that are closely intertwined with the kind of independent, higher-order reasoning that strong academic performance in Economics requires.

Sanghvi (2025), reporting on classroom-based observations of AI integration in secondary schools, noted that teachers observed improvements in students' presentations and academic performance, alongside gains in the retention of concepts over time, with students able to recall material taught through AI-supported methods several months after initial instruction. Within the specific domain of Economics, Salifu et al. (2024) found that Ghanaian economics students' behavioural intentions and actual use of ChatGPT were positively predicted by their perceived trust in the tool, their social influence networks, and, most strongly, the hedonic motivation or enjoyment they derived from the interaction, all of which fed into their broader engagement with course material.

2.3.2 Empirical Studies on the Challenges of AI Tool Use

Notwithstanding the largely favourable findings reviewed above, a parallel and equally substantial stream of literature draws attention to the risks and challenges associated with AI tool use in education. Chief among these concerns is the phenomenon of over-reliance, whereby students come to depend on AI-generated responses to the point that their own capacity for independent reasoning, critical evaluation, and problem-solving is diminished rather than enhanced (Oates & Johnson, 2025). Systematic reviews of over-reliance on AI dialogue systems have found that excessive dependence on such tools is associated with a reduced ability among students to analyse information, construct logical arguments, and integrate knowledge from multiple sources, competencies that are central to sound performance in a subject such as Economics that demands both theoretical and applied reasoning.

Closely related to the concern about over-dependence is the issue of academic integrity. Because AI tools can generate complete, coherent responses to assignment prompts within seconds, some students may be tempted to submit AI-generated work as their own, thereby circumventing the very learning process that assignments are designed to promote (Adams, Pente, Lemermeyer, & Rockwell, 2023). Zhai and Ma (2023), in a systematic review of ChatGPT's role in reshaping teaching and learning, observed that while the tool offers considerable pedagogical promise, its unregulated use raises legitimate concerns about diminished original thinking and a blurring of the boundary between assisted learning and academic dishonesty.

A further well-documented concern relates to the accuracy and reliability of AI-generated content. Generative AI systems, being probabilistic language models rather than verified knowledge repositories, can produce responses that are fluent and persuasive in tone but factually incorrect, a phenomenon commonly referred to as hallucination (Akgun & Greenhow, 2022). For a subject such as Economics, where precise

definitions, correctly labelled diagrams, and accurate numerical computations are essential, the uncritical acceptance of an AI-generated explanation that happens to be flawed could entrench rather than correct a student's misconception. This underscores the importance of students developing the habit of verifying AI-generated information against textbooks, teachers, or other reliable sources before incorporating it into their study, a practice that was itself measured as one of the survey items in the present study.

Chan and Hu (2023) further note that students themselves are often aware of these risks, expressing a nuanced, rather than uncritical, attitude toward generative AI, valuing its convenience and immediacy while simultaneously voicing concern about its potential to be misused or to mislead. This suggests that the relationship between AI tool use and academic performance is unlikely to be uniformly positive or negative, but is instead contingent on the manner, frequency, and purpose with which students engage with the tools, a nuance that the present study's dual measurement of perceived positive effects and perceived challenges is specifically designed to capture.

2.3.3 Demographic and Contextual Moderators

A number of studies have also explored how demographic and contextual factors moderate the relationship between AI tool use and academic outcomes. Differences by sex have been documented in several strands of educational technology research, although findings remain mixed, with some studies reporting no meaningful difference in outcomes between male and female students and others finding modest but statistically significant differences favouring one sex over the other, often attributable to differences in study habits, confidence, or patterns of technology use rather than any inherent difference in ability (Rajeswari & Madhusudan, 2022).

Similarly, comparisons between public and private school students have featured prominently in the broader literature on educational technology access, given that private institutions are often, though not universally, better resourced in terms of internet connectivity, devices, and technical support (Cardona, Rodriguez, & Ishmael, 2023). Such disparities in access could, in principle, translate into differences in the frequency and quality of AI tool engagement, and consequently into differences in academic performance, making school type a variable worthy of empirical scrutiny within the present study's context.

2.4 Summary of Literature and Research Gap

The literature reviewed in this section reveals a consistent, if not entirely uniform, pattern: AI tools, when perceived as useful and used purposefully, are associated with improvements in students' academic performance across a range of subjects and educational levels (Dong et al., 2025; Ünal et al., 2026; Wu & Zhang, 2025). At the same time, a substantial body of evidence cautions that unregulated or excessive use of these same tools carries genuine risks, including over-dependence, diminished critical thinking, and exposure to inaccurate information (Oates & Johnson, 2025; Zhai & Ma, 2023).

What remains comparatively underexplored, however, is the simultaneous empirical examination of both the positive and negative dimensions of AI tool use, specifically among Senior Secondary School students studying Economics, using a quantitative design that directly relates students' perceptions to a measured indicator of academic performance. Much of the existing literature on economics-specific AI use, such as the study by Salifu et al. (2024), has focused on higher education populations in different national contexts, leaving a clear gap with respect to Senior Secondary School Economics learners. The present study addresses this gap by simultaneously measuring students' perceived positive effects of AI tools, their perceived challenges, and their actual academic performance scores, within a single integrated survey of five hundred respondents, thereby providing a more holistic empirical account of how AI tools relate to Economics achievement at the senior secondary level.

3. MATERIALS AND METHODS

3.1 Research Design

This study adopted a descriptive survey research design of the correlational type. The descriptive survey design was considered appropriate because the study sought to describe existing patterns of AI tool access, use, and perception among Senior Secondary School Economics students as they naturally occur, without any experimental manipulation of the variables under investigation. The correlational component of the design enabled the examination of the strength and direction of the relationships between students' perceptions of AI tools (both positive effects and challenges) and their academic performance in Economics, as well as tests for significant differences in performance across selected demographic and usage-based subgroups.

3.2 Study Area

The study was conducted in Kaduna Metropolis, the administrative and commercial nerve centre of Kaduna State, located in the North-West geopolitical zone of Nigeria. Kaduna Metropolis was purposively selected as the study area because it hosts a large and diverse population of Senior Secondary Schools, spanning both public (government-owned) and private institutions, situated within a comparatively small geographic radius, a feature that facilitated efficient data collection across school types while holding broader state-level and regional infrastructural factors reasonably constant. In line with standard research ethics governing studies involving minors in Nigerian secondary schools, and consistent with the confidentiality assurances given to participating institutions and their students at the point of obtaining consent, the specific names of the schools that participated in the study are withheld throughout this manuscript and are instead referred to generically as "selected Senior Secondary Schools in Kaduna Metropolis." This practice is consistent with established convention in educational survey research, where withholding institutional identities protects participating schools from reputational or comparative exposure arising from the reporting of performance-related data, and encourages candid, undistorted responses from student respondents.

3.3 Population, Sample, and Sampling Technique

The population of the study comprised all Senior Secondary School students offering Economics as a subject in the selected public and private Senior Secondary Schools within Kaduna Metropolis. This population is characterised by considerable diversity in terms of sex, class level (SS1 to SS3), school type, and degree of access to digital devices and the internet, all of which are factors relevant to the study's objectives.

A total of five hundred (500) Senior Secondary School Economics students constituted the sample for this study. This sample size was considered adequate on several grounds. First, applying the Taro Yamane (1967) formula for sample size determination at a 95% confidence level and a 5% margin of error to the estimated population of Economics students across the selected schools yielded a minimum required sample comfortably below five hundred, so that the achieved sample provided a conservative margin above the statistically indicated minimum and correspondingly narrower confidence intervals around the study's estimates. Second, a sample of this size satisfies the recognised rule-of-thumb minimums for the inferential procedures employed, including multiple linear regression with two predictors, independent-samples t-tests, and one-way ANOVA across five groups, all of which require substantially fewer than five hundred cases to achieve adequate statistical power at conventional alpha levels; the achieved sample therefore affords considerable statistical power while also allowing sufficient cases within each of the smaller AI-use-frequency subgroups (for example, the "Never" category, n = 30) for meaningful subgroup comparison. Third, a sample of five hundred is consistent with, and comparable in scale to, similar quantitative studies on AI tool use and student achievement in the reviewed literature (for example, Wu & Zhang, 2025, who surveyed five hundred students across grades seven to twelve), supporting the comparability of the present findings with existing evidence.

Respondents were drawn using a combination of stratified and simple random sampling techniques. The stratified approach was adopted, in preference to simple random sampling alone, because it guaranteed proportionate representation of the key subgroups relevant to the study's hypotheses, namely school type (public and private) and class level (SS1, SS2, and SS3); a purely random draw from the pooled population could, by chance, have under-represented one school type or class level, thereby weakening the validity of the planned between-group comparisons (Hypotheses 3 and 4 in particular). Strata were therefore defined by school type and class level, and, within each stratum, respondents were selected at random from among consenting students, so that every eligible student within a given stratum had an equal probability of selection. This combination of techniques accordingly balanced the need for representativeness across the strata that the study's hypotheses required with the need for an unbiased, non-purposive method of selecting individual respondents within each stratum. The final achieved sample comprised 262 (52.4%) female and 238 (47.6%) male respondents, with an age range of 14 to 19 years and a mean age of approximately 16.3 years, distributed across SS1 (155 students, 31.0%), SS2 (193 students, 38.6%), and SS3 (152 students, 30.4%). In terms of school type, 287 (57.4%) respondents attended public schools while 213 (42.6%) attended private schools.

3.4 Instrumentation

Data for the study were collected using a structured questionnaire titled the "Artificial Intelligence Tools and Economics Academic Performance Questionnaire." The instrument was divided into three main sections. Section A elicited demographic information, including sex, age, class, school type, access to AI tools,

frequency of AI tool use, and the primary AI tool used by the respondent (with response options including ChatGPT, Google Gemini, QuillBot, Microsoft Copilot, and an open "Other" category).

Section B contained fifteen items measured on a five-point Likert scale (Strongly Disagree = 1 to Strongly Agree = 5), further divided into two sub-scales. The first sub-scale, comprising eleven items (labelled AI1 to AI11), measured students' perceptions of the positive effects of AI tools on their learning of Economics, covering dimensions such as understanding of concepts, ease of learning, provision of quick explanations, support with assignments, study efficiency, interest in the subject, examination preparation, problem-solving, retention of concepts, and encouragement of independent learning. The second sub-scale, comprising four items (labelled AI12 to AI15), measured students' perceptions of the challenges associated with AI tool use, including the risk of over-dependence, reduction in personal effort, the possibility of AI tools producing inaccurate information, and the extent to which students verified AI-generated information before using it.

Section C recorded each respondent's academic performance in Economics, expressed as a percentage score derived from the student's most recent continuous assessment and examination records. Composite mean scores for the positive-effect sub-scale (AI_Positive_Effect_Mean) and the challenges sub-scale (AI_Challenges_Mean) were computed for each respondent by averaging their responses across the respective sets of items.

3.5 Validity and Reliability of the Instrument

The face and content validity of the questionnaire were established through expert review, in which the instrument was scrutinised by specialists in Economics education and educational measurement to ensure that the items adequately captured the constructs of interest and were phrased in a manner appropriate for Senior Secondary School respondents. Adjustments were made to item wording based on the reviewers' recommendations prior to administration.

The internal consistency reliability of the positive-effect sub-scale was assessed using Cronbach's alpha, yielding a coefficient of 0.87, which indicates a high level of internal consistency and suggests that the eleven items reliably measured a coherent underlying construct, namely students' perceived positive effect of AI tools. The four-item challenges sub-scale yielded a comparatively low Cronbach's alpha of 0.16, indicating that, unlike the positive-effect items, the challenge-related items (over-dependence, reduced effort, inaccuracy, and information verification) do not form a single tightly unified construct, a finding that is unsurprising given that the sub-scale intentionally combines both a risk item (verification of information) worded in the protective direction with items worded in the risk direction. This distinction is addressed in the interpretation of the challenges-related findings in Section 4, where individual item means, in addition to the composite mean, are reported and discussed.

3.6 Procedure for Data Collection

Following the receipt of necessary institutional permissions, questionnaires were administered to consenting Senior Secondary School Economics students across the sampled public and private schools. Respondents were briefed on the purpose of the study and assured of the confidentiality and anonymity of their responses, with participation being entirely voluntary. Where digital administration was used, responses were captured directly into a structured spreadsheet; where paper-based administration was used, responses were subsequently coded and entered into the same electronic format for analysis. All five hundred (500) administered questionnaires were correctly completed and returned, yielding a response rate of 100 percent for the achieved sample.

3.7 Method of Data Analysis

Data collected were analysed using descriptive and inferential statistical techniques with the aid of Python's statistical and data-analysis libraries (pandas, NumPy, and SciPy). Descriptive statistics, including frequency counts, percentages, means, and standard deviations, were used to address the demographic profile of respondents, their level of AI tool access and use, and their perceptions of the positive effects and challenges of AI tools.

Pearson product-moment correlation coefficient (r) was computed to examine the relationship between students' perceived positive effect of AI tools, their perceived challenges, and their academic performance in Economics, testing Hypotheses 1 and 2. Independent-samples t-tests were used to compare mean academic performance scores between male and female students (Hypothesis 3), and between public and private school students (Hypothesis 4). A one-way analysis of variance (ANOVA) was used to compare mean academic performance scores across the five categories of AI tool use frequency (Never, Rarely, Sometimes, Often, Very Often) for Hypothesis 5. In addition, a multiple linear regression analysis was conducted to determine the

combined predictive contribution of students' perceived positive effect and perceived challenges to their academic performance in Economics. All hypotheses were tested at the 0.05 level of significance.

4. RESULTS

This section presents the results of the data collected from five hundred (500) Senior Secondary School Economics students, organised according to the objectives and hypotheses of the study. Results are presented using descriptive statistics (frequencies, percentages, means, and standard deviations), correlation and regression analysis, independent-samples t-tests, and one-way ANOVA, supported by tables and figures.

4.1 Demographic Characteristics of Respondents

Table 1 presents the demographic characteristics of the five hundred respondents who participated in the study, covering sex, class, school type, access to AI tools, frequency of AI tool use, and the primary AI tool used.

Variable	Category	Frequency (n)	Percentage (%)
Sex	Male	238	47.6
	Female	262	52.4
Class	SS1	155	31.0
	SS2	193	38.6
	SS3	152	30.4
School Type	Public	287	57.4
	Private	213	42.6
AI Access	Yes	418	83.6
	No	82	16.4
AI Use Frequency	Never	30	6.0
	Rarely	107	21.4
	Sometimes	173	34.6
	Often	127	25.4
	Very Often	63	12.6
Primary AI Tool	ChatGPT	253	50.6
	Google Gemini	97	19.4
	QuillBot	67	13.4
	Microsoft Copilot	47	9.4
	Other	36	7.2
Total	—	500	100.0

Table 1. Demographic Characteristics of Respondents (N = 500).

As shown in Table 1, the sample was fairly evenly distributed by sex, with a slightly higher proportion of female respondents (52.4%) compared to male respondents (47.6%). Respondents' ages ranged from 14 to 19 years, with a mean age of approximately 16.3 years (SD = 1.25), consistent with the expected age range for Senior Secondary School students. In terms of class distribution, SS2 students constituted the largest group (38.6%), followed by SS1 (31.0%) and SS3 (30.4%), reflecting a reasonably balanced spread across the three senior secondary class levels.

With respect to school type, a majority of respondents (57.4%) attended public schools, while 42.6% attended private schools. Notably, the overwhelming majority of respondents (83.6%) reported having access to AI tools, with only 16.4% indicating no access, underscoring the extent to which AI technologies have permeated the secondary school student population even in a developing educational context. Figure 1 illustrates the distribution of respondents according to their frequency of AI tool use.

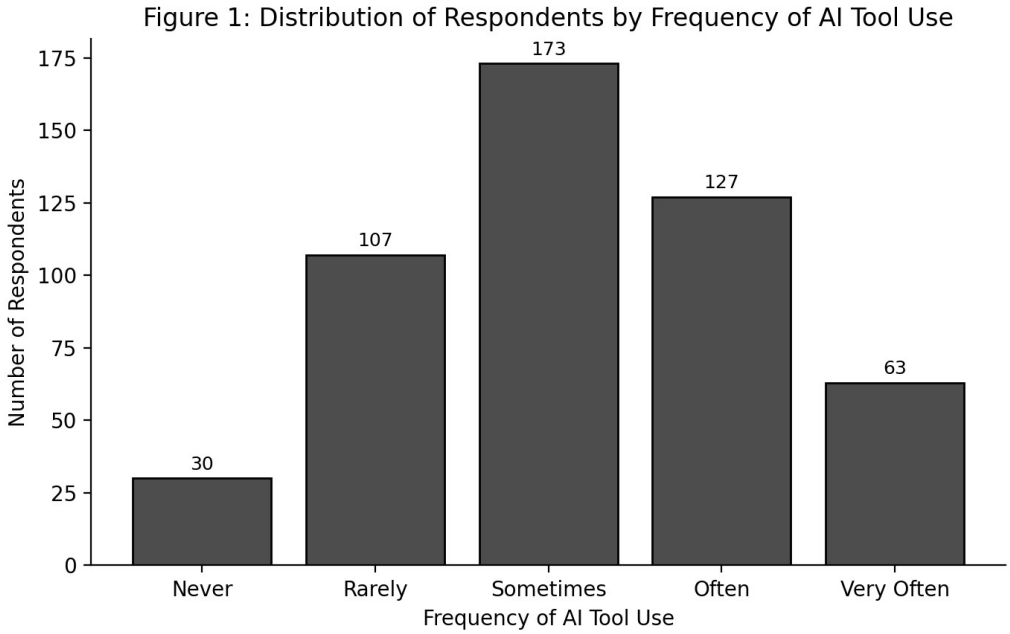

Figure 1. Distribution of Respondents by Frequency of AI Tool Use.

As Figure 1 shows, the modal category of use was "Sometimes" (34.6% of respondents), followed by "Often" (25.4%), "Rarely" (21.4%), "Very Often" (12.6%), and "Never" (6.0%). This distribution suggests that while a small minority of students remain entirely disengaged from AI tools, the majority of respondents engage with such tools at least occasionally, with a substantial proportion (38.0% combined) reporting frequent or very frequent use.

Figure 2 presents the distribution of respondents by their primary AI tool of choice. ChatGPT emerged as the dominant tool, used by exactly half of the respondents (50.6%), followed at a considerable distance by Google Gemini (19.4%), QuillBot (13.4%), Microsoft Copilot (9.4%), and other tools (7.2%).

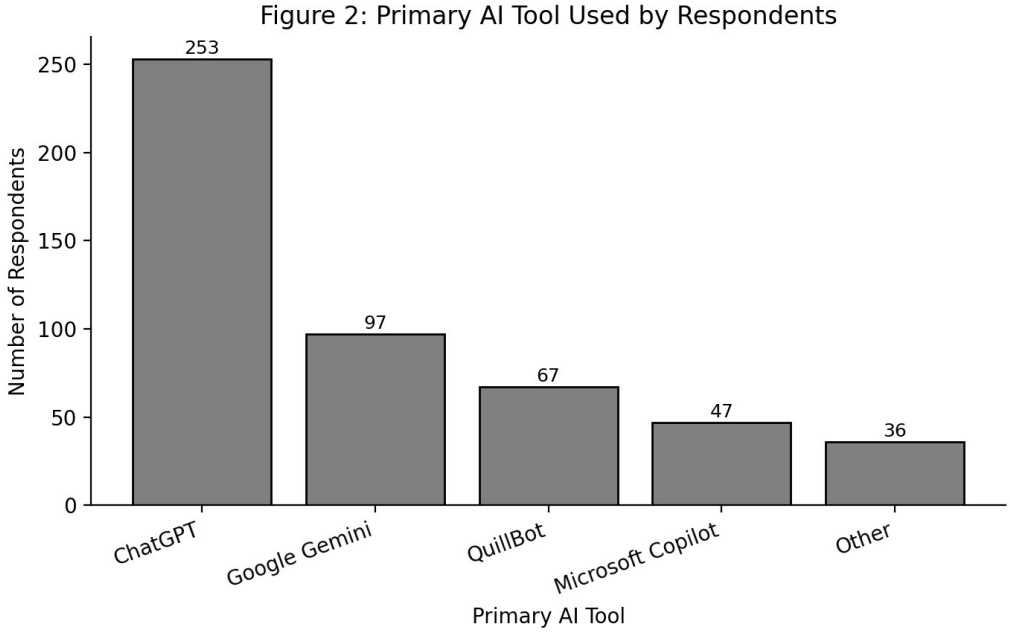

Figure 2. Primary AI Tool Used by Respondents.

This pattern mirrors global trends in which ChatGPT has become virtually synonymous with generative AI in the popular imagination, and suggests that any policy or pedagogical response to AI use in Economics classrooms must, at a minimum, take account of ChatGPT as the platform of primary relevance to the majority of students.

4.2 Perceptions of Positive Effects and Challenges of AI Tools

Table 2 presents the mean scores and standard deviations for the eleven items measuring students' perceptions of the positive effects of AI tools, alongside the overall composite mean.

Item	Statement	Mean	SD	Remark
AI1	AI tools help me understand Economics	2.96	1.07	Agreed
AI2	AI tools improve my Economics learning	3.08	1.06	Agreed
AI3	AI tools make Economics less difficult	2.96	1.07	Agreed
AI4	AI tools provide quick explanations	3.15	1.11	Agreed
AI5	AI tools help with Economics assignments	3.05	1.10	Agreed
AI6	AI tools improve my study efficiency	3.02	1.12	Agreed
AI7	AI tools increase my interest in Economics	2.98	1.10	Agreed
AI8	AI tools help me prepare for examinations	3.02	1.10	Agreed
AI9	AI tools improve my problem-solving	3.00	1.07	Agreed
AI10	AI tools improve retention of Economics concepts	2.97	1.06	Agreed
AI11	AI tools encourage independent learning	2.94	1.09	Agreed
	Overall Positive Effect Mean	3.01	0.72	Agreed

Table 2. Mean and Standard Deviation of Responses on Perceived Positive Effects of AI Tools.

As shown in Table 2, all eleven items relating to the perceived positive effects of AI tools recorded mean scores clustering closely around the midpoint of the five-point scale, ranging from a low of 2.94 (AI tools encourage independent learning) to a high of 3.15 (AI tools provide quick explanations). The overall composite mean for the positive-effect sub-scale was 3.01 (SD = 0.72), indicating that, on average, respondents held a moderately positive, rather than strongly positive or negative, view of the benefits AI tools confer on their study of Economics.

The item with the highest mean score, "AI tools provide quick explanations" (M = 3.15), suggests that the immediacy of AI-generated responses is the most strongly endorsed benefit among respondents, a finding consistent with Chan and Hu's (2023) observation that students particularly value the instantaneous feedback that generative AI tools provide relative to the delays inherent in traditional classroom instruction. Conversely, the item with the lowest mean score, "AI tools encourage independent learning" (M = 2.94), suggests a degree of ambivalence among students as to whether AI tool use genuinely fosters self-directed learning or, alternatively, risks substituting for it, an ambivalence that resonates with the theoretical caution, drawn from Vygotsky's (1978) sociocultural framework, that scaffolding must eventually be withdrawn for genuine independent competence to develop.

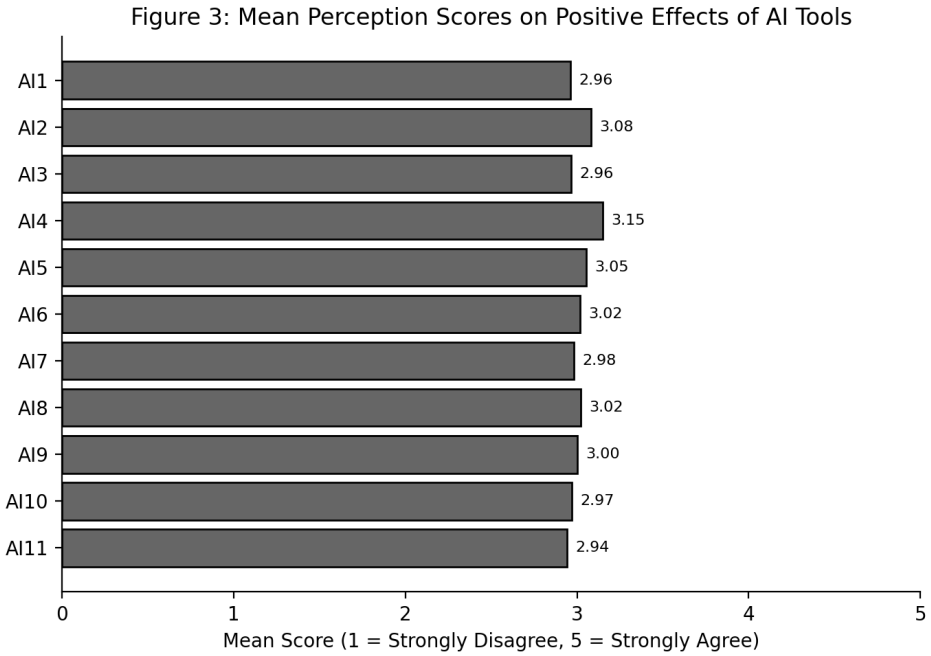

Figure 3. Mean Perception Scores on Positive Effects of AI Tools.

With respect to students' perceptions of the challenges associated with AI tool use, the mean scores and standard deviations for the four challenge-related items were as follows: "AI tools can lead to over-dependence" (M = 3.05, SD = 0.86); "AI tools can reduce personal effort" (M = 2.97, SD = 0.89); "AI tools can produce inaccurate information" (M = 3.01, SD = 0.95); and "I verify AI information before using it" (M = 3.01, SD = 0.85). The overall composite mean for the challenges sub-scale was 3.01 (SD = 0.53).

These results indicate that respondents, on average, expressed a moderate level of concern regarding the risk of over-dependence and the possibility of inaccurate AI-generated information, findings that align closely with the concerns raised by Oates and Johnson (2025) and Akgun and Greenhow (2022) regarding the double-edged nature of generative AI use in educational settings. Encouragingly, the mean score for the item measuring the extent to which students verify AI-generated information before using it (M = 3.01) suggests that a substantial proportion of respondents already exercise a degree of critical caution in their use of these tools, rather than accepting AI output uncritically, although the moderate rather than high mean score also indicates considerable room for improvement in this practice through deliberate instruction in AI literacy and information-verification skills.

4.3 Relationship Between Perceptions and Academic Performance

Figure 4 presents a scatter plot of the relationship between students' perceived positive effect of AI tools and their academic performance, with a fitted linear trend line.

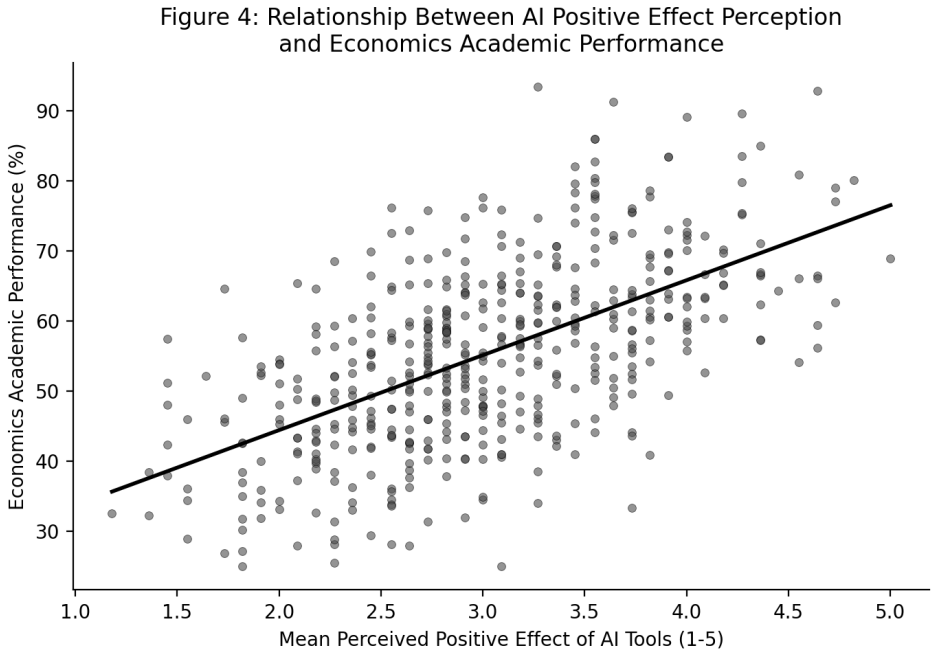

Figure 4. Relationship Between AI Positive Effect Perception and Economics Academic Performance.

As Figure 4 illustrates, there is a clear positive association between students' perceived positive effect of AI tools and their academic performance in Economics: students who reported more favourable perceptions of AI tools' usefulness tended, on average, to record higher academic performance scores. This visual pattern is confirmed by the Pearson correlation analysis reported under Hypothesis 1 below, which yielded a strong, statistically significant positive correlation. By contrast, the relationship between perceived challenges and academic performance, while also statistically significant, was considerably weaker in magnitude, indicating that students' concerns about the risks of AI tool use bear a much less pronounced association with their measured performance than do their perceptions of AI's benefits.

4.4 Hypotheses Testing

This subsection presents the results of the statistical tests conducted to examine the five hypotheses formulated for this study, all tested at the 0.05 level of significance. A summary of the results is presented in Table 3.

Hyp.	Statistical Test	Statistic	p-value	Decision
H01	Pearson r: Positive effect ↔ Performance	r = 0.590	p < .001	Rejected
H02	Pearson r: Challenges ↔ Performance	r = 0.121	p = .007	Rejected
H03	Independent t-test: Male vs Female	t(498) = -2.23	p = .026	Rejected
H04	Independent t-test: Public vs Private	t(498) = -1.57	p = .118	Not Rejected
H05	One-way ANOVA: AI use frequency groups	F(4,495) = 97.52	p < .001	Rejected

Table 3. Summary of Hypotheses Testing.

Hypothesis 1

Hypothesis 1 stated that there is no statistically significant relationship between students' perceived positive effect of AI tools and their academic performance in Economics. The Pearson correlation analysis yielded a coefficient of r = 0.590 (p < .001, n = 500), indicating a moderately strong, positive, and statistically significant relationship between the two variables. The null hypothesis is therefore rejected. This finding indicates that students who perceive AI tools as more beneficial to their learning of Economics tend to achieve higher academic performance scores, a result consistent with the meta-analytic evidence reported by Dong, Tang, and Wang (2025) and Ünal, Kaya, Uzun, and Erdem (2026), both of which found an overall positive relationship between AI tool engagement and academic achievement across varied educational contexts.

Hypothesis 2

Hypothesis 2 stated that there is no statistically significant relationship between students' perceived challenges of AI tool use and their academic performance in Economics. The Pearson correlation analysis yielded a coefficient of r = 0.121 (p = .007, n = 500). Although this correlation is statistically significant given the large sample size, its magnitude is weak, indicating that students' perceptions of the challenges associated with AI tools (over-dependence, reduced effort, and inaccuracy) bear only a marginal, and in this case slightly positive rather than negative, association with their academic performance. The null hypothesis is therefore rejected, though the practical significance of this weak relationship should be interpreted with caution. One plausible explanation for the small positive coefficient is that the challenges sub-scale includes a protective item (verification of AI information before use) alongside genuinely risk-oriented items, such that students who are more engaged and reflective about AI use, and therefore also more likely to verify information, may score moderately on this composite measure while still performing comparatively well academically.

Hypothesis 3

Hypothesis 3 stated that there is no statistically significant difference in the academic performance in Economics of male and female students. An independent-samples t-test revealed a statistically significant difference between male students (M = 53.87) and female students (M = 56.47), t(498) = -2.23, p = .026. The null hypothesis is therefore rejected. Female respondents in this sample recorded a modestly, but statistically significantly, higher mean academic performance in Economics than their male counterparts. This finding should be interpreted with some caution, as the magnitude of the difference, though statistically significant given the large sample size, is relatively modest in absolute terms (approximately 2.6 percentage points), and is broadly consistent with the mixed findings reported in the wider literature regarding sex differences in technology-mediated academic outcomes (Rajeswari & Madhusudan, 2022).

Hypothesis 4

Hypothesis 4 stated that there is no statistically significant difference in the academic performance in Economics of students in public and private schools. An independent-samples t-test revealed no statistically significant difference between public school students (M = 54.44) and private school students (M = 56.30), t(498) = -1.57, p = .118. The null hypothesis is therefore not rejected. This finding suggests that, within this sample, school type alone does not significantly account for differences in Economics academic performance, a result that may reflect the near-universal access to AI tools across both school types (83.6% overall access), which may have levelled a resource disparity that has historically favoured private school students in other domains of educational technology access (Cardona, Rodriguez, & Ishmael, 2023).

Hypothesis 5

Hypothesis 5 stated that there is no statistically significant difference in the academic performance in Economics of students across the different categories of AI tool use frequency. A one-way ANOVA revealed a statistically significant difference in academic performance across the five frequency categories, F(4, 495) = 97.52, p < .001. The null hypothesis is therefore rejected. Mean academic performance scores rose in a clear, monotonic pattern with increasing frequency of AI tool use: Never (M = 41.23), Rarely (M = 44.97), Sometimes (M = 53.32), Often (M = 62.67), and Very Often (M = 69.58). This dose-response pattern, in which each successive increase in frequency of use is accompanied by a corresponding increase in mean academic performance, provides some of the most compelling evidence in this study for a substantive relationship between AI tool engagement and Economics achievement, and closely mirrors the positive effects reported for regular AI tool users in the study by Samo, Shah, and Ramsha (2025).

Regression Analysis

To further probe the combined predictive contribution of students' perceptions to their academic performance, a multiple linear regression analysis was conducted with academic performance as the dependent variable and perceived positive effect and perceived challenges as predictors. The overall model was statistically significant, F(2, 497) = 134.09, p < .001, and accounted for approximately 35.0% of the variance in academic performance (R^2 = 0.350, Adjusted R^2 = 0.348). Perceived positive effect emerged as a strong, statistically significant predictor (B = 10.60, SE = 0.66, t = 16.03, p < .001), such that a one-point increase in a student's mean positive-effect rating was associated with an estimated 10.6 percentage-point increase in Economics academic performance, holding perceived challenges constant. Perceived challenges, by contrast, was not a statistically significant independent predictor in the combined model once perceived positive effect was accounted for (B = 1.12, SE = 0.90, t = 1.25, p = .212), suggesting that the weak bivariate correlation observed under Hypothesis 2 does not translate into an

independent predictive contribution once the much stronger positive-effect variable is controlled for.

5. DISCUSSION

Taken together, the findings of this study lend strong support to the view that AI tools exert a substantively positive influence on Senior Secondary School students' academic performance in Economics, at least as perceived and reported by the students themselves. The strong positive correlation between perceived positive effect and academic performance (r = 0.590), the substantial variance explained by the regression model (35.0%), and the clear, monotonic rise in mean performance across increasing categories of AI use frequency together constitute converging lines of evidence pointing in the same direction: students who engage more frequently and more favourably with AI tools tend to perform better in Economics.

These findings align closely with the broader international literature reviewed in Section 2. Dong, Tang, and Wang's (2025) meta-analysis and Ünal, Kaya, Uzun, and Erdem's (2026) second-order meta-analysis both concluded that AI tool use is, in aggregate, positively associated with academic achievement, a conclusion strongly echoed by the present study's Nigerian-context, Economics-specific data. The finding that ChatGPT was the overwhelmingly dominant tool of choice (50.6% of respondents) is likewise consistent with Salifu et al.'s (2024) observation of ChatGPT's centrality in economics students' technology-mediated learning experiences, even across markedly different national and institutional settings.

At the same time, the study's findings regarding students' perceptions of AI-related challenges warrant careful interpretation. The moderate mean scores recorded for over-dependence (M = 3.05) and the risk of inaccurate information (M = 3.01) indicate that students are not oblivious to the risks that AI tools pose, echoing the concerns articulated by Oates and Johnson (2025) and Zhai and Ma (2023) regarding the erosion of independent critical thinking and the danger of AI-generated inaccuracies. However, the weak and practically negligible relationship between the challenges composite and academic performance, and its loss of significance once perceived positive effect was controlled for in the regression model, suggests that, within this sample at least, the risks associated with AI use have not yet translated into a measurable academic cost, perhaps because the moderate degree of self-reported information verification (M = 3.01) is functioning as a partially effective safeguard against the more damaging consequences of over-reliance.

The absence of a statistically significant difference in performance between public and private school students is a noteworthy finding, given the historical association between private school attendance and superior access to educational technology in many developing-country contexts (Cardona, Rodriguez, & Ishmael, 2023). This result may reflect the genuinely high overall rate of AI tool access reported across the sample (83.6%), suggesting that, unlike earlier waves of educational technology that required costly institutional infrastructure, generative AI tools, accessible via ordinary smartphones and free-tier applications, may be contributing to a partial levelling of the digital divide between public and private secondary school students, at least with respect to AI access specifically.

Finally, the modest but statistically significant sex difference favouring female respondents invites further investigation beyond the scope of the present study, particularly with respect to whether it reflects differences in study habits, patterns of AI tool engagement, or other unmeasured factors, and should be interpreted with appropriate caution given its relatively small magnitude in absolute percentage-point terms.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study examined the effect of Artificial Intelligence tools on the academic performance of Senior Secondary School students in Economics, using a descriptive

correlational survey design with a sample of five hundred students drawn from public and private schools. The findings revealed that the overwhelming majority of respondents (83.6%) had access to AI tools, with ChatGPT emerging as the dominant platform of choice (50.6%), and that a substantial proportion of students engaged with AI tools frequently or very frequently (38.0% combined). Students expressed moderately positive perceptions of the benefits of AI tools for their learning of Economics, with the provision of quick explanations rated as the most strongly endorsed benefit, and, at the same time, expressed moderate levels of concern regarding the risk of over-dependence and the possibility of encountering inaccurate AI-generated information.

Statistically, the study found a strong, positive, and significant correlation between students' perceived positive effect of AI tools and their academic performance in Economics ($r = 0.590$, $p < .001$), while the correlation between perceived challenges and academic performance, though statistically significant, was weak ($r = 0.121$, $p = .007$) and lost its significance in a combined regression model. A multiple regression analysis showed that perceived positive effect and perceived challenges together accounted for approximately 35.0% of the variance in academic performance, with perceived positive effect standing out as the dominant predictor. Academic performance differed significantly by sex (favouring female students) and across categories of AI use frequency (rising monotonically from Never to Very Often), but did not differ significantly between public and private school students.

On the basis of these findings, the study concludes that Artificial Intelligence tools exert a substantively positive effect on the academic performance of Senior Secondary School students in Economics, particularly where students perceive these tools as genuinely useful and engage with them frequently and purposefully. The evidence gathered in this study is more strongly supportive of the benefits of AI tool integration than of the risks, although the moderate levels of concern expressed by students regarding over-dependence and information accuracy indicate that these risks remain real and warrant deliberate pedagogical attention rather than dismissal. The near-universal access to AI tools recorded across both public and private schools, and the absence of a significant performance gap between these two school types, suggest that AI tools may be playing a quietly equalising role in Senior Secondary Economics education, offering students in less well-resourced public schools a degree of access to explanatory and tutoring support that was previously the preserve of better-funded private institutions. At the same time, the clear, dose-response relationship between frequency of AI use and academic performance underscores the importance of consistent, sustained engagement with these tools, rather than sporadic or superficial use, in realising their full academic benefit.

6.2 Recommendations

Based on the findings and conclusions of this study, the following recommendations are made:

1. Economics teachers should actively explore structured, curriculum-aligned ways of incorporating AI tools, particularly ChatGPT given its dominant usage among students, into classroom instruction, assignments, and revision activities, rather than leaving students to navigate these tools entirely on their own.
2. School authorities should develop clear, formally communicated guidelines on the acceptable use of AI tools for academic purposes, addressing both the encouragement of beneficial use and the mitigation of risks such as over-dependence and academic dishonesty.
3. Curriculum planners and Economics teachers should deliberately teach AI literacy and information-verification skills alongside subject content, given that students' moderate self-reported verification practices suggest room for improvement in this critical safeguard against AI-generated inaccuracies.
4. Given the strong positive relationship between frequency of AI tool use and academic performance observed in this study, schools should consider providing structured opportunities and time, both within and outside the regular timetable, for consistent, supervised engagement with AI tools for Economics revision and assignment support.
5. Given the absence of a significant performance gap between public and private school students in this sample, education authorities should continue to support equitable access to digital devices and internet connectivity across all school types, so that the apparent levelling effect of AI tool access observed in this study can be sustained and strengthened.
6. Parents and guardians should be sensitised to both the benefits and the risks of AI tool use, so that they can provide informed guidance and monitoring of

their children's use of these tools for academic purposes at home.

6.3 Limitations and Suggestions for Further Research

As with any study, the findings reported here should be interpreted in light of certain limitations. First, the study relied on students' self-reported perceptions of AI tool benefits and challenges, which are subject to the usual limitations of self-report data, including social desirability bias and variation in respondents' introspective accuracy. Second, the correlational design of the study does not permit strong causal conclusions to be drawn; while frequent and favourable AI tool use is strongly associated with higher academic performance, it remains possible that academically stronger students are simply more inclined to use, and to perceive benefit from, AI tools, rather than AI tool use being the sole or primary cause of their stronger performance. Third, the low internal consistency reliability recorded for the challenges sub-scale (Cronbach's alpha = 0.16) suggests that this composite measure should be interpreted with caution, and that the individual item-level findings reported in Section 4 provide a more nuanced picture of students' perceptions of AI-related risks than the composite score alone. Fourth, because the study was confined to selected public and private Senior Secondary Schools within Kaduna Metropolis, the findings, while robust within this study area, should be generalised with appropriate caution to Senior Secondary Schools in other metropolitan, semi-urban, or rural settings within and beyond Kaduna State, where patterns of AI tool access and use may differ.

Future studies could build on the present findings by adopting a longitudinal or quasi-experimental design capable of establishing a clearer causal relationship between AI tool use and academic performance in Economics, for example, by tracking the same cohort of students' performance before and after a structured programme of AI-assisted instruction. Future research could also refine the measurement of AI-related challenges by developing and validating a more internally consistent scale, potentially separating over-dependence, reduced effort, information accuracy, and verification behaviour into distinct, independently validated sub-constructs. Further studies could also extend this line of inquiry to other subjects within the Senior Secondary curriculum, and to other regions and school systems, to establish the extent to which the patterns observed in this study generalise beyond the specific context of Economics education examined here.

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