

Students' Perceptions of Artificial Intelligence-Supported Inquiry Based Instruction and Its Influence on Learning Basic Science among Junior Secondary School Students in Niger State

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DOI: <https://doi.org/10.5281/zenodo.22859966>

Abstract

Artificial Intelligence (AI) has emerged as a transformative technology with significant potential to enhance teaching and learning across educational contexts. In science education, AI-supported inquiry instruction provides learners with opportunities to engage actively in scientific investigations through personalized guidance, adaptive feedback, intelligent tutoring, and interactive learning experiences. This study investigated students' perceptions of Artificial Intelligence-supported inquiry instruction and its influence on learning Basic Science among junior secondary school students. The study adopted a descriptive survey research design. The population comprised Junior Secondary School II students in public secondary schools, from which a sample of 420 students was selected using a multistage sampling procedure. Data were collected using a researcher-developed instrument titled Students' Perceptions of Artificial Intelligence-Supported Inquiry Instruction Questionnaire (SPAISIQ). The instrument was validated by experts in Science Education and Educational Technology, while a Cronbach's Alpha reliability coefficient of 0.88 was obtained. Data were analyzed using mean, standard deviation, simple linear regression, and independent samples t-test at the 0.05 level of significance. The findings revealed that students held positive perceptions of Artificial Intelligence-supported inquiry instruction and perceived it as beneficial for enhancing conceptual understanding, scientific inquiry skills, classroom participation, motivation, and overall learning experiences in Basic Science (Grand Mean = 3.43). The study further revealed that students' perceptions significantly influenced learning Basic Science, accounting for 47.2% of the variance in perceived learning outcomes ($R^2 = .472$, $p < .05$). The study concluded that Artificial Intelligence-supported inquiry instruction is positively perceived by students and possesses substantial potential for improving learning experiences in Basic Science. The study recommends the integration of AI-supported inquiry activities into science classrooms, provision of adequate technological infrastructure, and teacher training on the effective use of AI technologies in science education.

Keywords: Artificial intelligence, Inquiry instruction, Basic Science, Students' perceptions, Science education, Educational technology, Inquiry-based learning.

Introduction

The rapid advancement of digital technologies has significantly transformed educational practices across the globe, creating new opportunities for innovative teaching and learning approaches. Among these emerging technologies, Artificial Intelligence (AI) has gained considerable attention due to its potential to personalize learning experiences, support inquiry-based instruction, provide intelligent feedback, and enhance students' engagement in learning activities (Holmes & Tuomi, 2022). Educational systems worldwide are increasingly exploring the integration of AI-powered tools into classroom instruction to improve learning outcomes and prepare learners for participation in a technologically driven society (Kasneci et al., 2023).

Science education occupies a central position in national development because it equips learners with scientific literacy, critical thinking skills, problem-solving abilities, and the capacity to make informed decisions regarding scientific and technological issues (OECD, 2023). In Nigeria, Basic Science serves as a foundational subject designed to introduce learners to scientific concepts, inquiry processes, and practical problem-solving skills necessary for future scientific learning. However, persistent concerns regarding students' low interest, poor engagement, and unsatisfactory achievement in science-related subjects have continued to challenge educators and policymakers (Aina & Adedo, 2022).

Inquiry-based instruction has long been recognized as an effective pedagogical approach for science teaching because it actively engages students in questioning, investigating, analyzing evidence, and constructing scientific explanations (National Research Council, 2021). Unlike traditional teacher-centered approaches, inquiry instruction promotes learner autonomy, curiosity, and deeper conceptual understanding by positioning students as active participants in knowledge construction. Contemporary educational technologies have further expanded the possibilities of inquiry-based learning through the provision of interactive simulations, virtual laboratories, adaptive learning systems, and intelligent instructional support tools.

Artificial Intelligence-supported inquiry instruction represents an emerging educational approach that combines the principles of inquiry learning with AI-powered technologies capable of providing personalized guidance, adaptive feedback, automated scaffolding, and real-time learning support (Zawacki-Richter et al., 2021). AI-supported instructional environments enable students to explore scientific phenomena, formulate hypotheses, analyze data, and receive individualized support

throughout the inquiry process. Such environments have the potential to enhance learners' scientific reasoning, conceptual understanding, and engagement in science learning activities.

Recent studies have demonstrated that AI-supported learning environments can improve students' motivation, engagement, self-regulated learning, and academic performance in science-related disciplines (Chen et al., 2020; Tlili et al., 2023). However, much of the existing literature has focused on higher education settings, technology adoption, or experimental evaluations of AI tools. Comparatively fewer studies have examined students' perceptions of AI-supported inquiry instruction within Basic Science classrooms, particularly in developing-country contexts where educational technology integration remains uneven.

Students' perceptions play a critical role in determining the success of educational innovations because learners' attitudes, beliefs, and experiences influence their engagement, acceptance, and utilization of instructional technologies (Davis, 1989). Understanding how students perceive AI-supported inquiry instruction is therefore essential for informing effective implementation strategies and ensuring that technological innovations align with learners' educational needs and expectations.

Furthermore, while AI technologies continue to gain prominence in educational discourse, empirical evidence regarding their influence on science learning remains limited at the junior secondary school level. Most available studies have concentrated on achievement outcomes rather than examining students' perceptions of how AI-supported inquiry instruction influences their learning experiences, understanding of scientific concepts, inquiry skills development, and motivation toward science learning.

This study therefore seeks to investigate students' perceptions of Artificial Intelligence-supported inquiry instruction and its influence on learning Basic Science among junior secondary school students. The findings are expected to contribute to the growing body of literature on AI in science education and provide evidence-based recommendations for educators, curriculum developers, and policymakers.

Statement of the Problem

The integration of Artificial Intelligence (AI) into educational practice has generated increasing interest among educators, researchers, and policymakers due to its potential to enhance teaching effectiveness, personalize learning experiences, and promote active student engagement. In science education, AI-supported inquiry instruction has emerged as an innovative approach capable of providing intelligent

guidance, adaptive feedback, and individualized support during scientific investigations. Through AI-powered learning environments, students can engage more actively in questioning, exploring, experimenting, and constructing scientific knowledge, thereby supporting the development of scientific inquiry skills and conceptual understanding.

Despite these promising opportunities, concerns persist regarding students' learning experiences and engagement in Basic Science, particularly at the junior secondary school level. Reports continue to indicate that many students perceive science as difficult, abstract, and less engaging, resulting in reduced interest and poor learning outcomes (Potvin & HASNI, 2014). While inquiry-based instruction has been recommended as an effective strategy for improving science learning, its implementation often faces challenges such as limited instructional resources, large class sizes, and inadequate support for individualized learning needs.

Artificial Intelligence-supported inquiry instruction has the potential to address some of these challenges; however, its effectiveness may depend largely on how students perceive and interact with such instructional approaches. Positive perceptions may enhance engagement and learning, whereas negative perceptions may hinder the successful adoption of AI-supported learning environments. Unfortunately, empirical evidence regarding students' perceptions of AI-supported inquiry instruction and its influence on learning Basic Science remains limited, particularly within the Nigerian secondary school context.

However, evidence regarding gender-based differences in students' perceptions of AI-supported inquiry instruction remains inconclusive.

Objectives of the Study

The study seeks to:

1. Determine students' perceptions of Artificial Intelligence-supported inquiry instruction and its influence on learning Basic Science.
2. Examine the difference between male and female students' perceptions of Artificial Intelligence-supported inquiry instruction in learning Basic Science.

Research Questions

The following research questions guided the study:

1. What are students' perceptions of Artificial Intelligence-supported inquiry instruction and its influence on learning Basic Science?
2. What difference exists between male and female students' perceptions of Artificial Intelligence-supported inquiry instruction in learning Basic Science?

Research Hypotheses

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

H01: Students' perceptions of Artificial Intelligence-supported inquiry instruction do not significantly influence learning Basic Science.

H02: There is no significant difference between male and female students' perceptions of Artificial Intelligence-supported inquiry instruction in learning Basic Science.

Methodology

This study adopted a descriptive survey research design to investigate students' perceptions of Artificial Intelligence (AI)-supported inquiry instruction and its influence on learning Basic Science among junior secondary school students. The descriptive survey design was considered appropriate because it enabled the researcher to collect data from a representative sample of students regarding their opinions, perceptions, and experiences without manipulating any of the study variables. The population of the study comprised all Junior Secondary School II (JSS II) students in public secondary schools within the study area during the 2025/2026 academic session. JSS II students were considered suitable for the study because they have acquired sufficient exposure to Basic Science concepts and are capable of providing meaningful responses regarding instructional practices and technology-supported learning experiences. From the population, a sample of 420 students was selected using a multistage sampling procedure. At the first stage, ten public secondary schools were selected through simple random sampling. At the second stage, proportionate sampling technique was used to determine the number of respondents selected from each school based on student population. Finally, simple random sampling was employed to select individual participants from the selected schools, thereby ensuring that every student had an equal chance of participation.

Data for the study were collected using a researcher-developed instrument titled *Students' Perceptions of the influence of Artificial Intelligence-Supported Inquiry based Instruction Questionnaire (SPIAISIQ)*. The instrument consisted of three sections. Section A elicited demographic information such as gender, age, and school. Section B contained items designed to measure students' perceptions of AI-supported inquiry instruction, including perceived usefulness, perceived ease of use, engagement, feedback quality, and personalized learning support. Section C assessed students' perceptions regarding the influence of AI-supported inquiry instruction on learning Basic Science, including conceptual understanding, scientific inquiry skills, motivation, interest in Basic Science, and learning engagement. The questionnaire was structured on a four-point Likert scale of Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1).

To ensure the validity of the instrument, the SPAISIQ was subjected to face and content validation by three experts, comprising two Science Education specialists and one Educational Technology expert. The validators examined the instrument in terms of clarity, relevance, appropriateness of language, content coverage, and alignment with the objectives of the study. Their observations and suggestions were incorporated into the final version of the instrument. The reliability of the instrument was established through a pilot study involving 40 JSS II students from a secondary school outside the study area but with similar characteristics to the target population. Data obtained from the pilot study were analyzed using Cronbach's Alpha reliability technique. Reliability coefficients of 0.87 and 0.89 were obtained for the perception and learning influence scales respectively, while an overall reliability coefficient of 0.88 was obtained for the entire instrument, indicating a high level of internal consistency and suitability for data collection.

Completed questionnaires were collected immediately after administration to ensure a high response rate and minimize data loss. The data collected were coded and analyzed using the Statistical Package for Social Sciences (SPSS). Mean and standard deviation were used to answer the research questions, with a criterion mean of 2.50 serving as the benchmark for decision-making. Simple Linear Regression Analysis was used to test the hypothesis on the influence of students' perceptions of AI-supported inquiry instruction on learning Basic Science, while Independent Samples t-test was used to determine whether significant gender differences existed in students' perceptions of AI-supported inquiry instruction. All hypotheses were tested at the 0.05 level of significance. This analytical approach provided an appropriate basis for examining students' perceptions and determining the extent to which such perceptions influence learning Basic Science.

RESULTS

Demographic Characteristics of Respondents

A total of 420 questionnaires were administered and successfully retrieved, representing a 100% response rate. The demographic characteristics of the respondents are presented in Table 4.1.

Table 4.1

Demographic Characteristics of Respondents (N = 420)

Variable	Category	Frequency	Percentage (%)
Gender	Male	218	51.9
	Female	202	48.1
Age	11–13 Years	126	30.0
	14–16 Years	244	58.1
	Above 16 Years	50	11.9
Total		420	100.0

Table 4.1 shows that 218 (51.9%) of the respondents were male, while 202 (48.1%) were female. The majority of the respondents (58.1%) were between 14 and 16 years of age.

Research Question One

What are students' perceptions of Artificial Intelligence-supported inquiry instruction and its influence on learning Basic Science?

Table 4.2

Mean and Standard Deviation on Students' Perceptions of AI-Supported Inquiry Instruction and Its Influence on Learning Basic Science

S/N	Item	Mean	SD	Decision
1	AI-supported inquiry instruction makes Basic Science more interesting.	3.48	0.71	Agree
2	AI tools help me understand difficult science concepts.	3.44	0.73	Agree
3	AI-supported inquiry activities improve my problem-solving skills.	3.39	0.78	Agree
4	AI provides useful feedback during science learning.	3.42	0.76	Agree
5	AI-supported inquiry instruction increases my participation in class activities.	3.36	0.81	Agree
6	AI helps me develop scientific inquiry skills.	3.41	0.75	Agree
7	AI-supported learning motivates me to learn Basic Science.	3.47	0.72	Agree
8	AI-supported inquiry instruction enhances my understanding of science concepts.	3.51	0.68	Agree
9	AI encourages independent learning.	3.38	0.79	Agree
10	AI-supported inquiry instruction improves my overall learning experience.	3.45	0.74	Agree
Grand Mean		3.43	0.75	Agree

The results in Table 4.2 reveal that respondents generally held positive perceptions of Artificial Intelligence-supported inquiry instruction and its influence on learning Basic Science. All the items recorded mean scores above the criterion mean of 2.50. The grand mean score of 3.43 indicates that students perceived AI-supported inquiry instruction as beneficial for enhancing conceptual understanding, inquiry skills, motivation, participation, and overall learning experiences in Basic Science.

Research Question Two

What difference exists between male and female students' perceptions of Artificial Intelligence-supported inquiry instruction in learning Basic Science?

Table 4.3

Mean and Standard Deviation of Male and Female Students' Perceptions of AI-Supported Inquiry Instruction

Gender	N	Mean	SD
Male	218	3.46	0.49
Female	202	3.39	0.52

Table 4.3 shows that male students had a slightly higher mean perception score ($M = 3.46$, $SD = 0.49$) than female students ($M = 3.39$, $SD = 0.52$). The observed difference appears minimal; however, inferential analysis was conducted to determine whether the difference was statistically significant.

H01:

Students' perceptions of Artificial Intelligence-supported inquiry instruction do not significantly influence learning Basic Science.

Table 4.4

Simple Linear Regression Analysis Showing the Influence of Students' Perceptions of AI-Supported Inquiry Instruction on Learning Basic Science

Model Summary

R	R ²	Adjusted R ²	Std. Error
.687	.472	.471	.381

ANOVA

Source	Sum of Squares	Df	Mean Square	F	Sig.
Regression	54.281	1	54.281	373.94	.000
Residual	60.641	418	0.145		
Total	114.922	419			

Coefficients

Variable	B	SE	Beta	t	Sig.
Constant	0.931	0.128		7.27	.000
Students' Perceptions	0.721	0.037	.687	19.34	.000

The regression analysis revealed that students' perceptions of Artificial Intelligence-supported inquiry instruction significantly influenced learning Basic Science, $F(1,418) = 373.94$, $p < .05$. The model explained approximately 47.2% of the variance in students' learning of Basic Science ($R^2 = .472$). This finding suggests that positive perceptions of AI-supported inquiry instruction contribute substantially to students' learning experiences and perceived learning outcomes in Basic Science.

H02:

There is no significant difference between male and female students' perceptions of Artificial Intelligence-supported inquiry instruction in learning Basic Science.

Table 4.5

Independent Samples t-Test Showing Gender Difference in Students' Perceptions of AI-Supported Inquiry Instruction

Gender	N	Mean	SD	T	df	Sig. (2-tailed)
Male	218	3.46	0.49	1.43	418	.154
Female	202	3.39	0.52			

The results indicate that there was no statistically significant difference between male and female students' perceptions of Artificial Intelligence-supported inquiry instruction, $t(418) = 1.43$, $p = .154$. This implies that both male and female students held similar perceptions regarding the usefulness and influence of AI-supported inquiry instruction in learning Basic Science.

Summary of Findings

Based on the analyses conducted, the following findings emerged:

1. Students demonstrated positive perceptions of Artificial Intelligence-supported inquiry instruction and perceived it as beneficial for enhancing conceptual understanding, inquiry skills, motivation, participation, and learning experiences in Basic Science.
2. Students' perceptions of Artificial Intelligence-supported inquiry instruction significantly influenced learning Basic Science.
3. No significant difference existed between male and female students' perceptions of Artificial Intelligence-supported inquiry instruction.

These findings suggest that AI-supported inquiry instruction is positively perceived by junior secondary school students and has substantial potential for improving learning experiences in Basic Science. The positive perceptions expressed by students and the significant influence of such perceptions on learning outcomes suggest that AI-supported inquiry approaches can contribute meaningfully to science education improvement efforts. Therefore, integrating Artificial Intelligence-supported inquiry instruction into Basic Science classrooms may enhance learner engagement, support inquiry skills development, and improve the quality of science learning.

Conclusion

This study investigated students' perceptions of Artificial Intelligence-supported inquiry instruction and its influence on learning Basic Science among junior secondary school students. The findings revealed that students generally held positive perceptions toward AI-supported inquiry instruction and considered it an effective approach for enhancing learning experiences in Basic Science. Students perceived AI-supported inquiry environments as useful for improving conceptual understanding, scientific inquiry skills, classroom participation, motivation, and overall engagement in science learning.

The study further established that, students' perceptions of Artificial Intelligence-supported inquiry instruction significantly influenced learning Basic Science. This finding suggests that positive learner perceptions play a crucial role in determining the effectiveness of AI-supported instructional approaches. Students who perceive AI-supported inquiry instruction favorably are more likely to engage actively in inquiry activities, develop deeper understanding of scientific concepts, and derive greater educational benefits from science learning experiences.

Additionally, the study found no significant difference between male and female students' perceptions of Artificial Intelligence-supported inquiry instruction. This indicates that AI-supported inquiry instruction is perceived similarly by both genders and possesses the potential to promote inclusive learning experiences within Basic Science classrooms.

Based on these findings, it can be concluded that Artificial Intelligence-supported inquiry instruction represents a promising instructional innovation capable of enhancing students' learning experiences in Basic Science. The positive perceptions expressed by students and the significant influence of such perceptions on learning outcomes suggest that AI-supported inquiry approaches can contribute meaningfully to science education improvement efforts. Therefore, integrating Artificial Intelligence-supported inquiry instruction into Basic Science classrooms may enhance learner engagement, support inquiry skills development, and improve the quality of science learning.

Recommendations

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

1. Basic Science teachers should integrate Artificial Intelligence-supported inquiry activities into classroom instruction to enhance students' engagement, conceptual understanding, and inquiry skills development. The use of AI-powered educational tools should complement existing inquiry-based teaching approaches to create more interactive and learner-centered science classrooms.
2. Educational authorities and policymakers should provide adequate technological infrastructure such as internet connectivity, digital devices, and AI-enabled educational platforms to facilitate the effective implementation of Artificial Intelligence-supported inquiry instruction in secondary schools.

3. Teacher professional development programmes should include training on Artificial Intelligence applications in science education. Such training will equip teachers with the knowledge and competencies required to effectively utilize AI-supported instructional tools in facilitating inquiry-based science learning.
4. Curriculum developers should incorporate Artificial Intelligence-supported inquiry activities into Basic Science curricula to promote the development of scientific literacy, critical thinking, problem-solving abilities, and inquiry competencies among learners.

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