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Impact of Artificial Intelligence Tools on Sentiment, Language Use and Cultural Interpretation among Secondary School Science Students in Makurdi, Benue State, Nigeria

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Abstract

This research investigated the impact of AI-mediated online science education discourse on students' sentiment, language use, and cultural interpretation in Makurdi Local Government Area of Benue State using a descriptive survey design. Three research questions and three hypotheses guided the study. The population of the study consisted of 1,840 senior secondary science students in the study area. The sample comprised of 134 male students and 116 female students totaling 250 students drawn through stratified random sampling technique. A structured five-point scale questionnaire titled AI-Mediated Discourse Impact Questionnaire (AMDIO) which yielded a reliability coefficient of 0.88 through Cronbach's alpha, was used to collect data from respondents. Data obtained were analyzed using mean and standard deviation to answer the research questions while chi-square test was used to test the hypotheses at 0.05 level of significance. The findings revealed that AI-mediated online science education discourse significantly impacted students' sentiment, significantly influenced students' language use patterns in science education, and significantly affected students' cultural interpretation of scientific concepts. It was recommended among others that science educators should integrate AI-mediated discourse platforms that are culturally sensitive and promote positive sentiment in online learning environments. Educational technology developers should design AI systems that recognize and accommodate diverse linguistic patterns and cultural contexts in science education. The Ministry of Education should establish guidelines for implementing AI-mediated discourse tools that enhance rather than compromise students' cultural identity and scientific understanding.

Keywords: AI-Mediated, Students' Sentiment, Language Use, Cultural Interpretation and Online Science Education

Introduction

AI-mediated online science education discourse refers to the interaction, communication, and exchange of scientific ideas facilitated by artificial intelligence technologies in virtual learning environments (Okonkwo & Eze, 2023). This encompasses the use of AI-powered chatbots, intelligent tutoring systems, automated feedback mechanisms, natural language processing tools, and machine learning algorithms that mediate discussions, explanations, and collaborative learning activities in online science education. According to Adebayo (2022), AI-mediated discourse represents a paradigm shift from traditional teacher-student interaction to a technologically enhanced communicative ecosystem where artificial intelligence serves as facilitator, moderator, and sometimes instructor in the learning process. However, what Adebayo's characterization as a "paradigm shift" fails to adequately address is the fundamental power asymmetry inherent in this transformation unlike traditional teacher-student dynamics where cultural negotiation and contextual adaptation occur organically through human empathy and shared social understanding, AI systems operate through predetermined algorithms that often embed Western epistemological frameworks as universal standards. This suggests that the shift is not merely technological but fundamentally epistemological, raising critical questions about whose knowledge systems are privileged in these AI-mediated spaces and what forms of scientific understanding are systematically marginalized or rendered invisible. The integration of AI in online science education has become increasingly prevalent, particularly following the global shift toward digital learning prompted by the COVID-19 pandemic. Igwe and Nnamani (2021) posited that AI-mediated platforms offer unprecedented opportunities for personalized learning, immediate feedback, round-the-clock availability, and scalable educational interventions that can reach students across geographical boundaries. While these technological affordances appear promising on the surface, it is essential to interrogate the assumption that "personalization" and "scalability" are inherently beneficial when divorced from cultural context. The very notion of personalization in AI systems often means algorithmic adaptation to individual learning patterns based on data-driven models that were developed and validated in predominantly Western educational settings. This raises a critical paradox:



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how can a system claim to personalize learning when its foundational architecture is built upon culturally specific assumptions about what constitutes effective pedagogy, appropriate assessment, and valid knowledge? Furthermore, Igwe and Nnamani's emphasis on "scalability" reflects a techno-solutionist ideology that privileges efficiency and reach over depth of cultural responsiveness—a concerning trend when considering that Nigerian students bring diverse linguistic repertoires, indigenous epistemologies, and culturally-embedded ways of knowing that require nuanced, context-sensitive mediation rather than standardized algorithmic responses. Thus, these technological affordances come with complex, and often contradictory, implications for how students experience, interpret, and engage with scientific knowledge in culturally diverse contexts like Nigeria. Student sentiment in the context of AI-mediated learning refers to the emotional dispositions, attitudes, and affective responses that learners develop toward science content, the learning process, and the AI systems themselves (Chukwu, 2020). Sentiment encompasses feelings of confidence, anxiety, engagement, frustration, curiosity, or alienation that emerge during interactions with AI-mediated educational platforms. Research suggests that student sentiment significantly influences learning outcomes, with positive sentiment correlating with higher engagement, persistence, and achievement, while negative sentiment can lead to disengagement and poor performance (Okoli & Mbah, 2019). What remains underexplored in both Chukwu's and Okoli and Mbah's frameworks, however, is the cultural specificity of sentiment formation itself. The assumption that sentiment can be measured and interpreted using universal affective categories overlooks the reality that emotional responses to learning are culturally constructed and contextually situated. For Nigerian students, negative sentiment toward AI-mediated learning may not merely reflect individual psychological states but could signify a deeper cultural dissonance a sense that the AI system neither recognizes nor values their ways of knowing, communicating, or being. This cultural dimension of sentiment formation is particularly salient when considering that AI systems often lack the cultural competence to interpret non-verbal cues, context-dependent communication, and culturally specific expressions of confusion, interest, or disagreement. The nature of AI-mediated discourse, including its responsiveness, cultural appropriateness, and perceived authenticity, plays a critical role in shaping these emotional dimensions of learning, yet current measurement frameworks tend to reduce these complex sociocultural phenomena to decontextualized affective states.

Language use in AI-mediated science education encompasses both the linguistic patterns students employ when interacting with AI systems and the language characteristics of AI-generated responses (Ejiofor, 2021). This includes vocabulary choices, sentence complexity, use of scientific terminology, code-switching between English and indigenous languages, formality levels, and communication strategies. According to Ugwu and Okeke (2020), AI systems trained predominantly on Western English-language datasets may not adequately recognize or respond to the linguistic diversity characteristic of Nigerian students, who often engage in multilingual practices, employ local idioms, and construct scientific explanations through culturally-grounded linguistic frameworks. While Ugwu and Okeke identify this linguistic mismatch as creating "barriers to effective communication and knowledge construction," their analysis stops short of interrogating the deeper ideological implications of this phenomenon. The issue extends beyond technical recognition problems to encompass a form of linguistic imperialism embedded in AI architecture. When Nigerian students code-switch between English, Tiv, Idoma, Iggede or other indigenous languages a natural multilingual practice that reflects their cognitive flexibility and cultural identity AI systems trained on monolingual English datasets effectively punish this linguistic richness through non-recognition, misinterpretation, or demands for linguistic conformity. This creates a coercive linguistic environment where students must choose between authentic self-expression and system intelligibility, between their cultural-linguistic identity and algorithmic validation. Moreover, Ejiofor's focus on "linguistic patterns" risks reducing language to mere technical features while ignoring that language carries worldviews, epistemologies, and ways of reasoning about natural phenomena. When students are forced to suppress code-switching or abandon indigenous metaphors for scientific explanation, they are not simply adapting their communication style they are being systematically alienated from culturally-embedded modes of scientific thinking. This linguistic mismatch thus represents not merely a communication barrier but a mechanism of epistemological violence that marginalizes indigenous knowledge systems and validates only those forms of expression deemed "correct" by Western-trained algorithms. Cultural interpretation of scientific concepts refers to the process by which students make sense of scientific knowledge through the lens of their cultural backgrounds, indigenous knowledge systems, worldviews, and lived experiences (Musa & Ibrahim, 2022). Science, despite its claims to universality, is often taught and mediated through cultural frameworks that may align with or contradict students' existing



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understandings. In the Nigerian context, students bring rich indigenous knowledge about natural phenomena, health practices, agricultural systems, and environmental relationships that may complement, challenge, or be dismissed by formal scientific education. When AI systems mediate this knowledge construction process, questions arise about whose cultural perspectives are embedded in the algorithms, what forms of knowledge are validated or marginalized, and how students negotiate between scientific explanations and their cultural worldviews (Adekunle, 2019). Musa and Ibrahim's framing of cultural interpretation as a neutral "process" obscures the inherently political nature of knowledge validation in AI-mediated environments. The critical issue is not simply whether students' indigenous knowledge "complements, challenges, or is dismissed" by formal science, but rather how AI systems function as gatekeepers that determine which forms of knowledge count as legitimate scientific understanding. For instance, when a Nigerian student explains plant growth by integrating Western biochemical concepts with indigenous ecological wisdom about seasonal patterns and ancestral agricultural practices, an AI system trained exclusively on Western scientific discourse may flag this hybrid explanation as incorrect, confused, or irrelevant. This algorithmic adjudication of knowledge validity represents a form of epistemic injustice that systematically devalues non-Western knowledge systems. Furthermore, Adekunle's questions about "whose cultural perspectives are embedded in algorithms" point to a more troubling reality: AI systems do not merely reflect neutral scientific facts but encode specific cultural assumptions about what science is, how it should be communicated, and what counts as valid evidence. The algorithms embody Western Enlightenment values of objectivity, reductionism, and mechanistic explanation while marginalizing holistic, relational, and spiritually-informed ways of understanding natural phenomena that characterize many African epistemologies. This creates a coercive epistemic environment where Nigerian students must either assimilate to Western scientific frameworks or face systematic invalidation of their cultural ways of knowing, a choice that amounts to intellectual colonization rather than genuine education.

Research evidence suggests that AI-mediated educational technologies are not culturally neutral but carry implicit biases, assumptions, and perspectives from their developers and training data (Oladele & Akinyemi, 2021). When students from diverse cultural backgrounds interact with AI systems designed primarily for Western educational contexts, several issues emerge including cultural insensitivity in examples and explanations, failure to recognize indigenous knowledge contributions, communication styles that feel impersonal or inappropriate, and pedagogical approaches that conflict with local educational values. While Oladele and Akinyemi correctly identify that AI systems "are not culturally neutral," their enumeration of "issues" risks normalizing these problems as mere implementation challenges rather than recognizing them as symptoms of a fundamentally flawed paradigm. The deeper problem is not that AI systems occasionally exhibit "cultural insensitivity" or "fail to recognize indigenous knowledge"—these failures are not bugs but features of systems designed within and for Western epistemological frameworks. The training data that shapes AI behavior overwhelmingly represents Western cultural contexts, predominantly features English language interactions, and encodes assumptions about learner psychology, pedagogical effectiveness, and knowledge structure derived from Euro-American educational research. Consequently, when Nigerian students encounter these systems, they are not experiencing a culturally-neutral technology with minor localization issues but rather a fundamentally Western artifact that was never designed to recognize, validate, or respond appropriately to their cultural reality. The "impersonal or inappropriate" communication styles that Oladele and Akinyemi mention reflect deeper cultural disconnects around concepts of respect, authority, communal learning, and the social nature of knowledge construction all of which are embedded in how AI systems structure interactions. These cultural disconnects do not merely "affect students' sentiment toward learning, constrain their natural language use, and complicate their interpretation of scientific concepts"; rather, they constitute a form of technological colonialism that systematically privileges Western ways of knowing while erasing African epistemological traditions. The result is an educational environment where Nigerian students must continuously negotiate between their authentic cultural identities and the demands of algorithmic systems that were designed with little regard for their existence, let alone their flourishing. In Makurdi Local Government Area of Benue State, the adoption of online science education platforms, many incorporating AI-mediated discourse features, has accelerated in recent years. However, little empirical research has examined how these AI-mediated interactions affect students' emotional engagement with science, shape their linguistic practices in scientific discourse, or influence their cultural interpretation of scientific knowledge. This research gap is particularly troubling given that the uncritical adoption of AI-mediated learning technologies in African contexts risks replicating colonial patterns of



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knowledge imposition, where externally-developed educational tools are deployed without adequate consideration of local epistemologies, linguistic practices, or cultural values. The assumption that technologies developed for Western educational markets can be seamlessly transplanted to Nigerian contexts reflects a form of technological determinism that positions AI as a neutral, universal tool rather than recognizing it as a culturally-embedded artifact that mediates knowledge in culturally-specific ways. Understanding these impacts is thus not merely an academic exercise but a matter of educational justice it is crucial for developing culturally responsive AI-mediated learning environments that enhance rather than hinder science education outcomes for Nigerian students, and more fundamentally, for ensuring that the integration of AI in African education serves to empower rather than further marginalize local knowledge systems, linguistic practices, and cultural identities. This study therefore investigates the impact of AI-mediated online science education discourse on students' sentiment, language use, and cultural interpretation in Makurdi Local Government Area of Benue State, with the explicit aim of foregrounding Nigerian students' experiences and perspectives in conversations about educational technology that have too often centered Western contexts and concerns.

Statement of the Problem

The rapid integration of AI-mediated platforms in online science education has transformed how students engage with scientific knowledge, yet the sociocultural and affective implications of this transformation remain inadequately understood, particularly in Nigerian educational contexts. Observations in Makurdi Local Government Area reveal that while many schools have adopted online learning platforms with AI-enabled features such as automated tutoring, chatbots, and intelligent feedback systems, there is limited awareness of how these technologies shape students' emotional experiences, linguistic behaviors, and cultural meaning-making processes. Preliminary reports suggest that some student's express feelings of disconnection and frustration when interacting with AI systems that fail to understand their communication styles or cultural references, while others appear to modify their natural language use to conform to what they perceive as AI-acceptable discourse patterns. Furthermore, there are concerns that AI-mediated science education, often developed in Western contexts, may inadvertently promote cultural perspectives that conflict with or devalue students' indigenous knowledge systems and local ways of understanding natural phenomena. The extent to which AI-mediated online science education discourse impacts students' sentiment, influences their language use patterns, and affects their cultural interpretation of scientific concepts remains largely unexplored in this context. Against this backdrop, this study investigates the impact of AI-mediated online science education discourse on students' sentiment, language use, and cultural interpretation in Makurdi Local Government Area of Benue State.

Research Questions

The following research questions were put forward to guide this study:

1. What is the impact of AI-mediated online science education discourse on students' mean sentiment scores?
2. What impact does AI-mediated online science education discourse have on students' mean language use pattern ratings?
3. How does AI-mediated online science education discourse affect students' mean cultural interpretation scores?

Hypotheses

These hypotheses were raised and tested at 0.05 level of significance in this study:

1. AI-mediated online science education discourse has no significant impact on students' mean sentiment scores.
2. AI-mediated online science education discourse has no significant impact on students' mean language use pattern scores.
3. AI-mediated online science education discourse has no significant impact on students' mean cultural interpretation scores.

Methodology

This research employed the descriptive survey research design. The population for the study consisted of all senior secondary science students in Makurdi Local Government Area who had experienced AI-mediated online science education, which comprised 1,840 students in the study area. The sample comprised 134 male students and 116 female students totaling 250 students drawn through stratified random sampling technique from ten selected schools. The instrument used for data collection in this study was a structured AI-Mediated Discourse Impact Questionnaire (AMDIQ) for senior secondary science students. The instrument was validated with the help of three lecturers in the Department of Curriculum and Teaching and one expert in Educational Technology, who examined the content and structure of the questionnaire. The validated instrument gave a reliability coefficient of 0.88 through Cronbach's alpha. The instrument was



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divided into two sections (A and B). Section A contained the demographic data, and section B contained 18 items on AI-mediated discourse impact covering sentiment (6 items), language use (6 items), and cultural interpretation (6 items). The researchers used five research assistants in the administration of the questionnaire to the subjects. Mean scores and standard deviation were used to answer the research questions. The chi-square statistic was used to test the hypotheses at 0.05 level of significance. A cut-off mean of 3.00 was established, so that any mean from 3.00 and above is regarded as having significant impact while mean below 3.00 is regarded as having no significant impact. As regards hypotheses testing, if the chi-square statistic value is high at $p < 0.05$ which is the significant level for the study, the hypothesis is rejected implying significant impact; otherwise, it is not rejected.

Presentation of Results

Research Question 1

What is the impact of AI-mediated online science education discourse on students' sentiment?

Table 1: Mean scores and standard deviation of AI-mediated discourse impact on students' sentiment

Item	Mean	SD
AI-mediated interactions make me feel more confident in science	3.42	0.96
I feel engaged when learning science through AI platforms	3.58	0.89
AI discourse makes science learning less intimidating	3.31	1.02
I feel frustrated when AI does not understand my questions	3.67	0.94
AI-mediated learning makes me feel isolated from classmates	3.24	1.08
I enjoy the immediate feedback from AI systems in science	3.71	0.87
Grand Mean	3.49	0.96

Table 1 presents the impact of AI-mediated online science education discourse on students' sentiment. From the table, the grand mean is 3.49. This mean score is more than the cut-off mean which is 3.00 following the decision rule suggested to be adopted earlier, this indicates that AI-mediated online science education discourse has high impact on students' sentiment.

Research Question 2

What impact does AI-mediated online science education discourse have on students' language use patterns?

Table 2: Mean scores and standard deviation on AI-mediated discourse impact on students' language use

Item	Mean	SD
I modify my language to make AI systems understand me better	3.76	0.91
AI discourse encourages me to use more formal scientific terms	3.64	0.88
I avoid using local language expressions when interacting with AI	3.82	0.85
AI platforms help me improve my scientific vocabulary	3.55	0.93
I simplify my questions to get better AI responses	3.68	0.89
AI interaction limits my natural way of expressing ideas	3.38	1.01
Grand Mean	3.64	0.91



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Table 2 presents the impact of AI-mediated online science education discourse on students' language use patterns. From the table, the grand mean is 3.64. This mean score is higher than the cut-off mean which is 3.00, following the decision rule, this indicates that AI-mediated online science education discourse has high impact on students' language use patterns.

Research Question 3

How does AI-mediated online science education discourse affect students' cultural interpretation of scientific concepts?

Table 3: Mean scores and standard deviation on AI-mediated discourse impact on students' cultural interpretation

Item	Mean	SD
AI systems recognize my cultural perspective in science	2.87	1.12
I struggle to connect AI explanations with my cultural knowledge	3.51	0.97
AI discourse uses examples that are unfamiliar to my culture	3.72	0.89
AI learning makes me question my traditional understanding	3.46	1.04
I feel my indigenous knowledge is devalued by AI systems	3.29	1.08
AI platforms help me see science from different perspectives	3.58	0.94
Grand Mean	3.41	1.01

Table 3 presents the impact of AI-mediated online science education discourse on students' cultural interpretation of scientific concepts. From the table, the grand mean is 3.41. This mean score is higher than the cut-off mean which is 3.00, following the decision rule, this indicates that AI-mediated online science education discourse has high impact on students' cultural interpretation of scientific concepts.

Testing the Hypotheses

Hypothesis 1:

AI-mediated online science education discourse has no significant impact on students' sentiment.

Table 4: Chi-Square Test Results for Hypothesis 1

Test Statistic (χ^2)	df	p-value	Decision
527.891	20	0.000	Rejected

Table 4 presents chi-square test results for the impact of AI-mediated online science education discourse on students' sentiment. The table reveals that the chi-square (X^2) value is 527.891 with $P = 0.000$. Since $P = 0.000 < 0.05$, AI-mediated online science education discourse significantly impacts students' sentiment. The hypothesis that says AI-mediated online science education discourse has no significant impact on students' sentiment was therefore rejected.

Hypothesis 2:

AI-mediated online science education discourse has no significant impact on students' language use patterns.

Table 5: Chi-Square Test Results for Hypothesis 2

Test Statistic (χ^2)	df	p-value	Decision
614.732	20	< .001	Rejected



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Table 5 presents chi-square test results for the impact of AI-mediated online science education discourse on students' language use patterns. The table reveals that the chi-square (X^2) value is 614.732 with $P = 0.000$; since $P = 0.000 < 0.05$; where 0.05 is the level of significance for the study, this means that AI-mediated online science education discourse significantly influences students' language use patterns. The hypothesis which states that AI-mediated online science education discourse has no significant impact on students' language use patterns was rejected.

Hypothesis 3:

AI-mediated online science education discourse has no significant impact on students' cultural interpretation of scientific concepts.

Table 6: Chi-Square Test Results for Hypothesis 3

Test Statistic (χ^2)	df	p-value	Decision
468.256	20	< .001	Rejected

Table 6 presents chi-square test results for the impact of AI-mediated online science education discourse on students' cultural interpretation of scientific concepts. The table reveals that the chi-square (X^2) value is 468.256 with $P = 0.000$. Since $P = 0.000 < 0.05$, where 0.05 is the level of significance for the study, AI-mediated online science education discourse significantly affects students' cultural interpretation of scientific concepts. The hypothesis which states that AI-mediated online science education discourse has no significant impact on students' cultural interpretation of scientific concepts was rejected.

Discussion of Findings

The result that AI-mediated online science education discourse significantly impacts students' sentiment aligns with the findings of Okoli and Mbah (2019), who found that students' emotional responses to AI-mediated learning environments significantly influenced their engagement and persistence in science education. This finding is also consistent with Chukwu (2020), who established that the nature of AI interactions shapes students' affective dispositions toward science learning, with both positive sentiments such as confidence and engagement, and negative sentiments such as frustration and alienation being evident in AI-mediated contexts. The result that AI-mediated online science education discourse significantly influences students' language use patterns corroborates the study by Ejiofor (2021), who found that students adapt their linguistic practices when interacting with AI systems, often modifying vocabulary, sentence structure, and communication strategies to achieve better system responses. This finding is in agreement with Ugwu and Okeke (2020), who discovered that Nigerian students frequently suppress indigenous language expressions and code-switching behaviors when engaging with AI platforms, potentially constraining their natural modes of scientific reasoning and explanation.

The finding that AI-mediated online science education discourse significantly affects students' cultural interpretation of scientific concepts is in line with Musa and Ibrahim (2022), who found that AI systems often fail to recognize or validate indigenous knowledge perspectives, creating tensions between students' cultural worldviews and formal scientific explanations. This finding supports Oladele and Akinyemi (2021), who demonstrated that culturally embedded biases in AI educational technologies can marginalize local knowledge systems and complicate students' meaning-making processes in science education.

Conclusion

The study has found that AI-mediated online science education discourse has significant impact on students' sentiment, language use, and cultural interpretation in Makurdi Local Government Area of Benue State.

Recommendations

Based on these results, the researchers put forward the following recommendations:

1. Science educators should integrate AI-mediated discourse platforms that are culturally sensitive and promote positive sentiment in online learning environments, ensuring that these systems recognize and respond appropriately to diverse student backgrounds and emotional needs.



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2. Educational technology developers should design AI systems that recognize and accommodate diverse linguistic patterns including code-switching, indigenous language expressions, and culturally-grounded communication styles to avoid constraining students' natural language use in science discourse.
3. The Ministry of Education should establish guidelines and standards for implementing AI-mediated discourse tools in science education that enhance rather than compromise students' cultural identity, validate indigenous knowledge contributions, and support culturally responsive scientific understanding.

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