NIU Journal of Educational Research Copyright©2026
Nexus International University ISSN: *3007-1844;* 12(1): 35-43

Multimodal Digital Semiotics and Artificial Intelligence in Technology-Enhanced Teacher Education: Implications for Meaning-Making, Communication, and Educational Management among Undergraduates in Oyo State Universities

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Abstract. The rapid convergence of multimodal digital environments and Artificial Intelligence (AI) technologies is reshaping teacher education globally. This study examines how multimodal digital semiotics and AI-driven tools influence meaning-making processes, communication patterns, and educational management practices among undergraduate teacher trainees in universities in Oyo State, Nigeria. The study adopted the survey research design of the correlational type. Simple random sampling was used to select 150 200 Level students of Educational Management of Faculty of Education from University of Ibadan and Lead City University. In all, a total of 150 students of Educational Management participated in the study. Two research instruments were used for data collection. They are Students' Perception of AI-Enhanced Multimodal Digital Platforms, Questionnaire (r=.78) Questionnaire on Students' Attitude to AI-Enhanced Multimodal Digital Platforms, Questionnaire (r=.76). Data collected were analysed using descriptive statistics of percentage, mean, standard deviation and inferential statistics of t-test was used to test the hypotheses at 0.05 level of significance. Findings of the study revealed a weighted mean of 2.67 which is greater than the threshold set at 2.50. Also, the result indicated a weighted mean of 2.56 which is greater than the threshold set at 2.50. The result indicates that there was no significant difference between male and female undergraduates' perception about AI-enhanced multimodal digital platforms ($t = -.411$; $df=148$; $p>0.05$). It showed that there was no significant difference between male and female undergraduates' attitude to AI-enhanced multimodal digital platforms ($t = .414$; $df=148$; $p>0.05$). Based on the findings of this study, it was recommended that universities should make significant investments in strong digital infrastructure and consistently update AI-enhanced multimodal platforms. Also, to improve pedagogical competency in the use of AI-driven learning technologies and digital literacy, regular training sessions and workshops should be planned.

Keywords: Multimodal digital semiotics, Artificial Intelligence, teacher education, meaning-making, educational management, technology-enhanced learning, Nigeria

1. Introduction

Global academic systems are redefining their pedagogical architectures, communicative ecologies, epistemological orientations, and institutional governance structures as a result of the higher education sector's rapid digital revolution. Teaching and learning at modern universities are being redesigned as dynamic, data-driven, multimodal processes embedded in intricate technological ecosystems, going much beyond the simple digitisation of pre-existing instructional resources. Interactive environments that coordinate language, visual, audio, spatial, and computational resources into integrated meaning-making systems are gradually replacing the conventional paradigm of text-dominant knowledge transmission. The quick integration of artificial intelligence (AI), such as conversational agents, generative AI systems, automated assessment engines, intelligent tutoring systems, adaptive learning

platforms, and predictive learning analytics, exacerbates these environments even more (Holmes et al., 2022; Zawacki-Richter et al., 2019; UNESCO, 2023).

This shift represents a significant shift in higher education's epistemology as well as technological innovation. Algorithms, platforms, and data infrastructures actively shape educational experiences in increasingly co-constructed socio-technical assemblages, where knowledge production, dissemination, validation, and governance are no longer solely the domain of human players. According to Selwyn (2022), digital education needs to be viewed as a reorganisation of power, agency, and knowledge authority inside institutional systems as well as a change in pedagogy. AI systems have a growing impact on the selection, sequencing, filtering, and personalisation of these semiotic resources in digitally mediated learning settings. Content paths are curated by recommendation algorithms, evaluative discourse is produced by automated feedback engines, explanatory texts and visualizations are created by generative AI tools, and patterns that influence instructional decisions are found by predictive analytics. In this way, AI becomes a semiotic actor that contributes to the creation and dissemination of meaning rather than only aiding in learning. Thus, algorithmic agency, where computational systems impact discourse production and interpretative paths, becomes a part of the semiotic landscape of higher education.

This viewpoint is supported by recent research on digital epistemology and algorithmic governance. Datafication, according to Williamson and Eynon (2020), turns instructional communication into measurable patterns that allow for new kinds of institutional monitoring and decision-making. In a similar vein, Perrotta and Selwyn (2020) argue that AI-driven personalisation imperceptibly transfers control from teachers to computer systems, redefining pedagogical authority. Therefore, it is necessary to analyse multimodal digital semiotics in AI-enhanced contexts as a site of power negotiation and institutional reconfiguration in addition to being a communication phenomenon. Recent studies, however, indicate that scaffolding mediated by AI adds new complexity to human-machine interaction. According to Holmes et al. (2022), intelligent tutoring systems can improve student performance and engagement, but they can also change the ways in which students and teachers communicate. Communicative norms and interpretive techniques are altered as the locus of feedback moves from interpersonal speech to algorithmic reaction. This shift has significant ramifications for teacher education since it socializes aspiring teachers to both electronically mediated communication cultures and pedagogical theories, in which artificial intelligence functions as a co-educator.

In this digital revolution, teacher education holds a special strategic place. Universities, who are in charge of training future teachers, must simultaneously incorporate new technology and consider their pedagogical, ethical, and administrative ramifications. Competencies in multimodal literacy, digital pedagogy, data literacy, and AI awareness are essential for modern teacher preparation (Tondeur et al., 2021; Redecker, 2022). In addition to using AI-enhanced technologies, pre-service teachers need to be able to assess their sociocultural ramifications, ethical constraints, and semiotic affordances. This requirement has become much more pressing after 2022 with the advent of generative AI systems. Academic integrity, authorship, and assessment authenticity are all challenged by tools that may create essays, lesson plans, feedback reports, and multimedia content. Assessment methods must therefore be rethought in teacher education programs to emphasise ethical reasoning, reflective practice, and critical AI literacy in addition to technical proficiency. Through this reorientation, teacher education is positioned as a transformative space where new governance models, communication techniques, and epistemologies are discussed and formalised.

In Nigeria, post-pandemic technical demands, national policy changes, and pressures from globalization have all contributed to an acceleration of the digital transformation of higher education. Learning management systems, virtual classrooms, and digital collaboration platforms were widely adopted by universities as a result of the COVID-19 disruption. Universities like Lead City University and the University of Ibadan in Oyo State have increased their investments in multimedia teaching technology, AI-supported evaluation systems, and blended learning infrastructures. These changes are part of larger continental initiatives to bring African higher education into line with international digital trends (UNESCO, 2023). Nevertheless, pedagogical change is not always the result of infrastructure integration. Research conducted in sub-Saharan Africa reveals enduring issues such as unequal access to devices, uneven digital literacy, intermittent internet connectivity, and insufficient institutional support (Czerniewicz et al., 2021). Therefore, despite the growing visibility of AI-enabled multimodal platforms, little is known about how they affect semiotic practices, communication ecologies, and

educational administration structures in teacher education programmes.

AI-powered technologies are changing institutional governance in ways that go beyond classroom interaction. Data-driven insights that guide policy implementation and resource allocation are produced by learning analytics dashboards, automated admission systems, predictive retention models, and performance monitoring tools. This change is conceptualized by Williamson (2017) as the rise of "algorithmic governance" in education, as data infrastructures increasingly mediate decision-making processes. Complex ethical and equity issues are also brought about by the combination of AI with multimodality. Stories of technological advancement are complicated by algorithmic prejudice, data privacy difficulties, intellectual property issues, and inequities in digital literacy (Holmes et al., 2022; Selwyn, 2022). AI-enhanced learning may both increase access and perpetuate exclusion in environments marked by infrastructural inequality. Existing educational disparities may be widened if students with poor digital skills or poor connectivity find it difficult to interact with multimodal AI systems.

Furthermore, issues with accountability and openness in educational administration are brought up by the opacity of algorithmic decision-making. In order to minimize technological determinism and protect learner rights, UNESCO's 2023 guidance on generative AI in education highlights the necessity of human oversight, ethical frameworks, and inclusive design principles. In order to ensure that the deployment of AI is consistent with democratic educational norms and social justice commitments, teacher education institutions must strike a balance between innovation and critical governance. There is still a substantial contextual gap regarding the semiotic and managerial aspects of AI integration in Nigerian institutions, especially in teacher education, despite the growing body of international study on AI in higher education. Previous research frequently focuses on adoption rates, technological efficiency, or academic performance outcomes, paying little attention to how multimodal digital environments alter governance structures, interpretive practices, and communication exchanges. Furthermore, there aren't many empirical studies that explore how algorithmic systems affect discourse practices in African higher education environments or challenge AI as a semiotic actor in meaning-making processes. In addition to advancing digital semiotics theory, closing this gap is crucial for guiding practice and policy in quickly digitising educational systems. In light of this, the current study examines how multimodal digital semiotics and artificial intelligence connect with technology-enhanced teacher education, with a particular emphasis on undergraduate programs at Oyo State universities.

1.1 Statement of the Problem

The quick development of multimodal digital platforms and artificial intelligence (AI) in higher education has had a profound impact on institutional management structures, meaning-making processes, and instructional communication. To assist instruction, evaluation, and administrative decision-making, universities are rapidly implementing AI-enhanced learning management systems (LMS), adaptive platforms, generative tools, and learning analytics dashboards. These systems alter how knowledge is created, interpreted, conveyed, and managed in academic settings; they do more than just digitise conventional methods. Although AI integration in higher education has been the subject of significant global scholarship, the majority of the work that is now available focuses on automation, performance outcomes, or technological efficiency.

As semiotic places where linguistic, visual, auditory, and algorithmic resources converge, undergraduate teacher candidates' perceptions of these AI-mediated multimodal settings have received less study, especially in Nigerian universities. For teacher education programs that emphasize interpretive awareness, communicative competence, and pedagogical reflexivity, it is especially important to understand how students interact with AI-driven multimodal systems. Investments in AI-supported platforms and blended learning infrastructures have increased at Oyo State universities in the wake of the COVID-19 epidemic and larger digital transformation projects. Deploying infrastructure by itself, however, does not guarantee significant pedagogical change. The way that students view, feel, and are prepared to engage with digitally mediated communication ecologies greatly influences how effective AI-enhanced multimodal settings are.

AI-enabled LMS platforms have the potential to improve engagement, collaborative communication, and academic growth if undergraduates view them as helpful, dynamic, and cognitively stimulating. On the other hand, the anticipated advantages of technology integration may be undermined by unfavorable opinions, a lack of digital literacy, or skepticism regarding algorithmic mediation. Concerns over fair participation in AI-mediated learning settings are also raised by the gender differences in digital involvement that have been reported in a variety of educational

situations. Institutional strategies run the danger of ignoring possible equity disparities in the absence of empirical data investigating whether male and female undergraduates have different attitudes and perceptions regarding AI-enhanced multimodal systems. There is still a dearth of context-specific research examining how undergraduate teacher candidates at Oyo State universities view and react to AI-enabled learning management systems, despite the theoretical acceptance of AI as a semiotic and governance actor within digital education. This disparity hinders the creation of well-informed policies, redesigned curricula, and sustainable educational management techniques. Thus, this study aims to investigate the attitudes and views of undergraduate students at particular Oyo State universities about AI-enhanced multimodal learning management systems, as well as any gender-based variations in these attitudes and perceptions. In doing so, the study adds actual data to current discussions on equitable educational management, AI-mediated communication, and multimodal digital semiotics in African higher education contexts.

1.2 Research Questions

The following research questions guided the study:

- What is the perception of undergraduates about AI-enhanced multimodal digital platforms?
- What is the attitude of undergraduates to AI-enhanced multimodal digital platforms?

1.3 Hypotheses

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

$H_0$1: There is no significant difference between male and female undergraduates' perception about AI-enhanced multimodal digital platforms
$H_0$2: There is significant difference between male and female undergraduates' attitude to AI-enhanced multimodal digital platforms

2. Literature Review

2.1 Artificial Intelligence in Educational Management

In higher education, artificial intelligence (AI) technologies are changing institutional governance, administrative coordination, and strategic decision-making in ways that go beyond classroom instruction. More recent research highlights AI's systemic role in transforming educational management through datafication, automation, and predictive governance, in contrast to early conceptualisations of AI in education that focused on intelligent tutoring and personalised learning (Luckin et al., 2016) (Williamson, 2017; Holmes et al., 2022). Routine administrative tasks including grading, tracking attendance, assigning courses, screening applicants, scheduling time, and allocating resources are automated by AI-driven management systems. Universities can improve operational efficiency, decrease human error, and streamline workflows via robotic process automation and machine learning techniques. By integrating algorithmic decision-making into institutional procedures, these systems do more than just save labor; they transform organizational processes.

To track student involvement, estimate academic success, identify attrition concerns, and predict enrollment trends, more sophisticated apps use machine learning models and predictive analytics (Siemens, 2013; Williamson & Eynon, 2020). Learning analytics dashboards give visualized indicators that impact policy decisions by aggregating massive datasets from student information systems, assessment platforms, and learning management systems (LMS). Strategic resource allocation, evidence-based curriculum reform, and early-warning interventions for at-risk students are made possible by such technologies. AI is positioned as a strategic infrastructure rather than a supplementary tool in teacher education because of its simultaneous pedagogical and management function. AI-enabled governance produces a hybrid ecosystem that combines administrative planning, performance monitoring, and instructional activities. According to Selwyn (2019), this convergence results in new types of "algorithmic governance," where data metrics are used more frequently to gauge institutional performance and educational accountability. Although this improves responsiveness and openness, it also brings up issues with data determinism, autonomy erosion, and surveillance culture.

AI-driven governance requires ethical frameworks to be regulated, according to recent policy discourse. The significance of explainability, transparency, human oversight, and data protection in educational AI systems is emphasised by UNESCO (2023). Algorithmic systems run the potential of perpetuating bias, solidifying injustices, and giving priority to measurable results over comprehensive educational ideals in the absence of such protections. This challenge is especially important for teacher education institutions because they have to train future teachers to critically analyse the ethical and social

consequences of data-informed systems in addition to being able to operate within them.

2.2 Multimodal Digital Learning in Teacher Education

Text, audio, video, graphics, animation, simulation, and interactive interfaces are all included into multimodal digital learning environments to create unified instructional designs. By engaging numerous representational channels, these settings improve engagement, comprehension, and long-term retention. They are based on the multimodality theory (Kress, 2010) and the cognitive theory of multimedia learning (Mayer, 2009). Instead of depending solely on linguistic text, meaning-making in these circumstances arises through the orchestration of semiotic resources. Multimodal platforms are used in teacher education for professional modeling as well as instruction. Digital storytelling tools, multimedia case studies, simulation-based pedagogy, virtual classrooms, collaborative whiteboards, and immersive settings are all used by pre-service teachers. Multimodal literacy, or the ability to understand and create communication across several representational forms, is fostered by these encounters (Jewitt, 2008).

Tondeur et al. (2017; 2021) emphasize that rather than being viewed as technical add-ons, technology integration in teacher education works best when it is integrated into pedagogical frameworks. Teacher candidates' Technological Pedagogical Content Knowledge (TPACK) is improved by exposure to multimodal digital tools, which helps them match digital affordances with curriculum goals and student requirements. Additionally, reflective interaction with multimodal environments develops adaptive knowledge, equipping graduates for rapidly innovative technology-mediated classrooms. The use of immersive technologies like virtual reality (VR), augmented reality (AR), and simulation-based platforms in teacher training has grown, according to recent research. Pre-service teachers can use these tools to practice making decisions, model classroom scenarios, and try out different teaching methods in low-risk virtual environments. Simulations can produce performance statistics that facilitate professional development and reflective practice when combined with AI-driven feedback systems. However, creative instructional design, digital fluency, and fair access are necessary for multimodal learning to be pedagogically effective. Cognitive overload can result from an excessive amount of multimedia that is not coherent (Mayer, 2009). In order to ensure that multimodality helps rather than detracts from conceptual understanding, teacher education programs must strike a balance between innovation and pedagogical intentionality.

3. Methodology

The study adopted the survey research design of the correlational type. Simple random sampling was used to select 150 200 Level students of Educational Management of Faculty of Education from University of Ibadan and Lead City University. In all, a total of 150 students of English Language participated in the study. Two research instruments were used for data collection. They are Students' Perception of AI-Enhanced Multimodal Digital Platforms, Questionnaire (r=.78) Questionnaire on Students' Attitude to AI-Enhanced Multimodal Digital Platforms, Questionnaire (r=.76). Data collected were analysed using descriptive statistics of percentage, mean, standard deviation and inferential statistics of t-test was used to test the hypotheses at 0.05 level of significance.

4. Results

Research Question 1: What is the perception of undergraduates about AI-enhanced multimodal digital platforms?

Table 1: The perception of undergraduates about AI-enhanced multimodal digital platforms

S/N	AI-enhanced multimodal digital platforms:	SA	A	D	SD	Mean	St. D
1	Promotes learning among undergraduate students.	83 (55.3%)	46 (30.7%)	14 (9.3%)	7 (4.7%)	3.36	.838
2	Makes students hard working.	62 (41.3%)	80 (53.3%)	6 (4.0%)	2 (1.3%)	3.34	.623
3	Makes students have good impression about learning.	81 (54%)	62 (41.3%)	6 (4.0%)	1 (0.7%)	3.48	.610
4	Increases students' interest in learning.	56 (37.3%)	74 (49.3%)	10 (6.7%)	10 (6.7%)	3.17	.825
5	Stimulates students' ability to think very fast.	77 (51.3%)	64 (42.7%)	9 (6%)	-	3.45	.608
6	Should be banned due to poor network.	90 (60%)	39 (26%)	12 (8%)	9 (6%)	1.60	.874
7	Changes students' perception of learning.	79 (52.7%)	64 (42.7%)	7 (4.7%)	-	3.48	.587
8	Can be a challenging activity.	70 (46.7%)	72 (48%)	7 (4.7%)	1 (0.7%)	1.59	.614
9	Facilitates the development of students' competency.	80 (53.3%)	55 (36.7%)	9 (6%)	6 (4%)	3.39	.776
10	Does not develop students' ability to learn.	68 (45.3%)	65 (43.3%)	8 (5.3%)	9 (6%)	1.72	.820

11	Makes students passive recipient of knowledge.	81 (54%)	55 (36.7%)	11 (7.3%)	3 (2%)	1.52	.717
12	Makes students to have positive attitude towards learning.	64 (42.7%)	69 (46%)	12 (8%)	5 (3.3%)	3.28	.751
13	Changes students' wrong impression about learning.	77 (51.3%)	59 (39.3%)	13 (8.7%)	1 (0.7%)	3.41	6.77
14	Consumes money.	83 (55.3%)	57 (38%)	8 (5.3%)	2 (1.3%)	1.52	.662
15	Makes students attend class regularly.	108 (72%)	35 (23.3%)	4 (2.7%)	3 (2%)	3.65	.634
16	Makes students to be lazy.	77 (51.3%)	58 (38.7%)	10 (6.7%)	5 (3.3%)	1.62	.756
17	Is not a reliable platform of assessing students.	74 (49.3%)	59 (39.3%)	16(10.7%)	1 (0.7%)	3.37	.700
18	Does not give students the opportunity to ask questions where necessary.	78 (52%)	59 (39.3%)	10 (6.7%)	3 (2%)	1.58	.706
19	Does not give students the opportunity to interact like physical class.	41 (27.3%)	92 (61.3%)	13 (8.7%)	4 (2.7%)	3.13	.672
20	Is not good for academic activities.	46 (30.7%)	99 (66%)	4 (2.7%)	1 (0.7%)	1.73	.539
Weighted Mean = 2.67; Threshold = 2.50							

Table 1 shows the perception of undergraduates about AI-enhanced multimodal digital platforms. The result indicates a weighted mean of 2.67 which is greater than the threshold set at 2.50. This result implies that majority of the selected undergraduates had a positive perception of AI-enhanced multimodal digital platforms.

Question 2: What is the attitude of undergraduates to AI-enhanced multimodal digital platforms?

Table 2: The attitude of undergraduates to AI-enhanced multimodal digital platforms

S/N	ITEMS	SA	A	D	SD	Mean	St. D.
1	I have a favourable attitude to AI-enhanced multimodal digital platforms.	87 (58%)	43 (28.7%)	14 (9.3%)	6 (4%)	3.40	.820
2	I prefer AI-enhanced multimodal digital platforms to any other platform.	65 (43.3%)	60 (40%)	21 (14%)	4 (2.7%)	3.24	.791
3	I am favourable disclosed to learn through the AI-enhanced multimodal digital platforms.	72 (48%)	61 (40.7%)	15 (10%)	2 (1.3%)	3.35	.715
4	Interacting with AI-enhanced multimodal digital platforms does not require a lot of mental effort.	70 (46.7%)	68 (45.3%)	9 (6%)	3 (2%)	1.63	.689
5	I revert to AI-enhanced multimodal digital platforms each time I need materials on	52 (34.7%)	92 (61.3%)	4 (2.7%)	2 (1.3%)	3.29	.585
6	I like AI-enhanced multimodal digital platforms.	66 (44%)	63 (42%)	19 (12.7%)	2 (1.3%)	3.28	.735
7	If I have my way, I will not learn on the AI-enhanced multimodal digital platforms.	72 (48%)	61 (40.7%)	17 (11.3%)	-	1.63	.679
8	AI-enhanced multimodal digital platforms allow easy return to previous display page.	77 (51.3%)	55 (36.7%)	16 (10.7%)	2 (1.3%)	3.38	.729
9	Learning through the AI-enhanced multimodal digital platforms is burdensome.	62 (41.3%)	82 (54.7%)	5 (3.3%)	1 (0.7%)	1.63	.584
10	I am not comfortable with AI-enhanced multimodal digital platforms.	57 (38%)	89 (59.3%)	4 (2.7%)	-	1.64	.532
11	I always enjoy learning on AI-enhanced multimodal digital platforms.	76 (50.7%)	71 (47.3%)	3 (2%)	-	3.48	.540
12	If I have my way, I wish AI-enhanced multimodal digital platforms is used forever.	68 (45.3%)	79 (52.7%)	3 (2%)	-	3.43	.536
13	Using AI-enhanced multimodal digital platforms would increase my productivity in my coursework.	59 (39.3%)	83 (55.3%)	8 (5.3%)	-	3.34	.577
14	AI-enhanced multimodal digital platforms are not beneficial.	76 (50.7%)	66 (44%)	8 (5.3%)	-	1.54	.597
15	Learning through the use of AI-enhanced multimodal digital platforms is a waste of time.	86 (57.3%)	60 (40%)	4 (2.7%)	-	1.45	.550
16	Learning through AI-enhanced multimodal digital platforms consumes money.	69 (46%)	74 (49.3%)	7 (4.7%)	-	1.58	.581
17	I am not encouraged to learn from AI-enhanced multimodal digital platforms.	78 (52%)	67 (44.7%)	5 (3.3%)	-	1.51	.564
18	AI-enhanced multimodal digital platforms are convenient to use.	60 (40%)	82 (54.7%)	8 (5.3%)	-	3.34	.579
19	Using AI-enhanced multimodal digital platforms enables me to have more accurate information.	70 (46.7%)	74 (49.3%)	4 (2.7%)	2 (1.3%)	3.41	.615
20	AI-enhanced multimodal digital platforms do not promote effective learning.	48 (32%)	90 (60%)	8 (5.3%)	4 (2.7%)	1.78	.661
Weighted Mean = 2.56; Threshold = 2.50							

Table 2 shows the attitude of undergraduates to AI-enhanced multimodal digital platforms. The result indicates a weighted mean of 2.56 which is greater than the threshold set at 2.50. This result implies that majority of the selected undergraduates had a positive attitude to AI-enhanced multimodal digital platforms.

Testing of Hypotheses

$H_0$1: There is no significant difference between male and female undergraduates' perception about AI-enhanced multimodal digital platforms

Table 3: Difference between male and female undergraduates' perception about AI-enhanced multimodal digital platforms

Group	N	Mean	Standard Deviation	Mean Difference	t	Df	p-value	Remarks
Male	46	53.3696	2.49763	-.19774	-.411	148	.668	Not sig.
Female	104	53.5673	2.80348					

Table 3 shows the difference between male and female undergraduates' perception about AI-enhanced multimodal digital platforms using the independent samples t-test analysis. The result indicates that there was no significant difference between male and female undergraduates' perception about AI-enhanced multimodal digital platforms ($t = -.411$; $df=148$; $p>0.05$). This implies that gender did not cause a variance in the undergraduates' perception about AI-enhanced multimodal digital platforms.

$H_0$2: There is significant difference between male and female undergraduates' attitude to AI-enhanced multimodal digital platforms

Table 4: Difference between male and female undergraduates' attitude to AI-enhanced multimodal digital platforms

Group	N	Mean	Standard Deviation	Mean Difference	T	df	p-value	Remarks
Male	46	51.5652	2.72969	.21906	.414	148	.680	Not sig.
Female	104	51.3462	3.09641					

Table 4 shows the difference between male and female undergraduates' attitude to AI-enhanced multimodal digital platforms using the independent samples t-test analysis. The result indicates that there was no significant difference between male and female undergraduates' attitude to AI-enhanced multimodal digital platforms ($t = .414$; $df=148$; $p>0.05$). This implies that gender did not cause a variance in the undergraduates' attitude to AI-enhanced multimodal digital platforms.

5. Discussion of Findings

Undergraduates had a favourable opinion of AI-enhanced multimodal digital platforms, according to Table 1. This shows that students are aware of the potential, value, and relevance of AI-driven learning environments in assisting them in their academic endeavours. Any digital learning system must have a positive perception in order to be implemented successfully, since students' opinions about its value and usability frequently influence their degree of engagement and continued participation. Increased exposure to digital tools, institutional support for e-learning, and the incorporation of user-friendly AI elements that improve interaction, feedback, and accessibility could all be responsible for the favorable view shown in this study. This result is consistent with research by Armstrong (2011) and Rollinson (2008), who found that when learning management systems (LMS) are used well, students typically have positive opinions of them. By placing perception within AI-enhanced multimodal environments, the current study builds on these past researches and raises the possibility that integrating AI could increase students' trust in digital learning systems.

Undergraduates had a favourable opinion of AI-enhanced multimodal digital platforms, according to Table 2. Positivity indicates that one is open to technology-mediated learning experiences, keen to explore platform features, and prepared to participate. Students' perceptions that AI-supported platforms make learning more flexible, personalised, engaging, and productive may be connected to this result. Particularly in skill-based courses like English language studies, where interaction and feedback are crucial, positive attitudes are frequently linked to higher motivation and better academic achievement. The results support the research of Eiriemiokhale and Idiede (2020), who discovered that students had positive opinions of learning management systems. It, however, runs counter to Adeniyi's (2007) findings that teachers had unfavorable opinions about using ICT to teach English. Generational differences, the rise in digital literacy among today's undergraduates, and the development of technology from simple ICT tools to more intelligent and adaptable AI-enhanced systems could all account for the gap.

The perceptions of male and female undergraduates about AI-enhanced multimodal digital platforms did not differ significantly, according to Table 3. This suggests that students' perceptions of the value and efficacy of these platforms were not much impacted by gender. It suggests that conventional gender inequalities in technology perception are closing, with both male and female undergraduates finding AI-driven multimodal learning environments equally acceptable and accessible. Although the current result shows neutrality across gender lines, the former assertion that gender could impact perception is in contrast to this result, which partially fits with Dingwall (1998). Additionally, it runs counter to Roberts' (2000) assertion that women often have more unfavorable opinions of specific academic assignments. According to the current study, gender-based perceptual differences may be reducing in modern AI-supported digital situations.

The opinions of male and female undergraduates about AI-enhanced multimodal digital platforms did not differ significantly, as shown in Table 4. This suggests that both sexes showed comparable degrees of acceptance, zeal, and preparedness to use AI-assisted learning resources. The lack of gender differences in attitude serves as more evidence of the inclusiveness and allure of AI-enhanced digital learning environments in higher education. This finding is in line with the findings of Adebiyi (2012) and Eweniyi (1995), who found no discernible gender differences in attitudes toward learning management systems. It runs counter to Coates (1986) and Tannen (1990), who discovered that views regarding communication and learning technology varied by gender. According to the current study, these gender-based attitudes may have decreased as a result of improvements in digital access, exposure, and technology integration within academic institutions.

6. Conclusion

Undergraduates' attitudes and perceptions of AI-enhanced multimodal digital platforms were investigated in this study, along with the impact of gender on these factors. According to the results, undergraduates have favorable attitudes and favorable impressions of AI-driven multimodal learning environments. This implies that students are aware of these platforms' instructional value, applicability, and accessibility in promoting academic engagement, teaching, and learning.

The study also found that undergraduates' attitudes and perceptions of AI-enhanced multimodal digital platforms were not significantly influenced by gender. Students of both sexes showed similar degrees of acceptance and preparedness to use digital technologies aided by artificial intelligence. This suggests that the gender gap in university technology usage is closing. The study's overall findings indicate that undergraduates generally embrace AI-enhanced multimodal digital platforms, which have a great deal of promise to increase communication, meaning-making, and learning outcomes in higher education. Students' favorable attitudes offer a solid basis for the successful integration of AI into educational management and instructional delivery.

7. Recommendations

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

1. To guarantee easy access, usefulness, and sustainability, universities should make significant investments in strong digital infrastructure and consistently update AI-enhanced multimodal platforms.
2. To improve pedagogical competency in the use of AI-driven learning technologies and digital literacy, regular training sessions and workshops should be planned.
3. To encourage interactive, learner-centered, and adaptive learning experiences, curriculum designers should methodically incorporate AI-enhanced multimodal platforms.
4. Clear regulations pertaining to data protection, academic integrity, and responsible AI practices should be developed by university administration to guide the ethical use of AI in teaching and learning.
5. Institutions should regularly evaluate students' experiences, opinions, and learning results to make sure AI-enhanced platforms continue to be useful and in line with learning objectives.
6. Universities should keep encouraging inclusive access to digital resources to maintain fairness across all demographic groups, even though gender differences were not statistically significant in our study.

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