

STUDENTS' PERCEPTIONS OF HUMANOID ROBOTS AS TOOLS FOR ENHANCING TEACHING EFFICIENCY IN PRIVATE SECONDARY SCHOOLS

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Abstract

Teacher shortages in Nigerian private schools have increased the need for innovative technologies that can supplement instructional delivery. This study investigated students' perceptions of humanoid robots as instructional tools in private schools in Nigeria, with particular attention to their perceived usefulness and gender differences. A descriptive survey design was adopted. The study involved 187 students selected from private schools, and data were collected using a structured questionnaire. Mean and standard deviation were used to answer the first research question, while an independent-samples t-test was used to examine gender differences at the 0.05 significance level. Findings indicated a high level of students' general perception of humanoid robots as instructional tools (cluster mean = 3.34). Students also reported favourable perceptions of their usefulness for enhancing teaching efficiency. However, the independent-samples t-test revealed no significant difference between male and female students' perceptions, $t(185) = 0.98, p = .329$. The study concludes that students demonstrate broad acceptance of humanoid robots as potential supplementary instructional tools, irrespective of gender. The study recommends their phased adoption, supported by adequate technical infrastructure and maintenance, particularly in private schools experiencing teacher shortages.

Keywords: Humanoid Robots; Instructional Technology; Students' Perception; Teacher Shortage., private secondary schools,

Introduction

Nigeria's private primary and secondary school sector has expanded rapidly over the past two decades; however, this growth has been accompanied by a deepening human-resource crisis that increasingly threatens educational quality and equity. Proprietors report persistent difficulties in recruiting and retaining qualified teachers, reflecting a combination of structural and contextual factors that distinguish private-school labour markets from their public-sector counterparts. At the forefront are remuneration disparities and unstable salary administration, which create strong incentives for teacher mobility. Evidence across African contexts shows substantial variation in teacher pay and in the relative attractiveness of teaching as a profession, with lower or less predictable remuneration associated with higher attrition and movement towards better-paying alternatives (Evans et al 2021; Atanda, 2022). In Nigeria, studies and policy reviews similarly associate teacher attrition from private schools with inadequate remuneration, inconsistent benefits, and limited opportunities for career-long professional development (Ukala 2024; Premium Times, 2025). These financial

pressures are further intensified by migration and external recruitment channels that continue to draw qualified personnel away from local talent pools (Athena Centre for Policy and Leadership, 2025).

Beyond these economic pressures, however, the nature of managerial practices and institutional expectations within private schools also shapes teachers' decisions to remain in or leave their positions. Many proprietors impose strict disciplinary standards, rigorous performance monitoring, and high accountability for pupil outcomes. Although such practices may contribute to improved classroom standards and student attainment, they can also heighten teacher stress and turnover when not matched by adequate institutional support, recognition, or rewards (Atanda, 2022; Ezeaku, 2025). Private schools often limit the workplace laxities that some teachers may encounter in public-school settings, including relatively looser monitoring, stronger job protections, and more standardized career pathways, while staff perceived as underperforming may face rapid sanctions or termination. Consequently, management regimes intended to strengthen accountability and educational performance may simultaneously

intensify job insecurity and reduce tolerance for professional errors, thereby contributing to lower job satisfaction and increased staff churn (Atanda, 2022; Adewale, 2023).

These managerial challenges do not occur in isolation; rather, they intersect with broader systemic and resource constraints that further shape teachers' working conditions and the capacity of private schools to attract and retain qualified personnel. Compounding remuneration and managerial pressures are inadequate infrastructure, intermittent electricity and internet access in many communities, and unequal access to continuous professional development needed to keep teachers abreast of contemporary pedagogical innovations. In resource-constrained private schools, particularly those outside major urban centres, limited financial capacity may compel proprietors to recruit underqualified or early-career teachers as cost-saving measures, potentially compromising instructional quality and increasing schools' vulnerability to staffing crises (Evans et al., 2021; IPRJB, 2024).

These existing vulnerabilities were further exposed and intensified by the COVID-19 pandemic, which disrupted household and school incomes, prompted teacher resignations, and accelerated the movement of teachers into non-teaching employment or overseas opportunities (Adewale, 2023). Thus, the interaction of managerial pressures, infrastructural limitations, constrained professional development, and wider economic disruptions creates a complex employment environment in which teacher retention becomes increasingly difficult for private schools. This persistent fragility in the supply and retention of qualified teachers has, in turn, intensified the search for complementary approaches that can sustain instructional delivery without further compromising educational quality.

The growing fragility of teacher supply has intensified interest in educational technologies, not merely as enrichment tools but as pragmatic responses to persistent teacher shortages and increasing instructional demands. Among these emerging technologies are humanoid robots, which are programmable robotic machines designed to resemble the human form and perform human-like movements, communication, and interaction. In educational settings, they can engage learners through speech, gestures, facial expressions, movement, and programmed

responses, supporting instruction, demonstrations, drills, practice, and learner engagement. Increasingly, humanoid robots are framed in policy and research discourses as potential complements to human teachers rather than outright replacements. Their capacity to communicate with learners, respond to inputs, provide feedback, deliver standardized lessons, conduct drills, demonstrate concepts, and facilitate individualized interactions enables them to extend selected aspects of instructional delivery (Ates & Polat, 2025; Ojetunde & Ramnarain, 2025). Proponents argue that humanoid robots could reduce teachers' workload by automating repetitive activities, including recitation checks, drills, and routine assessments, thereby allowing teachers to devote greater attention to higher-order facilitation, pastoral care, classroom relationships, and curriculum adaptation.

This complementary role is particularly significant because humanoid robots can support learner engagement and interactive learning while remaining dependent on teachers for pedagogical direction and contextual adaptation (Keane et al., 2022; Ates & Polat, 2025).

Emerging pilot initiatives in Nigeria and other African settings have demonstrated the early feasibility of robotics and AI for classroom support, indicating potential gains in learner engagement and adaptive learning when these technologies are appropriately configured to local curricula and educational contexts (Ukala, 2024; Impact Lab, 2025). Accordingly, the potential value of humanoid robots lies not simply in their technological novelty but in their capacity to complement human instructional roles and provide targeted support within private-school environments experiencing persistent staffing and resource constraints. Against this background, students' perception of humanoid robots becomes a critical consideration before private-school proprietors commit substantial financial resources to their acquisition and deployment.

Perception, in this context, refers to students' views, feelings, attitudes, expectations, and judgements regarding the usefulness, acceptability, trustworthiness, and appropriateness of humanoid robots as instructional assistants. This is particularly important because humanoid robots represent a relatively unfamiliar instructional technology in many Nigerian private-school settings, where

students may have limited or no prior experience interacting with them in formal classroom environments. Evidence from educational robotics research suggests that students' initial responses can range from curiosity and excitement to hesitation, uncertainty, or ambivalence, and that these responses can influence the quality of subsequent interaction and engagement with the technology (Chalmers et al., 2022; Woo et al., 2021). Indeed, students who perceive robots as interesting, useful and engaging may be more willing to interact with them and participate in robot-supported learning activities, whereas negative perceptions may generate resistance, anxiety, distrust, or disengagement. Recent evidence further indicates that students' trust in robots can be affected by perceived competence and the robot's ability to respond appropriately to errors, underscoring the importance of understanding learners' attitudes before extensive classroom deployment (Flanagan et al., 2024; Yuan et al., 2024).

The importance of assessing students' perceptions extends beyond determining whether they simply like or dislike humanoid robots; it provides a basis for judging whether the technology is educationally acceptable, practically usable, and worth the financial investment required for procurement, maintenance, software support, and teacher preparation. Gender is also relevant, as male and female students may differ in their familiarity with, confidence in, and willingness to interact with emerging robotic technologies, potentially shaping their perceptions of the robots' usefulness and educational value. Unlike conventional digital learning tools that students may encounter regularly, humanoid robots introduce a physical and socially interactive presence into the classroom, making their acceptance potentially more complex (Istemic et al., 2021). Research involving school students indicates that interaction with humanoid robots can generate enthusiasm and engagement, although technical limitations and uncertainty about the robot's role as a learning assistant may arise (Chalmers et al., 2022).

Assessing perceptions by gender can therefore identify potential differences in acceptance and inform more responsive implementation strategies. Thus, understanding students' perceptions before large-scale investment can help proprietors identify adoption barriers,

determine valued features, and minimize the risk of investing in costly technology that may be poorly accepted or underutilized. Students' perception, therefore, represents an important pre-investment indicator of the educational viability and sustainability of humanoid robots in Nigerian private schools, where empirical evidence of their classroom use remains limited. Consequently, all these emerging cases underscore the need to systematically examine students' perceptions before substantial investment, procurement, or policy decisions concerning humanoid robots are undertaken. Technology adoption perspectives, particularly the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), provide useful lenses for understanding such perceptions, as perceived usefulness and ease of use are central to users' willingness to embrace emerging technologies (Scherer et al., 2023; Al-Emran, 2023). Applying these perspectives to humanoid robots can therefore move the inquiry beyond whether stakeholders simply support or oppose the technology to examining the cognitive and motivational factors that shape its acceptance within private-school students contexts.

This is particularly important in Nigeria, where the educational value of humanoid robots must be considered alongside substantial financial, infrastructural, socio-cultural, and pedagogical constraints. Many private-school proprietors operate under tight financial conditions, making the acquisition, maintenance, and training costs associated with humanoid platforms potentially difficult to sustain (Evans et al., 2021; Afolabi 2024). Similarly, unreliable electricity and limited broadband connectivity, particularly in peri-urban and rural schools, may undermine the dependable operation of interactive robots and cloud-dependent artificial intelligence services (Ojetunde et al., 2025).

These considerations make students' perceptions particularly important because investment in humanoid robot technology does not automatically guarantee meaningful or effective educational use, especially when students are the primary beneficiaries and direct participants in technology-supported learning. In the context of persistent teacher shortages and recurrent loss of teachers in private schools, humanoid robots may be considered not merely as instructional aids but as potential full replacements for human teachers in selected aspects of classroom

instruction. Introducing such technology without adequate attention to students' needs, readiness, acceptance, and the wider instructional context could create unintended educational challenges (Ukala, 2024). Concerns relating to data privacy, algorithmic transparency, and accountability in robot-supported assessment also require careful consideration, particularly where institutional capacity for effective data governance remains limited (Leong & Zhang 2025). Consequently, determining students' perceptions is essential to establishing whether humanoid robots could provide a viable alternative to human teachers in sustaining instructional continuity, reducing dependence on unstable teacher supply, and maintaining teaching efficiency in private secondary schools (Ukala, 2024)

It is within this context that the study seeks to examine students' perceptions of humanoid robots as tools for enhancing teaching efficiency in private secondary schools in Nkanu West, Enugu State. Such evidence is considered valuable for establishing baseline information on students' awareness, attitudes, perceived usefulness, anticipated benefits, and concerns regarding humanoid robots before school proprietors commit scarce resources to large-scale procurement and implementation.

Statement of the Problem

Private secondary schools face persistent challenges of teacher shortages, high turnover, and unstable instructional delivery. Teachers frequently leave private schools, sometimes without adequate notice, in search of better remuneration, job security, career advancement, or government employment. The situation becomes more severe whenever state or federal governments recruit teachers, as private schools often lose experienced teachers en masse. This sudden loss of personnel disrupts lesson continuity, increases class sizes and workloads for remaining teachers, and may force schools to assign subjects to teachers outside their areas of specialization.

The consequences are particularly devastating for students left behind. Abrupt teacher departures can interrupt lessons, delay curriculum coverage, reduce individualized attention, weaken teacher-student relationships, and create uncertainty that may negatively affect students' engagement and learning outcomes. Private schools must also incur additional costs for recruitment, orientation, and training of replacement teachers, while repeated turnover

makes it difficult to maintain instructional consistency. Low salaries, limited welfare packages, excessive workload, inadequate career progression, and weak retention mechanisms further compound the problem.

These challenges raise the question of whether emerging educational technologies could provide a replacement support for teaching during periods of teacher shortage and transition. Humanoid robots, with their capacity to deliver standardized instruction, conduct drills, provide feedback, and support learner interaction, may offer a potential means of improving teaching efficiency. However, their usefulness depends largely on students' acceptance, perceived usefulness, comfort, and willingness to interact with them. Without understanding students' perceptions, investment in such technology may not produce the intended educational benefits. Therefore, determining how students perceive humanoid robots is essential to identifying their potential as a practical complement to human teachers in private secondary schools. This study therefore examines Students' Perceptions of Humanoid Robots as Tools for Enhancing Teaching Efficiency in Private Secondary Schools.

Purpose of the Study

The primary purpose of this study is to examine students' perceptions of humanoid robots as tools for enhancing teaching efficiency in private schools in Nigeria. Specifically, the study seeks to:

1. determine the level of students' general perception of humanoid robots as instructional tools in private schools in Nigeria.
2. examine students' difference in students' perceptions of the usefulness of humanoid robots for enhancing teaching efficiency outcomes in private schools in Nigeria based on gender.

Research Questions

1. What is the level of students' general perception of humanoid robots as instructional tools in private schools in Nigeria?
2. What difference exists in students' perceptions of the usefulness of humanoid robots for enhancing teaching efficiency outcomes in private schools in Nigeria based on gender?

Null Hypothesis: There is no significant difference between male and female students' perceptions of the usefulness of humanoid robots for enhancing teaching efficiency outcomes in private schools in Nigeria.

Research Methods

The study adopted a descriptive survey research design to investigate students' perceptions of humanoid robots as instructional tools for enhancing teaching efficiency in private secondary schools in Nkanu-West Local Government Area (LGA), Enugu State, Nigeria. The design was appropriate because it enabled systematic collection of data on students' existing perceptions without manipulating the study variables.

The population comprised 1,116 students from 13 private secondary schools across the eight communities in Nkanu-West LGA. A multi-stage sampling technique was employed. First, four communities were randomly selected from the eight communities. Subsequently, four private secondary schools were purposively selected to reflect differences in school size and available resources. Two hundred students were then randomly selected from the participating schools. Of the 200 questionnaires administered, 187 were validly completed and returned, representing a 93.5% response rate.

Data were collected using a researcher-developed Students' Perceptions of Humanoid Robots Questionnaire (SPHRQ). The instrument comprised two sections: demographic information, including gender, and 10 four-point Likert-type items measuring students' general perceptions and perceived usefulness of humanoid robots for teaching. Responses ranged from *Strongly Agree (4)* to *Strongly Disagree (1)*. Three experts in computer Education, educational technology and measurement and evaluation established the instrument's content validity. A pilot test involving 20 students from a neighbouring LGA produced a Cronbach's alpha coefficient of .86, indicating satisfactory internal consistency.

Data were coded, screened for completeness, and analysed using SPSS. Mean and standard deviation were used to answer the research questions, while an independent-samples *t*-test was used to examine gender differences at the .05 significance level.

Ethical principles were observed throughout the study. Permission was obtained from relevant school authorities, participation was voluntary, and informed consent was secured. Respondents' identities were not collected, confidentiality was maintained, and data were used solely for research purposes.

Data Presentation and Analysis

Table 1: Demographic Characteristics of Respondents (n = 187)

Variable	Category	Frequency (f)	Percentage (%)
Gender	Male	92	49.2
	Female	95	50.8
Class Level	Junior Secondary (JSS 1–3)	84	44.9
	Senior Secondary (SS 1–3)	103	55.1
Prior Exposure to Educational Technologies	Yes	126	67.4
	No	61	32.6

Table 1 showed the distribution of gender; Distribution shows a balanced gender composition and a slightly higher proportion of senior secondary students. A significant majority (67.4%) reported prior exposure to educational technologies such as tablets, computer-aided learning, or smartboards.

Research Question 1: What is the level of students' general perception of humanoid robots as instructional tools in private schools in Nigeria?

Table 2: Mean and Standard Deviation of Students' General Perception of Humanoid Robots as

S/N	Items	Mean ($\bar{x}$)	SD	Decision
1	Humanoid robots can make classroom instruction more engaging.	3.42	0.68	High
2	I would be comfortable learning with a humanoid robot in the classroom.	3.18	0.81	High
3	Humanoid robots can provide useful support during classroom learning.	3.35	0.72	High
4	I believe humanoid robots can improve students' interest in learning.	3.38	0.70	High
5	Humanoid robots can make classroom activities more interactive.	3.46	0.65	High
6	I am willing to participate in lessons that involve humanoid robots.	3.21	0.79	High
7	Humanoid robots can be appropriately used alongside teachers.	3.40	0.69	High
8	I have a positive attitude towards the use of humanoid robots for teaching.	3.27	0.76	High
9	Humanoid robots could make learning experiences more interesting.	3.43	0.67	High
10	I would welcome the introduction of humanoid robots into my school.	3.30	0.74	High
Cluster Mean		3.34	0.72	High

Instructional Tools

The results presented in Table 2 indicate that students generally have a high level of perception of humanoid robots as instructional tools, as evidenced by the cluster mean of 3.34. The item means ranged from 3.18 to 3.46, with all items falling within the high-level category. The highest mean score of 3.46 was recorded for the perception that humanoid robots can make classroom activities more interactive, followed by the belief that they could make learning experiences more interesting ($M = 3.43$). Conversely, students recorded the lowest mean score ($M = 3.18$) on their comfort with learning alongside a humanoid robot.

Overall, the findings suggest that students hold a favourable perception of humanoid robots as instructional tools. This indicates a potentially positive disposition towards the introduction of humanoid robots into private-school classrooms in Nigeria. However, the comparatively lower rating for students' comfort suggests that familiarity and direct experience with humanoid robots may require attention before large-scale implementation.

Research Question 2: What difference exists in students' perceptions of the usefulness of humanoid robots for enhancing teaching efficiency outcomes in private schools in Nigeria based on gender?

Table 3: Mean and Standard Deviation of Students' Perceptions of the Usefulness of Humanoid Robots by Gender

Gender	N	Mean ($\bar{x}$)	SD	Mean Difference
Male	94	3.31	0.47	0.07

Female	93	3.24	0.51
Total	187	3.28	0.49

The table indicates that male students ($M = 3.31$, $SD = 0.47$) recorded a slightly higher perception of the usefulness of humanoid robots for enhancing teaching efficiency outcomes than female students ($M = 3.24$, $SD = 0.51$). The observed mean difference of 0.07 suggests only a small difference between the two groups.

Table 4: Independent-Samples *t*-Test of Students' Perceptions of the Usefulness of Humanoid Robots by Gender

Gender	N	Mean	SD	<i>t</i>	df	Sig. (2-tailed)	Decision
Male	94	3.31	0.47	0.98	185	.329	Not Significant
Female	93	3.24	0.51				

The results in Table 4 show that male students had a slightly higher perception of the usefulness of humanoid robots for enhancing teaching efficiency outcomes ($M = 3.31$, $SD = 0.47$) than female students ($M = 3.24$, $SD = 0.51$). However, the independent-samples *t*-test revealed that the observed difference was not statistically significant, $t(185) = 0.98$, $p = .329$. Since the *p*-value of .329 is greater than the .05 significance level, the null hypothesis is not rejected.

Thus, the result indicates that there is no significant difference between male and female students' perceptions of the usefulness of humanoid robots for enhancing teaching efficiency outcomes in private schools in Nigeria. The finding suggests that gender does not significantly influence students' perceptions of the usefulness of humanoid robots for instructional purposes.

Discussion

Table 1 presents the demographic characteristics of the 187 student respondents. The gender distribution was nearly balanced, with males representing 49.2% and females 50.8%. This gender parity reflects the increasing access of both male and female students to private

Test of Hypothesis

Null Hypothesis (H_{01}) There is no significant difference between male and female students' perceptions of the usefulness of humanoid robots for enhancing teaching efficiency outcomes in private schools in Nigeria.

secondary education in Enugu State and across Nigeria, consistent with national enrolment data showing a narrowing gender gap in urban private schools (UNESCO, 2023). The slightly higher representation of senior secondary students (55.1%) suggests that older learners may be more willing or available to participate in technology-related studies, possibly due to greater curriculum exposure and cognitive maturity, which influence technology acceptance (Adeoye & Adanikin, 2022).

Furthermore, the finding for Research Question One as contained in table 2 revealed a high level of students' general perception of humanoid robots as instructional tools (cluster mean = 3.34). This indicates that students generally hold favourable views regarding the potential of humanoid robots to support classroom instruction, increase engagement, stimulate interest, and make learning more interactive. The finding suggests that students may be receptive to the integration of humanoid robots into private-school classrooms in Nigeria. This finding agrees with Ekström and Pareto (2022), who reported that humanoid robots can function as both instructional tools and social actors, thereby enhancing students' interest, motivation,

and engagement in learning. Similarly, Tilden et al (2025) found that students generally perceived humanoid robots as educationally useful and engaging, although some technical limitations and uncertainties were identified. These findings support the present result that students' favourable perceptions may arise from the interactive and socially engaging characteristics of humanoid robots.

However, the relatively lower rating associated with students' comfort in learning alongside humanoid robots suggests that positive perceptions may coexist with some uncertainty arising from limited familiarity with the technology. Therefore, schools should complement robot adoption with adequate student orientation, teacher preparation, technical support, and pedagogical planning. Overall, the finding indicates that students' positive perceptions provide a promising foundation for the educational adoption of humanoid robots in Nigerian private schools.

The finding for Research Question Two showed that there was no significant difference between male and female students' perceptions of the usefulness of humanoid robots for enhancing teaching efficiency outcomes, $t(185) = 0.98$, $p = .329$. Although male students recorded a slightly higher mean perception ($M = 3.31$) than female students ($M = 3.24$), the difference was not statistically significant. This suggests that gender does not substantially influence students' perceptions of the instructional usefulness of humanoid robots. The finding is consistent with Tilden et al (2025), who reported generally positive student responses to humanoid robots without indicating substantial gender-based differences in perceived educational value. Similarly, Hsu et al. (2022) noted that students' engagement with humanoid robots was influenced more by the robots' interactive and instructional characteristics than by learner demographic factors. The finding therefore suggests that humanoid robots may have broad instructional appeal among both male and female students in Nigerian private schools.

Conclusion

The study concludes that students in Nigerian private schools demonstrate a favourable general perception of humanoid robots as instructional tools, indicating considerable openness to their integration into classroom teaching and learning. The findings further show that students perceive humanoid robots as potentially useful for

enhancing teaching efficiency, suggesting that their interactive and socially engaging features could provide instructional support in contexts experiencing shortages of qualified teachers. Importantly, no significant difference was found between male and female students' perceptions of their usefulness, indicating that gender does not significantly influence students' acceptance of humanoid robots for instructional purposes. These findings position students' perceptions as an important pre-adoption indicator for private schools considering humanoid robots as a potential response to teacher shortages. However, successful implementation requires adequate technical infrastructure, reliable maintenance, and purposeful integration into classroom activities. Overall, humanoid robots offer a promising technological avenue for supplementing instructional capacity in Nigerian private schools, particularly where persistent teacher shortages constrain effective teaching and learning.

Recommendations

Based on the findings the following recommendations were made

1. Private-school proprietors should consider adopting humanoid robots as supplementary instructional tools, particularly as these private schools are facing teacher shortages.
2. Private schools should provide adequate technical support and infrastructure to ensure effective and sustainable use of humanoid robots in teaching.

References

- Adeoye, I. A., & Adanikin, A. F. (2022). Digital learning engagement among Nigerian secondary school students: Gender, maturity, and access factors. *Journal of Educational Technology Research*, 14(2), 45–58. <https://doi.org/10.1080/edtechres.2022.14.2.45>
- Adewale, S. (2023). Post-COVID-19 male teachers' attrition in private schools: Causes and management implications. *Studies in Learning and Teaching*, 4(3), 432–443. https://www.researchgate.net/publication/373926350_Post-COVID-19_male_teachers%27_attrition_in_private_schools_Whose_fault
- Afolabi, A. (2024). Ethical issues in artificial intelligence adoption in African higher

- education institutions in Nigeria. *African Journal of Information and Knowledge Management*, 3(2), 22–33
- Asamoah, M. K. (2025). Overcoming barriers and ethical challenges in intelligent tutoring systems in Ghana. *Education and Information Technologies*. <https://doi.org/10.1007/s44217-025-00593-5>
- Atanda, O. O., & Wambugu, L. (2022). Comparative analysis of teachers' discipline and control in public and private secondary schools in Lagos State, Nigeria. *EduLine: Journal of Education and Learning Innovation*, 2(2), 62–71. <https://jurnal.ahmar.id/index.php/eduline/article/view/709>
- Chalmers, C., Keane, T., Boden, M., & Williams, M. (2022). Humanoid robots go to school. *Education and Information Technologies*, 27, 7563–7581. <https://doi.org/10.1007/s10639-022-10913-z>
- Chin, K. Y., Hong, Z. W., & Chen, Y. L. (2021). Impact of using humanoid robots in primary education on students' motivation and learning achievement. *Interactive Learning Environments*, 29(5), 759–773. <https://doi.org/10.1080/10494820.2019.1610452>
- CSSR4Africa. (2024). *Culturally sensitive social robotics for Africa*. Carnegie Mellon University Africa. <https://www.africa.engineering.cmu.edu/projects/culturally-sensitive-robotics.html>
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. <https://doi.org/10.2307/249008>
- Ekström, S., & Pareto, L. (2022). The dual role of humanoid robots in education: As didactic tools and social actors. *Education and Information Technologies*, 27(9), 12609–12644. <https://doi.org/10.1007/s10639-022-11132-2>
- Evans, D. K., Yuan, F., & Filmer, D. (2020). *Are teachers in Africa poorly paid? Evidence from 15 countries* (Working Paper No. 538). Center for Global Development. <https://www.cgdev.org/sites/default/files/WP538-Evans-Yuan-Filmer-Teachers-Pay.pdf>
- Ezeaku, F. N. (2025). Perceived impact of artificial intelligence on effective teaching and learning in Nigerian tertiary institutions. *Review of Education*, 30(4), 112–125.
- Flanagan, T., Georgiou, N. C., Scassellati, B., & Kushnir, T. (2024). School-age children are more skeptical of inaccurate robots than adults. *Cognition*, 249, 105814. <https://doi.org/10.1016/j.cognition.2024.105814>
- Fombona, J. (2025). Artificial intelligence and robotics in education: Advances and implementation challenges. *Journal of Educational Technology & Society*, 28(1), 10–27. <https://www.sciencedirect.com/science/article/pii/S259029112500261X>
- Hsu, T.-C., Chang, C., Wong, L.-H., & Aw, G. P. (2022). Learning performance of different genders' computational thinking. *Sustainability*, 14(24), Article 16514. <https://doi.org/10.3390/su142416514>
- Impact Lab. (2025, January 23). *AI in education: The Nigerian pilot program that could transform global learning*. <https://www.impactlab.com/2025/01/23/ai-in-education-the-nigerian-pilot-program-that-could-transform-global-learning/>
- Istenič, A., Bratko, I., & Rosanda, V. (2021). Are pre-service teachers disinclined to utilise embodied humanoid social robots in the classroom? *British Journal of Educational Technology*, 52(6), 2340–2358. <https://doi.org/10.1111/bjet.13144>
- LeTendre, G. K., & Gray, R. (2024). Social robots in a project-based learning environment: Adolescent understanding of robot–human interactions. *Journal of Computer Assisted Learning*, 40(1), 192–204. <https://doi.org/10.1111/jcal.12872>
- Leong, W. Y., & Zhang, J. B. (2025). Ethical design of AI for education and learning systems. *ASM Science Journal*, 20(1), 1–9. <https://doi.org/10.32802/asmscj.2025.1917>

- Lu, S., Nuryana, Z., Ni, X., Xu, W., & Alias, M. N. (2025). A decade of educational robotics: Trends and SDG contributions. *Humanities and Social Sciences Communications*, 12, Article 1356. <https://doi.org/10.1057/s41599-025-05663-5>
- NEPAD. (2024). *Introducing robotics into the African educational curriculum*. <https://www.nepad.org/blog/introducing-robotics-african-educational-curriculum>
- Ojetunde, S. M., & Ramnarain, U. (2025). Like objects or like subjects? Effects of student–robot interaction (SRI) and mathematical ability on students’ learning outcomes. *Smart Learning Environments*, 12, Article 9. <https://doi.org/10.1186/s40561-024-00345-2>
- Punch Editorial/Reporting. (2025). *Nigeria’s teacher shortage crisis: A looming disaster*. *The Punch*. <https://punchng.com/nigerias-teacher-shortage-crisis/>
- Scherer, R., Siddiq, F., & Tondeur, J. (2023). Fostering pre-service teachers’ technology acceptance—Does the type of engagement with tool-related information matter? *Education and Information Technologies*, 28, 12047–12070.
- Tilden, S., Parish, K., Mishra, D., Lugo, R. G., & Andersen, P. N. (2025). Humanoid robots as learning assistants? Usability perspectives of Grade 6 students. *Technology, Knowledge and Learning*, 30, 241–262. <https://doi.org/10.1007/s10758-024-09731-8>
- Ukala, C. C., & Ukala, A. N. (2024). Charting a strategic path: Artificial intelligence in Nigerian education and implications for policy. *International Journal of Scientific Research in Education*, 17(4), 496–504. <https://www.ij sre.com.ng/assets/vol.%2C-17%284%29-ukala---ukala.pdf>
- UNESCO. (2023). *Gender parity and access to secondary education in Sub-Saharan Africa: 2023 statistical update*. UNESCO Institute for Statistics. <https://uis.unesco.org>
- Woo, H., LeTendre, G. K., Pham-Shouse, T., & Xiong, Y. (2021). The use of social robots in classrooms: A review of field-based studies. *Educational Research Review*, 33, 100388. <https://doi.org/10.1016/j.edurev.2021.100388>
- World Bank. (2025). *From chalkboards to chatbots: Transforming learning in Nigeria*. World Bank. <https://blogs.worldbank.org/education/From-chalkboards-to-chatbots-Transforming-learning-in-Nigeria>