

Self-Reported Utilisation Patterns of Artificial Intelligence-Generated Feedback Among Undergraduate Science Students in Tertiary Institutions in Kwara State, Nigeria

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Abstract

The study investigated the self-reported utilization patterns of artificial intelligence-generated feedback among undergraduate science education students in three public universities in Ilorin, Kwara State. The study was a descriptive of survey type. The population of the study comprises all undergraduate science education students offering biology and computer science education in the three public universities in Ilorin metropolis, kwara state. The sample size was 397 respondents which comprising 146 male and 251 female students. A purposive sampling technique was used to select the institutions and simple random sampling to select respondents from each department. The instrument for data collection was a researcher designed copies of questionnaire entitled “Students Artificial Intelligence feedback pattern” (SAIFP)“. The Research instrument was given to three experienced science educators from the Department of Science Education, University of Ilorin, Nigeria for face and content validity. Also, the draft of the instrument was given to an expert in the field of measurement and evaluation for standard of the items. A reliability of 0.74 was obtained using Cronbach Alpha. Mean and standard deviation was used to answer the research questions, while t-test statistic was used to test the hypotheses at 0.05 level of significance. The study found out that AI-generated feedback utilization was high as reported by undergraduate students to support independent learning. Also, students encounter challenges that limit effective utilization, particularly issues related to technological accessibility, digital competence among others. The findings further revealed that gender does not determine students’ use of AI-generated feedback or the challenges they experience. It was recommended among others Universities should introduce structured AI literacy programmes to equip students with the knowledge and skills required to use AI-generated feedback to improve learning and every students be provided similar opportunities to access AI-based learning resources in the

institutions. As digital learning environments become more common in educational institutions, students' technology adoption may increase irrespective of gender

Keywords: *Patterns of Use, Artificial Intelligence, Generated Feedback, Undergraduate, Science Students, Tertiary Institutions*

Introduction

Artificial Intelligence (AI) has significantly reshaped science education through automated feedback systems, intelligent tutoring, and adaptive learning environments. Artificial Intelligence has been defined as the science and engineering of making intelligent machines. It has been proven to aid a positive influence on human life (Awofiranye, 2024). It is a technology that modifies educational tools and institutions by changing the teacher's job through advanced analytics, deeper learning and machine learning to monitor the speed of individuals. It increases proficiency of education by identifying the gaps in teaching and learning processes. It tends to explore and integrate into education a promising future as it improves learning, making it a valuable ally for progress and evolution in higher education (Ramirez & Fuentes Esparrell, 2024).

Artificial intelligence applications can directly enhance learning capabilities, save time, and obtain quick information for teaching and learning. Educators play a crucial role in the teaching-learning process by implementing interactive strategies that enable students to use AI applications to acquire new skills and knowledge, leading to better learning outcomes (Sirghi, et al., 2023). Enhancing the overall teaching experience and quality, AI systems are used to support the teacher and reduce workload by automating tasks such as administration, assessment, feedback, and plagiarism. AI helps educators have greater insight as to how students are progressing as well as adopting an approach for supporting students' individual differences. Furthermore, AI could foster the development of smart content and platforms for professional development of teachers. (Onaolapo and Onifade, 2020). The educational value of AI cannot be determined solely by the sophistication of the technology. AI becomes educationally meaningful when its application enhances teaching and learning processes through its feedback.

Feedback is very paramount in teaching and learning in education. In higher education, it helps students to understand their errors and improve their expression and clarity of ideas (Pang et al. 2024). Feedback encompasses the abilities of both learners and educators to comprehend, engage and benefit from it processes as well as highlighting their mutual responsibility in process (Boud & Dawson, 2023; Carless & Boud 2018). Feedback being universally acknowledged as a critical factor in educational success, its effective delivery and reception by students remains challenging (Carless and Winstone, 2023 & Yiğit and Seferoğlu, 2023). In recent times, researches have continued to emphasize AI-generated feedback as a key innovation that enhances formative assessment, learner engagement, and conceptual understanding in science

education. AI tools support scientific reasoning by analyzing student responses and generating instructional feedback in real time. He and Krajcik (2026) reported that AI technologies, including machine learning and large language models, are transforming science education by enabling personalized feedback and scalable instructional support.

Agostini and Picasso (2026) found that AI-generated feedback becomes more effective when guided by well-defined rubrics and contextual prompts, emphasizing the importance of instructional design in AI systems. In same vein, Xia et al. (2026) demonstrated that AI feedback guided by learning progressions is comparable in quality to expert-designed rubric-based feedback, with no significant differences in clarity, relevance, and engagement. In online science-related courses, generative AI feedback significantly improves student satisfaction and engagement, particularly when feedback is timely and actionable (Merodio et al., 2025). However, learners tend to prefer AI feedback when it complements rather than replaces human instructor feedback. Therefore, In this study, ***AI-generated feedback refers to automated generated comments, explanations, corrections or recommendations by artificial intelligence system that assist learners to provide answers or solve problems or assignments, clarify concepts or ambiguous words, simplifies learning with the purpose of helping the learners identify their strength and weaknesses , thus improving subsequent learning or performance.***

Several studies have been conducted on AI- generated feedback, among which was Li, et. al, (2026). Study on evaluating AI-generated feedback for formative assessment in higher education in Griffith University, Australia. The findings from the study revealed that AI-generated feedback provides structured and detailed comments for assessment components based on clear and objective criteria, with strong agreement with human marking practices. Findings from the study emphasised on the importance of human oversight for qualitative and interpretive evaluation. It was recommended that a balanced human-AI approach, grounded in pedagogical intent and careful integration, is essential for t effective adoption of AI-assisted feedback in higher education. Venter, et al. (2025). Explored the use of artificial intelligence in effective feedback delivery. The study focused on the development of a custom prompt for GPT-4 within a no-code web application, designed to deliver AI-generated feedback to second-year accounting students on discussion or essay-style questions in a large competency-based intermediate accounting course in South Africa. The prompt aligns with the principles of effective feedback and was tested in a pilot evaluation. Results indicated that the AI-generated feedback generally adhered to these principles, though some variability was observed across the different feedback dimensions. Findings revealed that large language models can complement traditional feedback. Danjuma (2025) studied the potential of Artificial Intelligence (AI) in enhancing assessment in Basic Science Education in Jalingo Education Zone, Taraba State, Nigeria. The findings revealed that AI tools can enhance feedback by making it faster, more accurate, and more consistent, thereby addressing delays associated with traditional teacher-based feedback. The study also,

highlighted the potential benefits of AI tools in improving assessment practices. It was recommended that science educators receive training to effectively use Artificial Intelligence tools in their assessments, and that policymakers should develop and implement AI-based assessment tools. Akintokun and Bolarinwa(2025) investigated the impact of artificial intelligence as a science education tool for enhancing academic experience of students in Federal College of Education (Special), Nigeria. The study showed that AI enhances feedback and learning engagement but a Low level of institutional AI integration. Agbarakwe and Chibueze (2024) conducted a study on leveraging artificial intelligence for enhanced assessment and feedback mechanisms in Nigeria higher education system in University of Port Harcourt, Nigeria. It was an analytical study The study argues that AI can significantly improve feedback by enabling real-time responses, automated grading, and personalized learning support, which are critical in science education where timely correction enhances conceptual understanding. It also discussed ethical concerns, data privacy issues, and digital literacy gaps as barriers to effective adoption.

The potential of AI-generated feedback is responding to the long-standing challenges of providing timely feedback to learners. Lee and Moore (2024), in a systematic review of empirical studies published between 2019 and 2023, analysed the use of generative AI for automated feedback in higher education. This review revealed that generative AI had been used to provide different forms of feedback across instructional contexts and could alleviate instructors' workload by automating repetitive feedback and grading activities. However, challenges were identified, indicating that the presence of an automated feedback mechanism does not automatically guarantee effective learning. However, the increasing advocate for the adoption of AI in education to meet up global development in this era of technological advancement has paved way for transforming teaching and learning. AI has been proved to providing students with instant, personalized, and adaptive feedback that can improve understanding, academic performance, and independent learning. AI-generated feedback is increasingly being used to support assignments, assessments, and other learning activities. Despite these importance, concerns have been raised on how students utilize this feedback in their learning processes. In Nigerian universities, there is limited empirical evidence on students' patterns of using AI-generated feedback. As a result, it remains unclear whether students use AI feedback to support meaningful learning or simply as a convenient means of completing academic tasks. This gap in knowledge was the rationale behind this present study. Therefore, this study investigated students' self-reported patterns of use of AI-generated feedback, with a view to providing evidence that will inform the integration of AI technologies into teaching and learning in tertiary institutions.

Research Questions

1. What is the level of pattern of use of AI-generated feedback in learning by undergraduate science education students?
2. Does difference exists in the self-reported pattern of use of AI-generated feedback in learning based on gender.
3. What challenges do undergraduate science education students encounter in using AI-generated feedback?

Hypotheses

1. There is no significant difference in the self-reported pattern of use of male and female undergraduate science education students toward AI-generated feedback in learning.
2. There is no significant difference between male and female undergraduate science education students in the challenges they encounter in using AI-generated feedback in learning

Methodology

The study was a ***descriptive research of survey type***. The population comprises all undergraduate students in the three purposively selected public universities in Ilorin metropolis, Kwara state. Students from offering Science education with specialization in biology and computer. A sample comprise of 397 undergraduate students study biology education and computer education. A purposive sampling technique was used to select the institutions and simple random sampling to select respondents from the two departments. The sample comprise of 146 male and 251 female students. A researcher designed copies of questionnaire entitled “Students Artificial Intelligence feedback pattern” (SAIFP)” was used for data collection. The Research instrument was given to three experienced science educators from the Department of Science Education, University of Ilorin, Nigeria for face and content validity. Also, the draft of the instrument was given to an expert in the field of measurement and evaluation for standard of the items. A reliability of 0.74 was obtained using Cronbach Alpha. Mean and standard deviation was used to answer the research questions, while t-test statistic was used to test the hypotheses at 0.05 level of significance. The questionnaire consisted of three sections: section A: Demographic Information consisted of gender; age; department and frequency of AI tool usage. Section B: pattern of use of AI-generated feedback. Section C: ***challenges encounter in using AI-generated feedback in learning in my university*** The instrument contained eight items for Section B and C each. Respondents indicate their level of agreement on a 4-point likert scale: Strongly Agree (SA) = 4, Agree (A) = 3 Disagree (D) = 2 and Strongly Disagree (SD) = 1.. Data collected were analysed using mean, standard deviation and t-test statistic at 0.05 level of significance. The researcher

and research assistants visited the institutions and distributed the copies of the questionnaires to the respondents personally.

Data Analysis and Results

Data collected were analysed using mean, standard deviation for research questions. **Decision Rule used for the results were;** 3.50–4.00 = Very High, 2.50–3.49 = High, 1.50–2.49 = Low and 1.00–1.49 = Very Low

Research Question 1: What is the pattern of use of AI-generated feedback in learning by undergraduate science students?

Table 1: Mean and Standard Deviation on the Patterns of Use of AI-generated Feedback among Science Students

S/N	Pattern of Use	Mean ($\bar{x}$)	SD	Decision
1.	I rely on AI-generated feedback to identify my mistakes.	3.36	0.79	Agree
2.	I use AI-generated feedback for examination preparation.	3.27	0.81	Agree
3.	AI-generated feedback helps me study independently.	3.48	0.70	Agree
4.	I compare AI-generated feedback with lecturers' comments.	3.18	0.87	Agree
5.	I verify AI-generated feedback before applying it.	3.11	0.86	Agree
6.	I use AI-generated feedback to improve my assignments.	3.42	0.71	Agree
7.	I use AI-generated feedback before submitting coursework.	3.31	0.83	Agree
8.	I use AI-generated feedback regularly during learning.	3.29	0.77	Agree
	Grand mean	3.30	0.79	High

Table 1 revealed that respondents exhibited high patterns of AI-generated feedback in learning. As the grand mean was 3.30 ($SD = 0.79$)

Research Question 2: Does difference exists in the self-reported pattern of use of AI-generated feedback in learning based on gender.

Table 2: Mean and Standard Deviation of Science education Students on the Patterns of Use of AI-generated Feedback based on Gender

Gender	N	Mean($\bar{x}$)	SD
Male	146	3.24	0.53
Female	251	3.34	0.48

Table 2 shows that female students obtained a slightly higher mean score (3.34) than male students (3.24), suggesting a marginally higher pattern of use of AI-generated feedback

among female students. **Therefore, there was a marginal difference in the patterns of use of AI-generated feedback in learning by the respondents based on gender**

2.2 Research Question 3: *What challenges do undergraduate science education students encounter in using AI-generated feedback in learning?

Table 3: Mean and Standard Deviation on the Challenges encountered by Science Students in Using AI-generated Feedback

S/N	Challenge	Mean	SD	Decision
1.	Difficulty interpreting technical feedback.	3.12	0.86	Agree
2.	Limited digital literacy.	3.09	0.84	Agree
3.	Lack of institutional guidance on AI use.	3.34	0.75	Agree
4.	Overdependence on AI-generated responses.	3.28	0.77	Agree
5.	Limited internet connectivity.	3.47	0.69	Agree
6.	Difficulty determining the accuracy of AI feedback.	3.25	0.82	Agree
7.	High cost of internet subscription.	3.39	0.74	Agree
8.	Inconsistent quality of AI-generated feedback.	3.20	0.81	Agree
<i>Grand Mean</i>		<i>3.27</i>	<i>0.79</i>	<i>High</i>

Table 3 indicates students responses to the challenges in using AI-generated feedback during learning. Limited internet connectivity and high cost of internet subscription had the high means among the challenges. The grand mean of 3.27 (SD=079) revealed a high acceptances of these challenges by the respondents

H0₁: There is no significant difference in the self-reported pattern of use of male and female undergraduate science students toward AI-generated feedback in learning.

Table 4: Independent Samples t-test on the Patterns of Use of AI-generated Feedback by Gender

Gender	N	Mean	SD	df	t-cal	Sig. (2-tailed)	Decision
Male	146	3.24	0.53	395	1.82	0.070	Not Significant
Female	251	3.34	0.48				

Table 4 shows that the calculated value p is 0.070 greater than the significant 0.05, hypothesis one is not rejected. Therefore, there is **no significant difference** between male and female undergraduate science education students in their patterns of use of AI-generated feedback in learning.

H0₂: There is no significant difference between male and female undergraduate science education students in the challenges they encounter in using AI-generated feedback in learning

Table 5:Independent Samples t-test on the Challenges Encountered in Using AI-generated Feedback by Gender

Gender	N	Mean	SD	df	t-cal	Sig. (2-tailed)	Decision
Male	146	3.23	0.55	395	0.96	0.338	Not Significant

Gender	N	Mean	SD	df	t-cal	Sig. (2-tailed)	Decision
Female	251	3.29	0.50				

Table 5 shows that the calculated value p is **0.338** greater than the significant **0.05**, the null hypothesis is **therefore not rejected**. This implies that there is **no statistically significant difference** between male and female science education undergraduate students' responses to challenges they encounter in using AI-generated feedback in learning

Discussion of Findings

This study revealed that undergraduate students use AI-generated feedback to improve learning. This provided evidence for undergraduate students utilisation of AI technologies in learning in tertiary institutions in Kwara State. The findings revealed that undergraduate students use AI-generated feedback as a learning support tool in improving assignments, identifying learning difficulties, clarifying concepts, and independent learning among others. This supports the findings of Agbarakwe and Chibueze (2024) that artificial intelligence has the potential to enhance formative assessment by providing timely and adaptive feedback that promotes conceptual understanding and self-regulated learning. The findings also, revealed that gender had a significant influence on students' utilization of AI-generated feedback in learning. The result suggests that gender may not be a major factor determining students' adoption of AI-generated feedback. This could be attributed to the availability of digital technologies, factors, accessibility, attitude, and perceived usefulness rather than gender. This is in line with the International Telecommunication Union (2023) reported that gender differences in internet access and digital participation continue to exist globally but are gradually influenced by broader improvements in connectivity and digital development. As well as Scherer, et.al (2020) that these differences in gender were shaped by experience, accessibility, and technological confidence rather than gender alone. In additions, male and female undergraduate science students differed significantly in the challenges they experienced while using AI-generated feedback. This implies that the difficulties associated with AI use are largely related to problems of internet connectivity, high data, subscription digital, competence, among others (Zawacki-Richter, et al., 2019).

Conclusion

The outcomes of this study concluded that AI-generated feedback has become an emerging learning resource among science education students in the sampled university in Ilorin. Students use AI-generated feedback significantly to improve personalized learning experiences, and promoted better student engagement in the three public universities in Ilorin metropolis. Students utilize AI-generated feedback for different academic purposes, including improving understanding, correcting errors, enhancing assignments, and supporting independent learning. However, despite its benefits, students encounter challenges that may limit effective utilization,

particularly issues related to technological accessibility, digital competence, e.tc. The findings further suggest that gender does not necessarily determine students' use of AI-generated feedback or the challenges they experience.

Recommendations

Based on the findings, the researcher recommended that:

1. Universities should introduce structured AI literacy programmes to equip students with the knowledge and skills required to use AI-generated feedback to improve learning.
2. All students be provided similar opportunities to access AI-based learning resources in the institutions. As digital learning environments become more common in educational institutions, students' technology adoption may increase irrespective of gender.
3. Institutions should improve access to reliable internet connectivity, digital devices, and technology-enabled learning facilities ensure that all learners can benefit from AI-supported learning opportunities.

References

- Agbarakwe, H. A., & Chibueze, O. O. (2024). Leveraging artificial intelligence for enhanced assessment and feedback mechanisms in Nigeria higher education system. *International Journal of Research and Innovation in Social Science*, 8(9), 142–151. <https://dx.doi.org/10.47772/IJRISS.2024.809012>
- Akintokun, O. A., & Bolarinwa, O. T. (2025). Perceived impact of artificial intelligence as a science education tool for enhancing a change in academic experience. *Journal of Theoretical and Empirical Studies in Education*, 10(1), 423–437.
- Awofiranye, M. (2024). The challenges of using AI in education. <https://www.afterschoolafrica.com>.
- Agostini, D., & Picasso, F. (2026). *Evaluation of large language models' educational feedback in higher education: Potential, limitations and implications for educational practice*. arXiv. <https://doi.org/10.48550/arXiv.2602.02519>
- Boud, D., and P. Dawson. 2023. "What Feedback Literate Teachers Do: An Empirically-Derived Competency Framework." *Assessment & Evaluation in Higher Education*, 48(2), 158–171. <https://doi.org/10.1080/02602938.2021.1910928>.
- Carless, D. and Winstone, N. (2023). Teacher feedback literacy and its interplay with student feedback literacy. *Teaching in higher education*, 28(1), 150-163. <https://doi.org/10.1080/13562517.2020.1782372>
- Carless, D., and D. Boud. (2018). "The Development of Student Feedback Literacy: Enabling Uptake of Feedback." *Assessment & Evaluation in Higher Education*, 43(8): 1315–1325. <https://doi.org/10.1080/02602938.2018.1463354>.
- Danjuma, S. G. (2025). Artificial intelligence in basic science education: A Nigerian perspective on enhancing assessment. *International Journal of Innovations in Educational Science and Technology Research*, 14(2), 33–40. <https://bwjournal.org/index.php/bsjournal/article/view/3024>

- Scherer, R., Siddiq, F., & Tondeur, J. (2020). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology. *Computers & Education*, 128, 13–35. <https://doi.org/10.1016/j.compedu.2018.09.009>
- Sirghi, N., Voicu, M. C., Noja, G. G. and Socoliuc (Gurija), O. R. (2023). Challenges of artificial intelligence on the learning process in higher education. *Amfiteatru Economic*, 26(65), 53-70.
- He, P., & Krajcik, J. (2026). Artificial intelligence in science education: Global insights and future directions. *Disciplinary and Interdisciplinary Science Education Research*, 8(6). <https://link.springer.com/article/10.1186/s43031-026-00154-2>
- Medina Merodio, J. A., Morales Chan, M., Barchino Plata, R., Amado-Salvatierra, H. R., & Hernandez-Rizzardini, R. (2026). Impact of generative artificial intelligence feedback on online student satisfaction. *Frontiers in Computer Science*, 7, Article 1708114. <https://doi.org/10.3389/fcomp.2025.1708114>
- International Telecommunication Union. (2023). *Facts and figures 2023: Measuring digital development*. International Telecommunication Union. <https://www.itu.int/itu-d/reports/statistics/facts-figures-2023/>
- Lee, S. S., & Moore, R. L. (2024). Harnessing generative AI (GenAI) for automated feedback in higher education: A systematic review. *Online Learning*, 28(3), 82–106.
- Li, X., Chen, D., Tuffley, D., Scott, G., Tuxworth, G., Yao, T., & Torrisi-Steele, G. (2026). Evaluating AI-generated feedback for formative assessment in higher education. *International Journal of AI in Pedagogy, Innovation and Learning Futures*, 2026(1). <https://doi.org/10.46787/ijaipil.v2026i1.6962>
- Onaolapo, S., & Onifade, T. (2020). Teaching and learning in the cloud: Prospects and challenges of artificial intelligence for education in Africa. In *Proceedings of the 2020 International Conference on Sustainable Development (ICSD)* (pp. 1–9). European Center of Sustainable Development. <https://ic-sd.org/2020/11/21/proceedings-from-icsd-2020/>
- Pang, T. Y., Kootsookos, A., & Cheng, C.-T. (2024). Artificial intelligence use in feedback: A qualitative analysis. *Journal of University Teaching and Learning Practice*, 21(6), 108–125. <https://doi.org/10.53761/40wmcj98>
- Ramirez, E.A.B., & Fuentes Esparrell, J.A. (2024). Artificial Intelligence (AI) in Education: Unlocking the Perfect Synergy for Learning. Educational Process: *International Journal*, 13(1): 35-51. <https://doi.org/10.22521/edupij.2024.131.3>
- Venter, J., Coetzee, S. A., & Schmulian, A. (2025). Exploring the use of artificial intelligence (AI) in the delivery of effective feedback. *Assessment & Evaluation in Higher Education*, 50(4), 516–536. <https://doi.org/10.1080/02602938.2024.2415649>
- Xia, X., Yuruk, N., Wang, Y., & Zhai, X. (2026). Using learning progressions to guide AI feedback for science learning. *arXiv*. <https://doi.org/10.48550/arXiv.2603.03249>
- Yiğit, M. F., & Seferoğlu, S. S. (2023). Effect of video feedback on students' feedback use in the online learning environment. *Innovations in Education and Teaching International*, 60(1), 15–25. <https://doi.org/10.1080/14703297.2021.1966489>
- Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – Where are the educators? *International Journal of Educational Technology in Higher Education*, 16, Article S39. <https://doi.org/10.1186/s41239-019-0171-0w>