

Influence of Artificial Intelligence-driven Feedback on the Motivation and Engagement of Economically Marginalised Students in Physical Fitness Classes

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Abstract

In the extant literature, no known research, especially within Sub-Saharan Africa (especially in Nigeria), has considered how economically marginalised students navigate this era of AI-infested learning, nor how their socioeconomic status, given these AI-driven technologies, impacts their motivation and engagement in physical education programmes. This study investigated the influence of artificial intelligence-driven feedback on the motivation and engagement of economically marginalised students in physical fitness classes at the Federal University Oye-Ekiti, Ekiti State, Nigeria. Adopting a descriptive survey design, the research examined how Artificial Intelligence (AI) driven feedback using video recordings enhances students' learning experiences and participation in physical fitness classes. The study population comprised 551 students enrolled in Human Kinetics and Health Education programmes at the sampled university, and a census approach was employed. Data were collected using a validated and reliable questionnaire titled Artificial Intelligence-Driven Feedback in Physical Fitness Classes Questionnaire (AIFPFQ), with a Cronbach's alpha coefficient of 0.87. The descriptive and inferential statistics of correlation and regression analyses were employed for data analysis at a 0.05 significance level. The results revealed that economically marginalised students held highly positive perceptions of AI-driven feedback, recognizing its role in improving understanding, performance, and interest in fitness sessions. Findings further indicated that AI-driven feedback significantly enhanced the economically marginalised students' motivation and engagement, with motivation showing a stronger association with AI-based feedback than engagement. Moreover, a strong positive relationship was observed between motivation and engagement, underscoring the reciprocal link between intrinsic drive and active participation in fitness learning.

Keywords: Artificial Intelligence, Engagement, Feedback, Motivation, Nigeria, Physical Fitness Classes.

Introduction

The rapid advancement of digital (enabling) technologies and the growing emphasis on holistic health and wellness have transformed the global fitness landscape (1). Traditionally, physical fitness programmes have followed a uniform pattern that often neglects individual differences in physiology, motivation, and learning styles (2, 3). Artificial intelligence (AI) technologies are now redefining this approach by offering personalized, adaptive, and data-informed exercise experiences (4, 5).

These innovations not only improve exercise outcomes but also enhance learners' motivation and engagement by giving them a clearer sense of their development (6-8). Feedback given to learners through AI technologies has been found to improve performance by guiding learners toward self-regulation, skill mastery, and sustained effort (9-12). AI-driven feedback has shown strong potential to increase motivation and engagement in physical fitness classes (13). Globally, the World

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Globally, the World Health Organization recognizes physical activity as one of the key determinants of both physical and mental well-being (14). Yet, physical inactivity continues to be a global concern, with sedentary lifestyles affecting between sixty and eighty-five percent of adults and youth, especially university students (15, 16). In Nigeria, for instance, physical education is a vital component of the national curriculum, designed to promote lifelong fitness, health, and wellness among students (17). However, amidst its merit of leading to better motivation and engagement, the implementation has been hampered by inadequate facilities, insufficient equipment, a shortage of qualified teachers, and learner-related factors (18-21). Economically marginalised students are those whose sources of income fall below the federal poverty threshold. Students who are economically marginalised frequently experience various forms of mistreatment, seclusion, exclusion, and discrimination because of their socioeconomic status, which negatively affects their academic outcomes (22, 23).

Most AI technologies are created for commercial use, which presents difficulties for their application in education (24). Feedback has received a lot of attention in education as a way to improve learning (25). Due to the rising workloads and time constraints faced by educators, it is difficult to provide prompt and tailored feedback on open-ended student responses (26). The motivational mechanisms by which AI-driven feedback promotes a growth mindset, learner engagement, and persistence were examined by previous research (27). The results showed that engagement and perseverance were significantly impacted by perceived AI feedback quality. An exploratory meta-analysis on the efficacy of AI-generated feedback in comparison to conventional human-provided feedback was carried out by a past study (25). The results show that students who got AI-generated input and those who received human-generated feedback did not differ statistically significantly in their learning outcomes. Past research investigated how the integration of AI into sport-based learning influences learners' physical performance and attitudes (28). Results showed that learners taught with AI support performed better in physical fitness tasks and displayed more positive attitudes towards physical education.

A past study explored how AI technologies reshape exercise experiences by enhancing personalization and consistency at a Ghanaian university (29). The study found that AI-assisted fitness tools led to more consistent activity patterns and better fitness outcomes. Studies conducted literature reviews on the use of AI in promoting physical activity and its effects on lifestyle and academic performance among university students (30, 31). The review revealed that AI-supported fitness tools not only improve physical health but also enhance mental well-being, reduce stress, and boost academic achievement. A previous study further analysed how AI is transforming the fitness industry through personalization and efficiency. Surveying 90 pre-service physical education students (29). This research found that AI tools helped participants create more individualized exercise routines, improve consistency, and increase activity levels. Previous research had explored the influence of AI on student engagement and learning outcomes among higher education physical education students using a quasi-experimental research design (32). Results showed that students in the AI group achieved higher engagement and learning outcomes. A similar past study also depicts that the usage of AI-Driven support affects the workload, autonomy, and role conceptualization of Physical Education intern instructors (33).

Underpinning this research are the Self-Determination Theory (SDT) and the Social Cognitive Theory. SDT is a psychological theory that proposes that human behavior is motivated by three innate psychological needs: autonomy, competence, and relatedness (34). According to SDT, people are more likely to be motivated and engaged in activities that satisfy these three needs. The SDT theory informs this study by highlighting the importance of autonomy, competence, and relatedness in motivating economically marginalized students to participate in physical fitness classes.

Social Cognitive Theory (SCT), originally formulated by Albert Bandura, offers a powerful explanatory framework for understanding how AI-driven feedback can influence the motivation and engagement of economically marginalized students in physical fitness classes. At its core, SCT posits that human behavior is shaped by the dynamic, reciprocal interaction of personal

(cognitive), behavioral, and environmental factors, a concept known as triadic reciprocal determinism (35, 36). Should feedback be authentic and thorough, these students need to be supported and given easy access to AI-driven technologies for learning purposes. In the extant literature, no known research, especially within the Nigerian space, has considered how these economically marginalized students navigate this era of AI-infested learning, nor how their socioeconomic status, given these AI-driven technologies, impacts their motivation and engagement in physical education programmes. It is against this backdrop that this study examined the influence of AI-driven feedback on economically marginalised students' motivation and engagement in physical fitness classes at the Federal University, Oye-Ekiti, Nigeria.

Research Questions

- (a) What are the perceptions of economically marginalised students on the use of AI-driven feedback in physical fitness classes?
- (b) What is the level of motivation among economically marginalised students participating in AI-driven physical fitness classes?
- (c) To what extent does AI-driven feedback influence economically marginalised students' engagement in physical fitness activities?
- (d) What challenges do students face in the use of AI-driven feedback for physical fitness learning?

Hypotheses

Ho1: AI-driven feedback using video recordings has no significant influence on economically marginalised students' motivation in physical fitness classes.

Ho2: AI-driven feedback using video recordings has no significant influence on economically marginalised students' engagement in physical fitness classes.

Ho3: There is no significant relationship between AI-driven feedback using video recordings, motivation, and engagement in physical fitness classes among economically marginalised students.

Methodology

This study adopted a descriptive survey research design to examine the influence of artificial intelligence-driven feedback via video recordings on motivation and engagement in physical fitness

classes among economically marginalized students at the Federal University Oye-Ekiti, Ekiti State, Nigeria. The design was considered appropriate because it allowed the researcher to collect data from a large population and describe existing conditions as they relate to students' experiences with AI-driven feedback in physical fitness learning (26). Furthermore, the design is methodologically appropriate when the goal is to describe and quantify relationships among AI feedback perceptions, motivation, and engagement in real-world educational contexts, while acknowledging the limits of causal inference (8). The approximate GPS coordinates for Oye-Ekiti (the town that serves as the headquarters of Oye Local Government Area in Ekiti State, Nigeria) are: Decimal degrees: Latitude 7.80° N, Longitude 5.33° E; Degrees-minutes-seconds (DMS): About 7° 48' N, 5° 20' E (more precisely ~7° 47' 59" N, 5° 19' 57" E).

The population of the study comprised all 1034 students enrolled in Human Kinetics and Health Education programmes (departments) in the faculty of education. Since the study's target was economically marginalized students, the purposive sampling technique was used in selecting those students who self-identified as such, given the criteria spelt out in the ethics approval and faculty guideline for "financially constrained students". In all, 551 respondents voluntarily agreed to participate in the study. With a 100% response rate. This was attained due to the fact that the questionnaires were only administered to participants upon their attending a designated required module, leading to their complete response to the administered questionnaire.

A structured questionnaire titled Artificial Intelligence-Driven Feedback in Physical Fitness Classes Questionnaire (AIFPFQ) was used to collect the study's data. The questionnaire consists of 25 items arranged in four sections. The first section captured the respondents' demographic information, while the other three focused on respondents' perceptions of AI-driven feedback, its influence on motivation, and its impact on engagement in physical fitness classes. To ensure validity, the instrument was reviewed by three experts in physical education, educational measurement, and educational technology, who examined the items for clarity, relevance, and alignment with the study objectives. Reliability of

the instrument was established through a pilot test, and the result yielded a Cronbach's alpha coefficient of 0.87, indicating that the questionnaire was internally consistent and reliable for data collection. The administration of the instrument was carried out by the researchers during regular lecture periods with the approval of departmental heads and course lecturers in the sampled departments. The purpose of the study was clearly explained to the students, and they were assured that their responses would be treated with confidentiality. Participation was entirely voluntary, and respondents were encouraged to provide honest answers.

For the data analysis, descriptive statistics such as frequency counts and percentages, mean, and standard deviation were used to summarise the

data and describe respondents' views on each research question. Inferential statistics, specifically correlation and regression analyses, were employed to examine the relationships among AI-driven feedback, motivation, and engagement in physical fitness classes, as well as to test the stated hypotheses at a 0.05 level of significance. Regarding ethical considerations, the study upheld the principles of respect, confidentiality, and informed consent. Permission was obtained from relevant authorities before the commencement of data collection. Participants were informed of the study's objectives and assured that their information would be used solely for academic purposes, with their identities remaining anonymous throughout the research process.

Results

Table 1: Frequency Distribution of Respondents by Demographic Characteristics and Physical Activity Engagement

Variables	Category	Frequency	Percentage (%)
Gender	Male	209	37.9
	Female	342	62.1
Age	16–19 years	190	34.5
	20–24 years	246	44.6
	25 years or more	115	20.9
Level	100	175	31.8
	200	77	14
	300	133	24.1
	400	166	30.1
Department	Human Kinetics	239	43.4
	Health Education	312	56.6
Frequency of Engagement in Physical Activity Outside Class	Daily	96	17.4
	2–3 times a week	169	30.7
	1–2 times a week	189	34.3
	Rarely	97	17.6

Table 1 presents the demographic characteristics of the respondents and their level of engagement in physical activities. Out of the total 551 respondents, 209 (37.9%) were male, while 342 (62.1%) were female, showing that females constituted the larger proportion of participants. In terms of age, 190 (34.5%) were between 16–19 years, 246 (44.6%) were aged 20–24 years, and 115 (20.9%) were 25 years or older, indicating that most respondents were young adults. Across academic levels, 175 (31.8%) were in 100 level, 77 (14.0%) in 200 level, 133 (24.1%) in 300 level, and 166 (30.1%) in 400 level, suggesting a fairly balanced representation across the four levels, with the highest proportion from 100 level. Departmental distribution reveals that 239 (43.4%) of the respondents were from Human

Kinetics, while 312 (56.6%) were from Health Education, reflecting a higher participation from the latter group. Regarding physical activity outside the classroom, 96 (17.4%) engaged daily, 169 (30.7%) participated 2–3 times a week, 189 (34.3%) took part 1–2 times a week, and 97 (17.6%) rarely participated. This pattern suggests that most students were moderately active in physical fitness activities beyond class sessions.

Research Questions

RQ 1: What are the perceptions of economically marginalised students on the use of AI-driven feedback in physical fitness classes?

Table 2 presents students' perceptions of the use of AI-driven feedback in physical fitness classes. The result indicates that most students have a favorable perception of AI-driven feedback in enhancing

their learning experience during physical fitness activities. Given the average mean score of 3.56, which is well above the criterion mean of 2.50, it can be inferred that economically marginalised students generally hold positive perceptions of AI-

driven feedback in physical fitness classes. This indicates that they recognize its usefulness, interactivity, accuracy, and effectiveness in enhancing learning outcomes and engagement in fitness activities.

Table 2: Frequency Distribution of Students' Perception of AI-Driven Feedback in Physical Fitness Classes

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree	Mean	SD
I find AI-driven feedback useful in improving my fitness performance.	5 (0.9%)	42 (7.6%)	185 (33.6%)	319 (57.9%)	3.48	0.68
AI-based feedback helps me understand my strengths and weaknesses in physical exercises.	3 (0.5%)	2 (0.4%)	167 (30.3%)	379 (68.8%)	3.67	0.51
The use of AI tools makes fitness sessions more interactive and interesting.	3 (0.5%)	4 (0.7%)	127 (23.0%)	417 (75.7%)	3.74	0.49
I trust the accuracy of AI-generated feedback during physical fitness activities.	3 (0.5%)	4 (0.7%)	224 (40.7%)	320 (58.1%)	3.56	0.54
Overall, I perceive AI-driven feedback as an effective tool for fitness learning.	3 (0.5%)	7 (1.3%)	335 (60.8%)	206 (37.4%)	3.35	0.53
Criterion Mean = 2.50; Average Mean = 3.56						

Note: SD = Standard Deviation, % = Percentage

RQ 2: What is the level of motivation among economically marginalised students participating in AI-driven physical fitness classes?

Table 3 reveals that students generally showed high motivation toward AI-driven physical fitness classes. With an average mean of 3.43 (above the

criterion mean of 2.50), these findings imply that economically marginalised students' motivation toward AI-based physical fitness learning is generally high, supported by a strong consensus as reflected in the low standard deviations.

Table 3: Frequency Distribution of Students' Motivation toward AI-Driven Feedback in Physical Fitness Classes

Statement	Very Low	Low	High	Very High	Mean	SD
AI-driven feedback motivates me to participate more actively in fitness classes.	3 (0.5%)	6 (1.1%)	280 (50.8%)	262 (47.5%)	3.45	0.58
I feel more confident about my progress when I receive AI-generated performance reports.	5 (0.9%)	4 (0.7%)	224 (40.7%)	318 (57.7%)	3.55	0.6
The personalized feedback from AI tools encourages me to improve my physical fitness.	2 (0.4%)	7 (1.3%)	222 (40.3%)	320 (58.1%)	3.56	0.57
The use of AI in physical fitness keeps me consistent with my exercise routine.	7 (1.3%)	38 (6.9%)	263 (47.7%)	243 (44.1%)	3.35	0.64
I am excited to attend classes that incorporate AI-driven fitness evaluation.	5 (0.9%)	38 (6.9%)	321 (58.3%)	187 (33.9%)	3.26	0.63
Criterion Mean = 2.50; Average Mean = 3.43						

Note: SD = Standard Deviation, % = Percentage

Table 4: Frequency Distribution of Students' Engagement toward AI-Driven Feedback in Physical Fitness Activities

Statement	Very Low	Low	High	Very High	Mean	SD
AI-driven feedback increases my concentration during fitness sessions.	6 (1.1%)	40 (7.3%)	281 (51.0%)	224 (40.7%)	3.31	0.65
I participate more actively in exercises when AI feedback is provided.	4 (0.7%)	77 (14.0%)	205 (37.2%)	265 (48.1%)	3.33	0.74
AI-based performance tracking encourages teamwork and collaboration.	4 (0.7%)	40 (7.3%)	357 (64.8%)	150 (27.2%)	3.19	0.58
Receiving immediate feedback from AI tools sustains my interest in class activities.	5 (0.9%)	38 (6.9%)	357 (64.8%)	151 (27.4%)	3.19	0.59
The use of AI feedback promotes continuous participation in physical activities.	3 (0.5%)	38 (6.9%)	264 (47.9%)	246 (44.6%)	3.37	0.64

Criterion Mean = 2.50; Average Mean = 3.28

Note: SD = Standard Deviation, % = Percentage

RQ 3: To what extent does AI-driven feedback influence economically marginalised students' engagement in physical fitness activities?

Table 4 presents the extent to which AI-driven feedback influences students' engagement in physical fitness activities. The findings show that a large proportion of respondents reported a high level of engagement across all items. The mean scores, which range from 3.19 to 3.37, all exceed the criterion mean of 2.50, with an average mean of 3.28 (SD = 0.64), suggesting that economically marginalised students generally exhibit a high level of engagement when AI-driven feedback is integrated into fitness sessions. This indicates that AI tools play a positive and motivating role in enhancing students' active participation and consistency during physical fitness activities.

RQ 4: What challenges do students face in the use of AI-driven feedback for physical fitness learning? Table 5 presents the challenges students face in using AI-driven feedback for physical fitness learning. The results show that a large proportion of respondents experienced notable difficulties with the technology. With mean scores ranging from 3.17 to 3.60, all above the criterion mean of 2.50 and an average mean of 3.33, the findings indicate that students generally face high levels of challenges in the use of AI-driven feedback. These challenges largely stem from technical difficulties, inadequate internet connectivity, limited training, and cost-related barriers, which may hinder the effective integration of AI tools in physical fitness learning.

Table 5: Frequency Distribution of Students' Challenges in the Use of AI-Driven Feedback for Physical Fitness Learning

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree	Mean	SD
I experience technical difficulties when using AI fitness tools.	4 (0.7%)	38 (6.9%)	132 (24.0%)	377 (68.4%)	3.60	0.65
Poor internet connection affects the use of AI feedback systems.	6 (1.1%)	38 (6.9%)	303 (55.0%)	204 (37.0%)	3.28	0.64
I find it difficult to interpret some of the feedback provided by AI tools.	6 (1.1%)	38 (6.9%)	321 (58.3%)	186 (33.8%)	3.25	0.62
The cost of accessing AI-driven fitness applications is a challenge.	8 (1.5%)	77 (14.0%)	281 (51.0%)	185 (33.6%)	3.17	0.71
Lack of training on how to use AI tools limits my effective participation.	6 (1.1%)	38 (6.9%)	248 (45.0%)	259 (47.0%)	3.38	0.66
Criterion Mean =2.50; Average Mean = 3.33						

Note: SD = Standard Deviation, % = Percentage

Table 6: Regression showing Influence of AI-Driven Feedback Using Video Recordings on Motivation in Physical Fitness Classes

Model	Coefficients		t-value	Sig.
	Unstandardized Coefficients	Standardized Coefficients		
	B	Beta		
(Constant)	9.362	0.744	12.586	0.00
AI-driven feedback	0.438	0.411	10.550	0.00

a. Dependent Variable: motivation in physical fitness classes
R = 0.411; R² = 0.169; Adj R² = 0.167; F = 111.312; p < 0.05

Note: *R-multiple correlation coefficient, R² = R-squared, Adj R² = Adjusted R-squared, F = Fisher Statistic Tests, p = p-value, Sig. = Significance, Std. Error = Standard Error

Ho1: AI-driven feedback using video recordings has no significant influence on economically marginalised students' motivation in physical fitness classes.

The result in Table 6 reveals that AI-driven feedback has a significant positive influence on students' motivation in physical fitness classes (B = 0.438, t = 10.550, p < 0.05). The R value of 0.411

indicates a moderate positive relationship, while the R² value of 0.169 shows that AI-driven feedback explains about 16.9% of the variation in students' motivation. The F-statistic (F = 111.312, p < 0.05) confirms the model's significance. Therefore, the null hypothesis is rejected, implying that AI-driven feedback using video recordings

significantly enhances students' motivation in physical fitness classes.

Ho2: AI-driven feedback using video recordings has no significant influence on economically marginalized students' engagement in physical fitness classes.

The result in Table 7 indicates that AI-driven feedback has a significant but weak positive influence on students' engagement in physical fitness classes ($B = 0.121$, $t = 2.168$, $p < 0.05$). The correlation coefficient ($R = 0.092$) suggests a very weak relationship between AI-driven feedback and

engagement. The R^2 value of 0.008 shows that only 0.8% of the variation in engagement can be explained by AI-driven feedback, while the remaining 99.2% is attributed to other factors. Despite the weak relationship, the F-statistic ($F = 4.701$, $p < 0.05$) indicates that the model is statistically significant. Hence, the null hypothesis is rejected, implying that AI-driven feedback using video recordings has a statistically significant, though minimal, impact on students' engagement in physical fitness classes.

Table 7: Regression showing Influence of AI-Driven Feedback Using Video Recordings on Engagement in Physical Fitness Classes

Model	Coefficients		t-value	Sig.
	Unstandardized Coefficients	Standardized Coefficients		
	B	Std. Error	Beta	
Constant	14.214	1.004		14.163
Engagement in physical fitness	0.121	0.056	0.092	2.168

a. Dependent Variable: Engagement in physical fitness

$R = 0.092$; $R^2 = 0.008$; Adj $R^2 = 0.007$; $F = 4.701$; $p < 0.05$

Note: *R-multiple correlation coefficient, R^2 = R-squared, Adj R^2 = Adjusted R-squared, F = Fisher Statistic Tests, Sig. = Significance, Std. Error = Standard Error

Ho3: There is no significant relationship between AI-driven feedback using video recordings, motivation, and engagement in physical fitness classes among economically marginalised students.

The results in Table 8 reveal that there is a significant positive relationship between AI-driven feedback and motivation ($r = 0.41$, $p < 0.01$), indicating that students who receive AI-based feedback tend to show higher levels of motivation in physical fitness activities. Similarly, AI-driven feedback has a weak but significant positive correlation with engagement ($r = 0.09$, $p < 0.05$),

suggesting that the use of AI feedback slightly enhances student engagement during fitness sessions. Furthermore, there is a strong positive correlation between motivation and engagement ($r = 0.69$, $p < 0.01$), implying that motivated students are more likely to be actively engaged in physical fitness classes. Given these significant relationships, the null hypothesis is rejected, confirming that AI-driven feedback using video recordings is significantly related to both motivation and engagement among Human Kinetics and Health Education students.

Table 8: Correlation showing Relationship Between AI-Driven Feedback Using Video Recordings, Motivation, And Engagement in Physical Fitness Classes

Correlations		AI-driven feedback	Motivation	Engagement in Physical Fitness
AI-driven feedback	Pearson Correlation	1	0.41**	0.09*
	Sig. (2-tailed)		0.00	0.03
	N	5519	551	551
Motivation	Pearson Correlation	0.41**	1	0.65**
	Sig. (2-tailed)	0.00		0.00
	N	551	551	551
Engagement in physical fitness	Pearson Correlation	0.09*	0.69**	1
	Sig. (2-tailed)	0.03	0.00	
	N	551	551	551

Note: * = Correlation is significant at the 0.05 level (2-tailed). ** = Correlation is significant at the 0.01 level (1-tailed).

Discussion

This study provides further evidence on the influence of AI-driven feedback (via video recordings) on economically marginalised students' motivation and engagement in physical fitness classes, using a sample from a Nigerian public university. The findings indicate that students perceived AI-driven feedback in physical fitness classes positively. They found it helpful in improving performance, identifying strengths and weaknesses, and making sessions more interactive and enjoyable. This enabling technology enhanced their confidence and trust in the accuracy of feedback, providing a more engaging and personalised learning experience. These findings support previous research that reported that AI-based learning promotes personalization, motivation, and engagement (28, 29, 32, 33). AI systems can analyse movement, pace, repetitions, posture, heart rate, or exercise intensity and provide feedback while the student is still performing (37). Unlike conventional teacher feedback, which may be delayed or limited by large class sizes, AI can tell students what to adjust immediately (38). This makes feedback more actionable: students can apply it, observe improvement, and try again within the same lesson. Research on AI-supported physical education reports improvements in movement quality, learning fluency, interest, and self-directed learning when real-time feedback is used (39). Moreover, physical fitness classes often contain students with different levels of strength, endurance, coordination, previous sporting experience, and health status (40). They also align with findings of past research that emphasized that timely, individualized feedback enhances learning outcomes and self-regulation (9, 30). Students also reported a high level of motivation when exposed to AI-driven feedback. The technology increased enthusiasm, self-confidence, and consistency in maintaining fitness routines. This corroborates the findings of past research that found that AI-supported training improves endurance, participation, and positive attitudes towards exercise (29, 31). It further affirms that AI functions as a motivational tool that sustains learner interest and encourages healthy behavioral patterns. This strongly aligns with the findings of previous research (41, 42).

The study also revealed that AI-driven feedback improved student engagement by increasing concentration, teamwork, and sustained participation during physical fitness sessions. These results are in line with past research, which indicates that AI integration encourages active participation and collaborative learning (29, 31-33). Findings from the hypothesis testing confirmed that AI-driven feedback significantly influenced students' motivation and engagement. The relationship between AI feedback and motivation was strong, while its influence on engagement was moderate. AI-driven feedback can also help students remain active for longer periods. Personalised feedback prevents activities from becoming too difficult for beginners or too easy for more experienced students (43). The system can suggest progressive targets, allowing each learner to experience an appropriate level of challenge. Recognition of improvement, such as completing more repetitions, maintaining better form, or improving endurance, can increase perceived competence and encourage students to continue (40). This is important for students who may otherwise lose interest in repetitive fitness drills. Motivation was also found to mediate the connection between AI feedback and engagement, indicating that AI enhances participation largely through its motivational effects. This aligns with the conclusions of previous research that personalized AI feedback fosters both motivation and engagement through performance-based insights (28, 30).

Other possible reasons for the positive results, such as previous experience with technology, instructor quality, online literacy, or institutional support, may have affected students' responses. Despite these positive outcomes, students encountered notable challenges such as technical issues, unreliable internet access, cost limitations, and difficulty interpreting AI feedback. These barriers reflect infrastructural and literacy gaps that hinder effective AI adoption. Similar observations were made by previous research that identified data privacy, accessibility, and inadequate training as critical obstacles (18, 29). Moreover, the findings buttress the tenets of SDT and SCT by reaffirming the essence of AI-driven feedback on economically marginalized students' autonomy, competence, and relatedness, which

impacts their perceptions, motivation, and engagement in physical fitness classes.

Conclusion

This study demonstrates that integrating AI-driven feedback into physical fitness education holds significant potential for transforming the learning experience. The technology supports a more engaging, personalised, and responsive approach to teaching and learning, fostering self-regulation and sustained participation among students. It enhances the pedagogical value of feedback by providing real-time insights that promote motivation, engagement, and improved performance. However, for its full potential to be realised, attention must be given to addressing infrastructural deficiencies, digital literacy gaps, and ethical concerns surrounding access and data management. Strengthening institutional support, training, and policy frameworks will be crucial in ensuring that AI-driven feedback becomes a sustainable and equitable tool for advancing physical education in Nigerian higher institutions.

Recommendations

Drawing from the study's findings, it is recommended that the government should provide adequate technology infrastructure, stable internet access, and funding to support the integration of AI technologies in physical education across institutions. Universities should prioritize low-cost or free AI tools with offline capabilities to bridge the digital divide, especially for the economically marginalized students. University teachers should undergo continuous professional training to enhance their competence in using AI-driven tools for feedback, assessment, and motivation in fitness education. Health educators and sport scientists should develop AI-based training and feedback programmes that will ensure that students benefit from safe and effective technological applications. Students should embrace AI-assisted learning platforms to improve their self-monitoring, engagement, and overall physical performance. Institutions should establish clear policies on ethical use, data privacy, and equitable access to AI technologies to promote fairness and inclusivity in physical education.

Limitations of the Study

The cross-sectional, non-experimental nature of the research design used in the study did limit the study's ability to infer causality, as well as temporal

insights. The use of surveys via Likert-scale questionnaires, which are vulnerable to social desirability bias (students reporting what they think is expected), Recall bias (inaccurate recollection of experiences with AI feedback), and Common-method variance (artificially inflated correlations due to using the same instrument for all variables), may have affected the study's results. Sampling and generalizability constraints, including non-response bias, may have negatively impacted the overall results of the study. The survey design used in the study measured perceived engagement and motivation, not actual behavior or physiological indicators, and may have overlooked structural barriers unique to the economically marginalised students as sampled in the study.

Future Research Directions

Future research could consider using longitudinal and mixed-methods designs in exploring a similar research aim.

Experimental or quasi-experimental studies that might compare AI-driven feedback vs. teacher-only feedback, or different types of AI feedback (e.g., corrective vs. motivational; text vs. visual) are encouraged. Integrating wearable devices or learning analytics, as well as performance assessments, could yield insightful results. A Pilot of AI feedback systems in low-resource schools and an assessment of the implementation barriers, with cost-effectiveness analyses to inform policy decisions about scaling AI tools in under-resourced physical education programs would be advantageous. Moreover, future research should investigate whether demographic variables (gender, academic level, age, or previous technological experience) influenced students' perceptions of AI-driven feedback. Subgroup analyses may provide further insights.

Abbreviations

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Author Contributions

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Conflict of Interest

No conflict of interest is declared by the authors.

Data Availability

Data for this study can be made available by the corresponding author upon reasonable request.

Declaration of Artificial Intelligence (AI) Assistance

No Generative AI nor AI assisted Technologies was used during the writing process of this manuscript. The authors take full responsibility for the content's originality, interpretation and accuracy.

Ethics Approval

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