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Exploring the impact of artificial intelligence and digital tools on physical fitness, health, and physiological outcomes in physical education

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ABSTRACT

Artificial Intelligence (AI) and digital technologies are increasingly being integrated into Physical Education (PE) to enhance physical fitness, promote healthy behaviors, and support physiological monitoring. However, evidence regarding their combined effects on physical fitness, physiological responses, health behaviors, and students' learning experiences in higher education remains limited, particularly in the Philippine context. This study investigated the effects of AI and digital tools on these outcomes among Physical Education students. A mixed-methods, one-group pretest–posttest quasi-experimental design was employed involving 15 purposively selected undergraduate Physical Education students from Cebu Technological University–Moalboal Campus, Philippines. Quantitative data were obtained through physical fitness assessments, physiological measurements, and health behavior evaluation before and after a technology-supported intervention, while qualitative data were collected through semi-structured interviews and analyzed using thematic analysis. Following the intervention, improvements were observed in cardiorespiratory endurance (72.40 to 78.67), muscular endurance (28.53 to 34.27), flexibility (28.80 to 32.47), and physical activity performance (71.33 to 81.20). Resting heart rate decreased from 78.60 to 73.87 beats/min, exercise heart rate decreased from 154.20 to 148.13 beats/min, recovery time improved from 5.20 to 4.10 min, and exercise intensity increased from 64.33% to 71.20%. Exercise frequency, daily physical activity, health awareness, fitness goal monitoring, and exercise motivation also increased after the intervention. Qualitative findings revealed enhanced physiological awareness, personalized feedback, improved self-monitoring, and increased motivation, although participants identified concerns regarding device accuracy, accessibility, and privacy. These findings indicate that AI-assisted digital technologies can effectively complement Physical Education by supporting fitness development, physiological self-monitoring, and health-promoting behaviors while providing more engaging and personalized learning experiences. Future studies using larger samples and controlled designs are recommended to strengthen the evidence for AI-supported Physical Education.

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INTRODUCTION

Regular physical activity is fundamental to maintaining physical fitness, preventing non-communicable diseases, and promoting overall health and well-being across the lifespan. Adequate participation in physical activity improves cardiorespiratory fitness, muscular strength, body composition, metabolic health, and psychological well-being (World Health Organization [WHO], 2020). The WHO (2020) recommends that children and adolescents accumulate an average of at least 60 minutes of moderate- to vigorous-intensity physical activity daily, whereas adults should engage in 150–300 minutes of moderate-intensity or 75–150 minutes of vigorous-intensity physical activity each week. Despite these recommendations, physical inactivity remains a significant global public health concern, highlighting the need for innovative approaches that encourage sustained participation in physical activity and healthier lifestyles (WHO, 2020).

Physical Education (PE) plays a pivotal role in promoting lifelong physical activity by developing students' physical fitness, motor competence, health literacy, and understanding of exercise science. Beyond movement skill development, contemporary PE increasingly emphasizes students' awareness of physiological responses to exercise, including changes in heart rate, exercise intensity, energy expenditure, and post-exercise recovery. Recent advances in digital technologies have expanded opportunities to monitor these physiological responses through wearable devices, smartphone applications, and sensor-based systems, enabling both students and teachers to obtain objective information that supports exercise participation and fitness monitoring (Xiao *et al.*, 2024). Likewise, wearable Internet-of-Things (IoT) technologies have demonstrated potential for enhancing physical education performance by facilitating continuous monitoring and individualized feedback during physical activity (Xu *et al.*, 2024).

The rapid advancement of Artificial Intelligence (AI) has further transformed digital technologies used in educational and health settings. AI algorithms can analyze large volumes of physiological and behavioral data collected through wearable devices and mobile applications, providing personalized feedback that supports exercise planning, performance monitoring, and health management. Such capabilities enable students to regulate exercise intensity, monitor progress, and make informed decisions regarding their physical activity based on real-time data. Consequently, AI-assisted technologies are increasingly recognized as valuable tools for promoting personalized learning, evidence-based instruction, and data-informed decision-making in Physical Education (Xu *et al.*, 2024).

Growing evidence indicates that digital health interventions can effectively increase physical activity participation among university students. A recent systematic review and meta-analysis by Bi *et al.* (2024) demonstrated that digital health interventions significantly improve physical activity engagement among college students. Similarly, Peng *et al.* (2023) reported that pedometer- and accelerometer-based interventions effectively increased physical activity and improved health-related outcomes in higher education settings. Furthermore, wearable activity trackers have been shown to encourage sustained physical activity and contribute to improvements in health outcomes through continuous self-monitoring and behavioral feedback (Ferguson *et al.*, 2022). Collectively, these findings suggest that AI-supported digital technologies can provide practical tools for encouraging healthy behaviors and supporting fitness development among university students.

In the Philippine context, integrating AI and digital technologies into Physical Education is particularly relevant as many college students continue to experience insufficient physical activity and sedentary lifestyles. Acampado and Valenzuela (2018) reported relatively low levels of regular physical activity among Filipino college students, highlighting the need for effective interventions that promote active lifestyles. More recently, Campoamor-Olegario *et al.* (2025) demonstrated that physical activity and positive health behaviors are significant predictors of well-being among Filipino tertiary students, emphasizing

the importance of strengthening health-promoting initiatives within higher education institutions. These findings underscore the need to explore innovative approaches capable of improving both physical activity participation and health awareness among Filipino students.

Although previous studies have demonstrated the benefits of wearable technologies, digital health interventions, and AI-assisted educational tools, important research gaps remain. Most existing studies have focused on individual outcomes, such as physical activity participation, technology acceptance, or instructional effectiveness (Bi *et al.*, 2024; Xu *et al.*, 2024). Comparatively few investigations have simultaneously examined the effects of AI and digital technologies on physical fitness, physiological responses, health-related behaviors, and students' learning experiences using a mixed-methods approach. Moreover, empirical evidence from Philippine higher education institutions remains limited, particularly regarding the application of AI-assisted technologies within Physical Education. Addressing these gaps is important for understanding how AI-supported digital tools can contribute not only to improved physical performance but also to enhanced physiological awareness and healthier behavioral practices among university students.

Therefore, this study investigated the effects of Artificial Intelligence and digital tools on physical fitness, physiological responses, health behaviors, and students' experiences among undergraduate Physical Education students at Cebu Technological University–Moalboal Campus, Philippines. By integrating quantitative assessment with qualitative inquiry, the study provides a comprehensive evaluation of how AI-assisted technologies support technology-enhanced Physical Education while strengthening the connection among exercise physiology, health science, and educational practice.
Specifically, the study aimed to (1) determine the effects of Artificial Intelligence and digital tools on the physical fitness of Physical Education students; (2) examine changes in selected physiological responses following technology-supported physical activities; (3) assess the influence of AI and digital tools on students' health behaviors and engagement in physical activity; and (4) explore students' experiences and perceptions regarding the usefulness of AI and digital technologies in monitoring fitness, health, and physiological outcomes.

MATERIALS AND METHODS

Research design

This study employed a mixed-method, one-group pretest–posttest quasi-experimental design to examine the effects of Artificial Intelligence (AI) and digital tools on physical fitness, health behaviors, and physiological outcomes among Physical Education students. The quantitative component evaluated changes in selected physical fitness and physiological indicators before and after the intervention, whereas the qualitative component explored participants' experiences, perceptions, and reflections regarding the use of AI-supported digital technologies during physical activity.

The mixed-methods approach allowed objective measurement of intervention outcomes while providing contextual insights into students' experiences with technology-assisted Physical Education. The one-group pretest–posttest design was considered appropriate because the study aimed to determine changes within the same participants following exposure to the intervention.

Study setting and participants

The study was conducted at Cebu Technological University-Moalboal Campus, Philippines. Participants consisted of undergraduate students enrolled in Physical Education courses during the study period.

Participants were selected using purposive sampling based on predetermined eligibility criteria. Eligible students were required to be officially enrolled in a Physical Education course, willing to participate throughout the study, physically capable of performing the required activities, and able to use digital technologies during the intervention. Students with medical conditions or physical limitations that could

compromise safe participation in moderate physical activity were not included.

Fifteen students who met the selection criteria participated in the study. Because the investigation adopted a one-group pretest–posttest design, each participant served as his or her own control, allowing comparisons between baseline and post-intervention measurements.

Research instruments

Data were collected using a combination of physical fitness assessments, digital monitoring technologies, and qualitative interviews.

Physical fitness was assessed through field-based tests aligned with the Philippine Physical Fitness Test (PFT), including measures of cardiorespiratory endurance, muscular endurance, flexibility, and overall physical activity performance. Height and weight were measured using standard procedures to obtain body mass index (BMI).

Physiological responses were monitored using commercially available wearable fitness devices or smartphone-based fitness applications capable of recording heart rate, exercise duration, activity level, and exercise performance. These technologies provided real-time information that enabled participants to monitor their physical activity throughout the intervention.

Health behaviors and physical activity engagement were evaluated using structured questionnaires administered before and after the intervention. To further explore participants' experiences, perceptions, and opinions regarding AI and digital technologies in Physical Education, semi-structured interviews were conducted after completion of the intervention.

The research instruments and interview guide were reviewed by specialists in Physical Education and research methodology to ensure their suitability and alignment with the objectives of the study.

Data collection procedure

Following approval from the appropriate university authorities, eligible students were informed about the objectives, procedures, potential benefits, possible risks, and ethical safeguards of the study. Written informed consent was obtained before data collection. Baseline assessments were conducted using standardized testing procedures to establish participants' initial physical fitness, physiological responses, and health behavior profiles. Participants then completed a technology-supported Physical Education intervention incorporating AI-assisted fitness applications together with wearable or smartphone-based activity-monitoring technologies. These digital tools enabled participants to monitor exercise performance, heart rate, activity duration, exercise intensity, and personal fitness progress while receiving immediate feedback throughout the intervention.

The intervention was implemented under researcher supervision to ensure participant safety and consistency in data collection. Upon completion of the intervention, the same assessment procedures were repeated to obtain posttest measurements.

After the quantitative phase, semi-structured interviews were conducted to obtain participants' reflections on the usefulness, benefits, and limitations of AI and digital technologies in supporting physical activity and fitness monitoring. Interviews were audio-recorded with participants' consent, transcribed verbatim, anonymized using participant identification codes, and prepared for qualitative analysis.

Ethical considerations

The study was conducted in accordance with established ethical principles for research involving human participants. Institutional permission was obtained before data collection, and participation was entirely voluntary. All participants signed informed consent forms after receiving clear explanations regarding the purpose of the study, research procedures, confidentiality measures, potential risks

and benefits, and their right to withdraw at any stage without academic consequences.

To ensure participant safety, all physical activities were conducted under appropriate supervision using standardized procedures. Participants were encouraged to discontinue participation if they experienced discomfort, dizziness, pain, or excessive fatigue.

All personal information and research records were treated as confidential. Participant identities were replaced with identification codes during analysis and reporting, and information obtained from digital applications and wearable devices was used exclusively for research purposes. AI-generated feedback served only as an educational and monitoring tool and was not intended to replace professional medical assessment or clinical judgment.

Data analysis

Quantitative data were coded, organized, and analyzed using descriptive statistical techniques. Frequencies and percentages were used to summarize participants' demographic characteristics, whereas means and standard deviations were used to describe the pretest and posttest measurements of physical fitness, physiological responses, and health-related behaviors. Mean differences between the pretest and posttest scores were calculated to describe changes observed following the technology-supported intervention. Qualitative interview data were analyzed using thematic analysis. Interview transcripts were read repeatedly to achieve familiarity with the data, followed by systematic coding, categorization, theme development, and interpretation. Representative quotations were presented using participant identification codes to maintain confidentiality. Finally, quantitative and qualitative findings were integrated through methodological triangulation to provide a comprehensive interpretation of how AI-assisted digital technologies influenced physical fitness, physiological responses, health behaviors, and students' learning experiences during Physical Education.

RESULTS

Participant characteristics

A total of 15 Physical Education students participated in the study. Their demographic characteristics are presented in Table 1. Of the participants, 9 (60.0%) were female and 6 (40.0%) were male. With respect to age, 7 students (46.7%) were between 20 and 21 years old, followed by 5 (33.3%) aged 22–24 years and 3 (20.0%) aged 18–19 years. In terms of year level, 5 participants (33.3%) were fourth-year students, 4 (26.7%) were third-year students, and 3 (20.0%) each were first- and second-year students.

Table 1. Respondents' characteristics

Characteristic	Category	Frequency	Percentage
Sex	Female	9	60.0%
	Male	6	40.0%
Age	18–19	3	20.0%
	20–21	7	46.7%
	22–24	5	33.3%
Year level	1st Year	3	20.0%
	2nd Year	3	20.0%
	3rd Year	4	26.7%
	4th Year	5	33.3%
Total		15	100.0%

Effects of artificial intelligence and digital tools on physical fitness

The pretest and posttest physical fitness performance of the respondents is presented in Table 2. Cardiorespiratory endurance increased from a pretest mean of 72.40 to a posttest mean of 78.67, representing a mean difference of 6.27. Muscular endurance improved from 28.53 before the intervention to 34.27 after the intervention, with a mean difference of 5.74. Flexibility also increased from 28.80 to 32.47, corresponding to a mean difference of 3.67. The largest change was observed in physical activity performance, which increased from a mean score of 71.33 during the pretest to 81.20 during the posttest, yielding a mean difference of 9.87.

Table 2. Pretest and posttest physical fitness performance of the respondents (N = 15)

Physical fitness indicator	Pretest mean	Posttest mean	Mean difference	Interpretation
Cardiorespiratory endurance	72.40	78.67	+6.27	Improved
Muscular endurance	28.53	34.27	+5.74	Improved
Flexibility	28.80	32.47	+3.67	Improved
Physical activity performance	71.33	81.20	+9.87	Improved

Table 3. Pretest and posttest physiological responses (N = 15)

Physiological indicator	Pretest mean	Posttest mean	Mean difference	Interpretation
Resting heart rate (bpm)	78.60	73.87	−4.73	Improved
Exercise heart rate (bpm)	154.20	148.13	−6.07	Improved regulation
Recovery time (minutes)	5.20	4.10	−1.10	Faster recovery
Exercise intensity (%)	64.33	71.20	+6.87	Increased capacity

Table 4. Changes in health behaviors and physical activity engagement

Indicator	Pretest mean	Posttest mean	Mean Difference	Interpretation
Exercise Frequency	3.07	4.27	+1.20	Increased
Daily Physical Activity	52.40 min	68.13 min	+15.73 min	Increased
Fitness Goal Monitoring	2.87	4.13	+1.26	Improved
Health Awareness	3.13	4.40	+1.27	Improved
Exercise Motivation	3.20	4.27	+1.07	Improved

Changes in physiological responses

The changes in selected physiological responses before and after the intervention are shown in Table 3. The mean resting heart rate decreased from 78.60 beats per minute (bpm) at baseline to 73.87 bpm after the intervention, resulting in a mean difference of −4.73 bpm. Exercise heart rate also decreased from 154.20 bpm to 148.13 bpm, corresponding to a mean difference of −6.07 bpm.

Recovery time declined from 5.20 minutes during the pretest to 4.10 minutes during the posttest, representing a mean reduction of 1.10 minutes. In contrast, exercise intensity increased from 64.33% before the intervention to 71.20% after the intervention, with a mean difference of 6.87 percentage points.

Changes in health behaviors and physical activity engagement

The results for health behaviors and physical activity engagement are presented in Table 4. Exercise frequency increased from a pretest mean of 3.07 to a posttest mean of 4.27, resulting in a mean difference of 1.20. Daily physical activity increased from 52.40 minutes to 68.13 minutes, corresponding to an increase of 15.73 minutes.

Fitness goal monitoring improved from a mean score of 2.87 during the pretest to 4.13 after the intervention, with a mean difference of 1.26. Health awareness increased from 3.13 to 4.40, producing a mean difference of 1.27, while exercise motivation increased from 3.20 to 4.27, representing a mean difference of 1.07.

Students' experiences and perceptions of AI and digital technologies

The thematic analysis identified four major themes describing students' experiences with AI and digital technologies in Physical Education (Table 5). The first theme, Enhanced Physiological Awareness, reflected participants' awareness of changes in heart rate, exercise intensity, activity duration, and recovery during physical activity. One participant stated, *"The application helped me see how my heart rate changed while I was exercising"* (P4).

The second theme, Personalized Feedback and Motivation, described how digital feedback supported participants in monitoring their progress and maintaining their exercise routines. A representative response was, *"Seeing my progress every day motivated me to continue my exercise"* (P7).

Table 5. Thematic Summary of Students' Experiences

Theme	Core meaning	Representative Participant Statement*
Enhanced physiological awareness	Students became more aware of how their bodies responded to exercise.	"The application helped me see how my heart rate changed while I was exercising." (P4)
Personalized feedback and motivation	Digital feedback encouraged students to monitor progress and continue exercising.	"Seeing my progress every day motivated me to continue my exercise." (P7)
Improved self-monitoring and fitness management	Students used digital information to regulate exercise and track personal goals.	"I could check my activity and adjust my exercise when I was not reaching my target." (P11)
Technological limitations and concerns	Students experienced limitations involving device availability, connectivity, accuracy, and dependence on technology.	"Sometimes the application did not record my activity accurately, so I still needed to check it myself." (P13)

Table 6. Data Integration

Objective	Quantitative findings	Qualitative findings	Integrated result
Physical fitness	Fitness improved	Increased exercise motivation	AI/digital tools supported fitness development
Physiological responses	Improved heart rate and recovery	Greater physiological awareness	Enhanced physiological self-monitoring
Health behaviors	Increased activity and health awareness	Better exercise tracking	Improved health-related behaviors
Student experiences	Favorable posttest results	Positive feedback with some technology concerns	Technology supported PE but had limitations
Overall	Measurable improvements	Positive student experiences	AI and digital tools enhanced fitness, health, and physiological monitoring

The third theme, Improved Self-Monitoring and Fitness Management, highlighted participants' use of digital information to monitor activity levels and adjust their exercise according to personal fitness goals. One participant noted, *"I could check my activity and adjust my exercise when I was not reaching my target"* (P11).

The fourth theme, Technological Limitations and Concerns, included issues related to device availability, internet connectivity, measurement accuracy, and dependence on technology. As expressed by one participant, *"Sometimes the application did not record my activity accurately, so I still needed to check it myself"* (P13).

Integration of quantitative and qualitative findings

The integration of quantitative and qualitative findings is presented in Table 6. For physical fitness, the quantitative findings showed improvements in measured fitness indicators, while the qualitative findings indicated increased exercise motivation, resulting in an integrated finding that AI and digital tools supported fitness development.

For physiological responses, quantitative data showed changes in heart rate and recovery measures, whereas qualitative data demonstrated greater physiological awareness among participants. Regarding health behaviors, increases in physical activity and health awareness corresponded with participants' reports of improved exercise tracking. Finally, favorable posttest outcomes and participants' positive experiences, together with reported technological concerns, were integrated to describe the overall role of AI and digital tools in supporting Physical Education.

DISCUSSION

The present study examined the influence of Artificial Intelligence (AI) and digital tools on physical fitness, physiological responses, health behaviors, and students' experiences in Physical Education. Although the participants represented different sexes, age groups, and year levels, the sample was composed primarily of students aged 20–21 years, with females slightly outnumbering males. This demographic profile provided a diverse representation of undergraduate Physical Education students and established the context for evaluating technology-assisted physical activity within a higher education setting.

The findings demonstrated consistent improvements in all assessed components of physical fitness following participation in the technology-supported intervention. Cardiorespiratory endurance, muscular endurance, flexibility, and overall physical activity performance all increased from baseline measurements, suggesting that integrating AI-assisted applications and digital monitoring into Physical Education may facilitate more effective engagement with structured exercise. Rather than replacing conventional physical activity, digital technologies appeared to complement instruction by providing participants with continuous information about their exercise performance and progress. Similar findings have been reported in previous studies indicating that wearable activity trackers and digital health technologies promote greater participation in physical activity and contribute to improvements in health-related outcomes through continuous self-monitoring and behavioral support (Ferguson *et al.*, 2022; Bi *et al.*, 2024; Xu *et al.*, 2024).

The observed improvements in physiological measures further support the potential value of digital technologies in exercise monitoring. Reductions in resting heart rate, exercise heart rate, and recovery time, together with an increase in exercise intensity, are consistent with physiological adaptations commonly associated with regular participation in physical activity. These changes suggest improved cardiovascular efficiency and exercise tolerance during the intervention period. AI-supported monitoring enabled participants to observe these physiological responses in real time, allowing exercise performance to be guided by measurable indicators rather than subjective perception alone. Such immediate feedback may encourage individuals to regulate exercise intensity more effectively and maintain adherence to recommended activity levels. Previous studies have similarly shown that wearable monitoring technologies provide valuable physiological information for tracking exercise performance, although the accuracy of measurements may vary across devices and applications (Chan *et al.*, 2022; Germini *et al.*, 2022).

In addition to improvements in physical fitness and physiological responses, participants demonstrated positive changes in health-related behaviors. Exercise frequency, daily physical activity, fitness goal monitoring, health awareness, and exercise motivation all increased after the intervention. These findings suggest that AI-assisted digital technologies may positively influence health behaviors by increasing awareness of daily activity patterns and providing personalized feedback that encourages sustained participation in exercise. The availability of real-time progress indicators, activity summaries, and individualized fitness goals may strengthen self-regulation and promote greater accountability for maintaining healthy lifestyles. These observations are consistent with systematic reviews showing that wearable technologies and digital health interventions improve physical activity participation, exercise adherence, and health-related behaviors among university students (Bi *et al.*, 2024; Peng *et al.*, 2023; Ferguson *et al.*, 2022).

The qualitative findings provide additional insight into the mechanisms that may explain the observed quantitative improvements. Participants consistently described greater awareness of their physiological responses during exercise, including changes in heart rate, exercise intensity, activity duration, and recovery. This increased awareness suggests that digital technologies can help bridge theoretical concepts taught in Physical Education with students' direct observation of their own physiological responses. By making biological changes visible during exercise, AI-assisted monitoring may strengthen students' understanding of exercise physiology and promote more informed participation in physical activity. Similar observations have been reported in studies demonstrating that wearable sensors and smartphone-based technologies enhance students' understanding of movement patterns and physiological monitoring during physical activity (Xiao *et al.*, 2024; Xu *et al.*, 2024).

Participants also emphasized the motivational value of personalized feedback generated by AI-supported

applications. Progress tracking, achievement monitoring, and immediate performance feedback encouraged many students to continue exercising and to monitor their fitness more consistently. Personalized information allowed participants to compare their current performance with previous achievements and adjust their activities according to individual goals. This individualized approach aligns with the growing emphasis on learner-centered Physical Education, where technology supports students with different fitness levels and exercise capacities through tailored feedback rather than uniform instruction (Bi *et al.*, 2024; Xu *et al.*, 2024).

Another important finding was the development of stronger self-monitoring behaviors. Participants reported using digital applications to track activity levels, heart rate, exercise duration, and progress toward personal fitness goals. Such practices encourage greater responsibility for managing one's own health and fitness while promoting evidence-based decision-making during exercise. Self-monitoring has long been recognized as an important behavioral strategy for maintaining physical activity, and AI-assisted technologies appear to strengthen this process by providing accessible and continuously updated performance information (Peng *et al.*, 2023; Ferguson *et al.*, 2022).

Despite these benefits, participants also identified several practical challenges associated with AI and digital technologies. Concerns regarding measurement accuracy, device availability, internet connectivity, battery life, privacy, and possible dependence on technology indicate that digital tools should be viewed as complementary rather than as substitutes for professional instruction and scientifically validated assessment methods. These concerns are consistent with previous systematic reviews reporting that although wearable devices provide valuable monitoring capabilities, variations in accuracy, reporting standards, and device performance should be considered when interpreting digitally generated health data (Chan *et al.*, 2022; Germini *et al.*, 2022).

Taken together, the quantitative and qualitative findings indicate that AI and digital technologies can contribute to multiple dimensions of Physical Education. Improvements in physical fitness, favorable physiological changes, increased health-promoting behaviors, and positive student experiences collectively suggest that technology-enhanced learning environments may support both educational and health-related outcomes. Rather than functioning solely as data collection tools, AI-assisted applications appear to encourage active participation, facilitate physiological self-monitoring, strengthen motivation, and promote greater engagement in physical activity. Overall, the present findings support growing evidence that AI-enabled digital technologies can be effectively integrated into Physical Education to enhance physical fitness, health awareness, and lifelong healthy behaviors while complementing teacher-guided instruction (WHO, 2020; Bi *et al.*, 2024; Ferguson *et al.*, 2022; Xu *et al.*, 2024).

CONCLUSION

The findings of this study indicate that integrating Artificial Intelligence (AI) and digital tools into Physical Education can positively support students' physical fitness, physiological responses, health-related behaviors, and learning experiences. Improvements in physical fitness performance, heart rate, recovery, exercise intensity, physical activity engagement, and health awareness, together with students' positive perceptions of personalized feedback and self-monitoring, demonstrate the potential of AI-assisted technologies to enhance fitness monitoring and promote active lifestyles. Although challenges related to device accuracy, accessibility, and privacy remain, AI and digital technologies can serve as valuable complementary tools for Physical Education when implemented alongside appropriate instructional guidance, contributing to more engaging, evidence-informed, and learner-centered physical activity experiences.

Recommendations

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

1. Physical Education instructors should integrate AI-assisted applications and digital fitness technologies into regular instructional activities to support physical fitness assessment, exercise monitoring, and individualized feedback while ensuring that technology complements, rather than replaces, teacher guidance.
2. Higher education institutions should provide adequate digital resources, including reliable wearable devices, mobile applications, and internet connectivity, to facilitate the effective implementation of technology-enhanced Physical Education programs.
3. Curriculum developers should incorporate digital health literacy, AI literacy, and the interpretation of physiological indicators such as heart rate, exercise intensity, and recovery into Physical Education curricula to strengthen students' understanding of exercise science and health promotion.
4. Students should be encouraged to use AI and digital fitness tools as self-monitoring aids to support regular physical activity, set realistic fitness goals, and make informed decisions about their health while recognizing the limitations of technology-generated data.
5. Future researchers should conduct studies with larger and more diverse samples, include control or comparison groups, extend the duration of interventions, and employ validated physiological measurement devices to generate stronger evidence regarding the effectiveness of AI-assisted technologies in Physical Education. Additional research should also investigate the long-term effects of specific AI applications on physical fitness, physiological adaptation, and health behaviors.

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