

Artificial Intelligence-Enabled Monitoring and Educational Intervention for High-Intensity Training in College Students: A Narrative Review for University Physical Education

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Abstract – In the context of digitalization, artificial intelligence, wearable monitoring, and blended educational platforms are increasingly used to support high-intensity training in college physical education. This review synthesizes recent evidence on three linked questions: whether high-intensity interval training is effective for university students, whether AI-assisted and wearable monitoring can improve the regulation of training load and safety, and whether digital educational intervention can strengthen motivation and teaching effectiveness. Recent peer-reviewed studies and reviews published between 2021 and 2025 were examined, with emphasis on university and physical education settings. The literature indicates that HIIT is a time-efficient strategy for improving cardiorespiratory fitness and selected body composition indicators in university students. At the same time, wearable and heart rate-based monitoring can provide real-time physiological feedback, support intensity control, and strengthen students' awareness of self-regulated exercise. Studies on blended and digital physical education further suggest that technology-assisted instruction can improve exercise attitudes, learning engagement, and skill development when it is embedded in sound pedagogy. However, the current evidence also shows several limitations, including uneven data quality, insufficient long-term follow-up, privacy concerns, and limited teacher readiness for data-informed instruction. Overall, AI-enabled monitoring should be treated as a pedagogical tool that can help physical education become safer, more individualized, and more evidence-based.

Keywords – Artificial Intelligence, Digitalization, College Students, High-Intensity Training, Physical Education, Wearable Monitoring

I. INTRODUCTION

University physical education is under pressure to achieve several goals at once: improve students' health, increase participation, deliver measurable learning outcomes, and respond to the digital transformation of higher education. Within this context, high-intensity interval training (HIIT) has attracted considerable attention because it is time-efficient and can be integrated into limited class schedules. Yet HIIT also raises practical concerns. If intensity is poorly regulated, students may experience excessive fatigue, negative emotions, or avoidable risk. For this reason, digital monitoring tools and AI-based feedback systems are increasingly discussed as possible supports for safe and effective implementation.

Recent reviews show that artificial intelligence has moved from a marginal topic to a visible research direction in physical education. Zhou et al. (2024) describe rapid growth in AI-related physical education studies, especially in movement recognition, feedback, instructional optimization, and assessment. Bofill et al. (2025) similarly argue that AI has entered physical education mainly through automated analysis, individualized feedback, and decision support.

These studies do not suggest that technology replaces pedagogy. Instead, they show that digital tools can strengthen pedagogical precision when used within a clear teaching design.

For university teachers, the practical question is not whether AI is fashionable, but whether it helps students train more scientifically. This is especially relevant in HIIT-based classes, where the difference between productive effort and harmful overload can be narrow. Accordingly, a focused synthesis is needed to connect three strands of evidence that are often discussed separately: the effectiveness of HIIT in university students, the value of wearable or AI-supported monitoring, and the educational role of digital intervention in college physical education.

II. PROBLEM STATEMENT

Although research on high-intensity interval training in university students has expanded, and separate studies on artificial intelligence, wearable monitoring, and blended learning in physical education have also increased, relatively few papers integrate these domains in a way that speaks directly to the realities of university physical education classes.

As a result, teachers and researchers still lack a concise account of how intelligent monitoring and digital educational intervention can support high-intensity training implementation among college students. A clearer synthesis is therefore needed to connect training effectiveness, monitoring value, and pedagogical application within one analytical framework.

III. LITERATURE REVIEW

High-Intensity Training in University Students

HIIT is widely valued because it produces meaningful physiological adaptation within a relatively short training time. In a recent meta-analysis focused specifically on university students, Yin et al. (2025) concluded that HIIT significantly reduced BMI, body fat percentage, waist-to-hip ratio, and heart rate, while improving VO₂max and muscle strength. The authors also noted that interventions lasting longer than eight weeks were more favorable for gains in muscle strength. This finding is important for higher education, where semester schedules often favor compact but structured interventions.

At the same time, the effectiveness of HIIT does not remove the need for careful instructional control. University students are highly heterogeneous in fitness level, exercise history, motivation, and recovery ability. In mixed physical education classes, a standardized HIIT prescription may be

too easy for some students and too demanding for others. This is precisely where monitoring and individualized feedback become important.

Artificial Intelligence and Digital Transformation in Physical Education

Systematic reviews now show that AI and related digital technologies are being used in physical education for movement analysis, learning analytics, automated assessment, feedback generation, and personalized instruction. Zhou et al. (2024) found that the most common AI applications were associated with identifying movement patterns, optimizing teaching, and supporting assessment. Bofill et al. (2025) emphasized that AI in physical education remains an emerging field, but its main educational value lies in improving feedback, personalization, and the interpretation of student performance data. Tohanean et al. (2025) broadened this picture by reviewing AI together with ICT-based innovations, concluding that digital technologies can improve engagement and instructional variety, while also creating demands related to ethics, privacy, and teacher competence.

These reviews suggest that the strongest case for AI in physical education is not technological novelty but pedagogical fit. When intelligent systems are used to help teachers visualize intensity, interpret movement data, or adapt instruction, they can support more responsive teaching. When they are used without pedagogical integration, they risk becoming little more than devices that collect numbers without educational meaning.

Wearable Monitoring and Real-Time Feedback

Wearable technologies are among the most practical entry points for digital physical education because they can be deployed in real class settings. Heart rate monitors, smart watches, and app-connected devices give teachers and students access to immediate indicators of effort and recovery. Braun-Trocchio et al. (2022) showed that heart rate monitoring influences ratings of perceived exertion and attentional processes during exercise, highlighting the cognitive as well as physiological significance of real-time feedback.

Evidence from educational settings is also encouraging. Cunningham-Rose et al. (2024) reported that projecting heart rate data during school-based HIIT significantly increased peak heart rate and time spent above 90% of age-predicted maximum heart rate, while qualitative findings suggested improved motivation and more active effort regulation. Although this study involved school students rather than university students, its pedagogical logic is highly relevant to college physical education, where class-wide visualization of effort zones may help students better understand target intensity.

In higher education populations, McFadden (2021) found that regular use of wearable exercise technology during exercise was associated with higher exercise behaviour among college women. The finding does not prove that wearables alone change behaviour, but it indicates that technology-supported self-monitoring can be

meaningfully related to exercise participation in a university population.

Digital Educational Intervention and Student Engagement

The educational value of digitalization becomes clearer when monitoring is linked to teaching design. Hrusova et al. (2024) examined a blended physical education approach using wearables and the Strava application in 368 university students and reported that such tools could support personalized learning and motivation in outdoor aerobic activities. Their work shows that digital intervention is most useful when it is embedded in a structured learning model rather than treated as an isolated gadget.

Similarly, Wang et al. (2024) conducted a cluster randomized controlled trial with 78 first-year university students and found that blended learning significantly improved exercise attitudes and basketball skills compared with traditional instruction. Reported effect sizes ranged from 0.57 to 1.92 across exercise-attitude dimensions, with additional benefits for basketball skill outcomes. Although this was not a HIIT study, it provides strong evidence that digital instructional design can positively affect university physical education outcomes.

At the same time, broader reviews advise caution. Watson-Mackie et al. (2024), in a systematic review focused on young women, found that technology-supported physical activity interventions showed limited but promising effects overall, with stronger potential when grounded in behaviour change theory. This reminder is important: devices do not automatically create motivation. Pedagogical structure, feedback quality, and user experience remain decisive.

IV. METHOD

This paper uses a narrative review design. The purpose was not to perform a formal meta-analysis but to synthesize recent, relevant evidence that connects AI-enabled monitoring, wearable technology, digital educational intervention, and high-intensity training in university physical education.

Recent peer-reviewed articles and reviews published between 2021 and 2025 were examined through publisher pages, PubMed records, journal databases, and accessible full-text sources. Priority was given to studies involving university students, physical education contexts, HIIT, wearable monitoring, heart rate feedback, AI-supported teaching, and blended or digital intervention.

Studies were retained when they could inform at least one of the following issues: effectiveness of HIIT for university students, value of physiological monitoring and wearable feedback, or pedagogical impact of digital intervention in physical education. Because the available evidence spans systematic reviews, randomized trials, mixed-method studies, and observational designs, the analysis was interpretive rather than statistical. The emphasis was placed on educational relevance, methodological transparency, and transferability to university physical education.

V. FINDINGS

Three findings stand out from the reviewed literature. The first is that HIIT is not only compatible with university physical education but can be a valuable strategy when class time is limited. The second is that wearable and AI-supported monitoring can help translate target intensity into visible, actionable feedback. The third is that digital intervention becomes educationally meaningful only when it is integrated into pedagogy, reflection, and feedback.

Taken together, the literature supports a layered model of practice. At the physiological layer, HIIT offers efficiency. At the monitoring layer, wearable and AI-enabled tools help teachers and students track intensity and recovery more accurately. At the educational layer, digital platforms and blended learning models can improve attitudes, engagement, and skill acquisition. The strongest educational scenario is therefore not HIIT alone and not technology alone, but HIIT delivered through monitored, feedback-rich, pedagogically structured teaching.

VI. DISCUSSION

The reviewed evidence has clear implications for university physical education. First, intelligent monitoring can make intensity prescription more transparent. Many students struggle to interpret what high intensity actually feels like. Real-time heart rate, perceived exertion prompts, and app-based dashboards can narrow this gap and help students understand the relationship between effort, feedback, and recovery.

Second, AI-enabled systems may support a shift from uniform instruction to differentiated instruction. In traditional class settings, teachers often prescribe the same work-rest pattern to all students. Monitoring data make it more realistic to adjust targets, identify students who need recovery, and provide individualized guidance. This is especially important in general physical education courses, where students with very different fitness levels are taught together.

Third, technology must remain subordinate to educational judgment. The literature repeatedly points to barriers such as privacy concerns, unequal access to devices, data overload, and limited teacher digital literacy. Tohanean et al. (2025) and Bofill et al. (2025) both indicate that successful implementation depends on teacher competence and ethical awareness as much as on software capability. In other words, intelligent tools are helpful only when teachers can interpret data critically and connect them with sound pedagogical aims.

Finally, the evidence base remains uneven. Some findings come from systematic reviews and randomized trials, while others are derived from exploratory or context-specific studies. Long-term intervention studies in university HIIT classes that directly test AI-assisted monitoring are still limited. Future work should therefore move beyond general enthusiasm for digitalization and examine which combinations of monitoring, feedback, and instructional design actually improve student outcomes over time.

VII. CONCLUSION

The available literature suggests that high-intensity interval training is a practical and effective option for university students, while AI-enabled monitoring and wearable feedback can strengthen intensity control, self-regulation, and instructional precision. Digital educational intervention appears most beneficial when it supports, rather than replaces, teacher-led pedagogy.

The main conclusion is therefore straightforward: in university physical education, the educational value of AI lies not in automation itself, but in its capacity to help teachers deliver safer, more individualized, and more evidence-based high-intensity training. More direct empirical studies with university samples are still needed, but current evidence already supports cautious, pedagogically grounded integration.

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