Physical Education, Health and Social Sciences

https://journal-of-social-education.org E-ISSN: 2958-5996

P-ISSN: 2958-5988

Effects of Artificial Intelligence-Assisted Physical Education on Students' Motivation, Engagement, and Physical Activity Levels: A Quasi-Experimental Study

Muhammad Javed Bajwa[1]

[1] Lecturer, Department of Physical Education & Sports Sciences, Government College University, Lahore, Punjab, Pakistan, Email: javed.bajwa@gcu.edu.pk

Corresponding author: Muhammad Javed Bajwa

DOI: ***https://doi.org/10.63163/jpehss.v4i1.1724***

Abstract

Artificial intelligence (AI) technology is becoming common in educational settings, but its application in university physical education (PE) has not been studied enough. This research project explores the potential impacts of AI-enabled PE on students' motivation, engagement, and physical activity levels compared to traditional PE. Within the framework of Self-Determination Theory, an intervention based on integration of AI-powered learning guidance, feedback, reminder of activities, monitoring, and interactive support is proposed in teacher-directed PE. A quasi-experimental design with pretest and posttest assessments was designed with university students randomized into two conditions of AI-enabled and traditional PE during eight weeks of an intervention program. Motivation, engagement, and physical activity were measured before and after an intervention, and baseline-controlled comparisons of the two groups were established. The illustrative analysis revealed increased motivation, engagement, and physical activity in the AI group after an intervention relative to their baseline values. These trends are congruent with the expected ability of personalized guidance and feedback to support autonomy, competence, and relatedness and stimulate involvement in physical activity. However, the numerical findings presented in the current manuscript are illustrative due to the unavailability of the original individual-level dataset. Consequently, these should not be taken as empirically validated evidence. The study thus offers a theory-based approach towards studying AI-supported PE and underscores the need for teacher-mediated intervention, responsible use of data, and objectivity in assessing physical activity. There is need for future research that uses real student-level data, rigorous experimental design, long-term follow-up, and objective measurement of physical activity.

Keywords: Artificial intelligence; physical education; student motivation; student engagement; physical activity; self-determination theory; university students; quasi-experimental study

Introduction

The integration of artificial intelligence (AI) in educational environments to facilitate personalized learning experiences, automate feedback provision, assess the performance of students, and make data-driven instructional decisions has attracted much attention in recent times (Wang et al., 2024; Almasri, 2024). While AI has found its applications in academic and technology-related courses, the use of AI applications in the domain of physical education (PE) is gaining growing importance. AI-assisted applications could be used for facilitating movement analyses, making exercise

suggestions tailored to an individual, performance tracking, feedback provision, and, thus, create learning environments that are different from the traditional PE lessons (Jastrow et al., 2022; Wang et al., 2024). The use of AI applications may be especially useful in PE due to the involvement of the cognitive, motivational, behavioral, and physical aspects of student learning within PE classes. Unlike in the case of a mere technological addition to the teaching process, the use of AI-assisted PE may enable to track students' performance and activity and tailor the instructional process accordingly. Significance of this issue is highlighted by continuing problems with the lack of physical activity among youth. School setting is considered one of the important ways of encouraging physical activity, since PE lessons provide structured conditions for participating in physically active activities (Fernández-Espínola et al., 2022). Nevertheless, involvement in PE lessons does not guarantee continuous motivation and high levels of physical activity. Motivation is known to be tightly related to students' engagement and behavior in PE lessons (Vasconcellos et al., 2020; Owen et al., 2014). For example, according to Self-Determination Theory (SDT), motivation of students is affected by the degree to which the environment satisfies psychological needs of students in autonomy, competence, and relatedness (Deci & Ryan, 2000; Ryan & Deci, 2020). Systematic review of studies, which implemented the theory to PE, revealed that autonomous motivation is associated with positive outcomes, while low self-determined types of motivation lead to negative outcomes (Vasconcellos et al., 2020). Thus, creating a proper instructional environment in PE lessons involves not only physical activities but also motivation of participants. Student motivation is crucial since it determines how much students would like to voluntarily engage in physical activity and persevere despite difficulties. SDT recognizes different types of motivation from amotivation and extrinsic regulation to autonomy-supporting types of motivation such as identified and intrinsic motivations (Deci & Ryan, 2000; Ryan & Deci, 2020). Research on motivation found in a systematic review and meta-analysis of PE research revealed that autonomous motivation is related to adaptive outcomes, while external regulation and amotivation are linked with non-adaptive outcomes (Vasconcellos et al., 2020). Moreover, results of another systematic review and meta-analysis of SDT-based interventions demonstrated that these interventions are capable of affecting various types of motivation regulations, however, the influence varies depending on the characteristics of an intervention, age of participants, the duration of the study, and methodological quality (Manninen et al., 2022). The implications of this evidence are that educational innovations should be assessed by their ability to provide motivationally supportive learning experience rather than technical complexity.

There are a number of possible mechanisms how AI-assisted PE could support such motivational conditions. Personalized feedback would allow students to assess their performance and determine areas where they need to improve. Student motivation is crucial since it determines how much students would like to voluntarily engage in physical activity and persevere despite difficulties. SDT recognizes different types of motivation from amotivation and extrinsic regulation to autonomy-supporting types of motivation such as identified and intrinsic motivations (Deci & Ryan, 2000; Ryan & Deci, 2020). Research on motivation found in a systematic review and meta-analysis of PE research revealed that autonomous motivation is related to adaptive outcomes, while external regulation and amotivation are linked with non-adaptive outcomes (Vasconcellos et al., 2020). Moreover, results of another systematic review and meta-analysis of SDT-based interventions demonstrated that these interventions are capable of affecting various types of motivation regulations, however, the influence varies depending on the characteristics of an intervention, age of participants, the duration of the study, and methodological quality (Manninen et al., 2022). The implications of this evidence are that educational innovations should be assessed by their ability to provide motivationally supportive learning experience rather than technical complexity. There are a number of possible mechanisms how AI-assisted PE could support such

motivational conditions. Personalized feedback would allow students to assess their performance and determine areas where they need to improve. AI-based systems might increase the engagement due to provision of real-time performance data, personalized challenges, progress tracking, and feedback, which would make the learning activities more tailored to students' current competencies (Jastrow et al., 2022; Wang et al., 2024). Implementation of the technology could increase interactivity of PE activities and allow students to see their progress. Still, the novelty of technology alone does not ensure engagement. The educational benefits of AI depend on the way in which it is used in instructional processes and supports students' psychological and learning needs. There are some recent systematic findings about ChatGPT-based learning, including examples of engagement and disengagement from behavioral, emotional, and cognitive perspectives, which shows the necessity of proper implementation and empirical investigation (Lo et al., 2024). Therefore, empirical investigation is needed to establish whether the use of AI-based instruction improves engagement of the students compared to traditional PE.

The physical activity level is another key indicator since the true benefit of PE is connected to participation of students in physical activity. Prior research has found the connection between motivational processes and physical activity of children and adolescents. The results of a systematic review and meta-analysis reveal positive correlations between self-determined types of motivation and physical activities, whereas autonomous motivation was more positively correlated with physical activities than controlled motivation (Owen et al., 2014). Recent research on SDT further focuses on the significance of motivational interventions in promoting physical activity, yet the effects of such interventions might differ greatly depending on context (Manninen et al., 2022; Fernández-Espínola et al., 2022). Therefore, combining the examination of motivation, engagement, and physical activities will be more helpful to understand whether AI-assisted PE produces behavioral changes among students apart from their improved learning perception.

Although there is currently a growing number of studies focusing on technology-supported education and significant role of motivational processes in PE, empirical studies that investigate motivation, engagement, physical activities in combination in an AI-assisted PE intervention are lacking. In fact, existing literature usually addresses each aspect individually or compares motivation, technology-assisted learning, physical activity, while comparatively little attention is paid to a quasi-experimental design that combines all aspects in order to compare AI-assisted instruction and traditional PE classes (Jastrow et al., 2022; Wang et al., 2024). The recent research findings also emphasize the importance of robust empirical designs and outcome measures in assessing the effectiveness of AI-supported interventions in education (Lo et al., 2024). Thus, this study aims at addressing this limitation by exploring the impact of AI-assisted physical education on students' motivation, engagement, and physical activity levels through a quasi-experimental approach. Namely, the study will involve comparing the outcomes related to students who have been receiving AI-assisted physical education classes with those who have been receiving conventional PE classes and changes between the measurements conducted before and after the intervention. By including both psychological and behavioral aspects in the study design, the researcher intends to explore the educational implications of AI integration into physical education more comprehensively. Therefore, the major purpose of this study is to test whether there are more significant positive effects of AI-assisted physical education on students' motivation, engagement, and physical activity levels compared to conventional physical education classes. The study will be based on the theory of self-determination and will be focused on the potential benefits of personalized feedback, performance monitoring, and individualized instruction in improving students' participation in PE.

Research hypotheses

H1: Artificial intelligence assisted physical education has an effect of positively improving students' level of motivation in comparison to traditional physical education.

H2: Artificial intelligence assisted physical education has an effect of positively improving students' level of engagement in comparison to traditional physical education.

H3: Artificial intelligence assisted physical education has an effect of positively increasing students' level of physical activity in comparison to traditional physical education.

H4: Students enrolled in artificial intelligence assisted physical education show better improvements in terms of motivation, engagement, and physical activity in comparison to those enrolled in traditional physical education.

Literature Review and Theoretical Framework

Artificial Intelligence-Assisted Physical Education

The use of artificial intelligence in physical education constitutes a novel trend in the sphere of enhanced learning through technology. AI is able to process information concerning students' performance, movement, level of activity, and progress and then provide individualized feedback or recommendations. Unlike other forms of digital technologies that are designed to deliver only standardized learning material, AI-powered technologies are able to adapt learning activities to individual needs and performance. Such features in physical education may include automated assessment of movement, individualized exercise suggestions, performance tracking, adaptive feedback, and activity tracking. Thus, there is a chance for teachers to shift from a standardized approach to instruction and create a more individualized learning experience (Jastrow et al., 2022; Wang et al., 2024; Suniga et al., 2026). Some empirical studies have already addressed these possibilities. The application of AI-supported movement assessment and feedback has been studied as means of enhancing physical performance and learning experiences of students, whereas recently performed quasi-experimental studies have studied AI-supported instruction with respect to motivational and engagement aspects of students' learning experience in physical education. However, the effectiveness of AI-assisted PE is contingent upon the manner in which the technological components are incorporated into the pedagogical approach. Thus, personalized feedback may turn out to be helpful provided that it is clear, prompt, and encouraging, while too much monitoring or impersonal feedback may negatively affect students' feelings of autonomy. It means that AI should be viewed as an instruction support tool rather than a substitute for a teacher (Jastrow et al., 2022; Daly et al., 2026; Huang et al., 2026).

The benefits of AI-assisted PE may become evident considering three interrelated roles. First, AI can help in providing personalized information concerning the performance of the learners and their progress. Second, it can be used to deliver adaptive instruction and recommend particular activities based on the individual performance or skillset. Third, it can serve as a constant source of feedback and monitoring, making it possible to trace the progress. These factors may foster the development of circumstances under which students will be willing to engage in physical activities voluntarily and consistently. However, empirical evidence on the matter remains emerging. This study addresses this issue by examining all three outcomes within a common quasi-experimental framework (Jastrow et al., 2022; Huang et al., 2026; Daly et al., 2026).

AI-Assisted Physical Education and Student Motivation

Motivation plays an essential role in the involvement of students in PE, since students who see the activities as meaningful, feasible and useful, will be willing to get involved in these activities and sustain participation. Self-determination theory offers a framework for the explanation of these processes. Motivation under this theory is regulated by the fulfillment of three psychological

needs, namely autonomy, competence, and relatedness. By autonomy, one means the feeling of willfulness and choice, while competence implies the ability to perform successfully the activities. Relatedness is associated with the feeling of meaningful relationship with others. In cases when the learning environment supports these needs, students become motivated in an autonomous way and get involved in activities voluntarily (Deci & Ryan, 2000; Ryan & Deci, 2020; Vasconcellos et al., 2020). AI-assisted PE can satisfy these psychological needs. Personalized activity recommendations will offer choices suitable for the abilities and preferences of students, thus helping to achieve autonomy. Performance feedback will make students realize their improvements and understand what aspects need more practice. While AI itself cannot substitute personal interaction, AI-assisted learning can give teachers information about each particular student and help them offer more personalized encouragement and assistance. Using these tools, AI can contribute to the creation of a more supportive instructional environment (Ryan & Deci, 2017, 2020; Jastrow et al., 2022; Daly et al., 2026).

Numerous empirical studies conducted in physical education show a connection between autonomous motivation and adaptive behavior of students. In cases when students take part in PE classes because of their desire to do something enjoyable or useful, or because they identify themselves with the practice, they show higher levels of persistence and active behavior than those students whose behavior is driven mainly by external factors. A systematic review and meta-analysis of research on SDT showed significant correlations between different forms of motivation and various desirable outcomes. This means that there is a theoretical foundation for believing that the instructional approach aimed at enhancing students' feeling of competence and autonomy might increase motivation (Vasconcellos et al., 2020; Owen et al., 2014). Thus, AI-assisted instruction can be motivating if it is organized according to students' needs. Personalized feedback would help students see the improvements in performance, adaptive exercises can minimize the discrepancy between the task difficulty and students' ability, and personalized goals can help set up the attainable objectives for the students. These features would be likely to boost students' perceptions of competence and autonomy and then motivate them. Similarly, recent PE studies have shown that the use of AI and affective AI may be associated with motivational and self-efficacy outcomes, albeit context-specifically (Chen et al., 2025; Daly et al., 2026). Accordingly, based on theoretical considerations, the current study hypothesizes:

H1: AI-assisted physical education improves the motivation of the students more effectively than the traditional one.

AI-Assisted Physical Education and Student Engagement

Student engagement is the degree to which learners are involved in, and exert efforts in, educational activities. In PE, engagement is crucial for effective learning since learning in PE implies the need to be physically engaged in educational activities rather than being exposed to the information provided. Engagement can involve participation, effort, perseverance, concentration, and desire to get involved in the process of education. Engaged students are supposed to engage themselves in more exercise effort, respond to feedback more actively, and persevere during the activity (Fredricks et al., 2004; Lo et al., 2024). Personalization and customization of the PE activities facilitated by AI can lead to the improvement of engagement since the traditional PE instruction can provide the same activity, intensity, and feedback to the entire class regardless of differences in physical capabilities and prior experience. The use of AI-supported systems allows for providing individualized data about students' performance and progress, thus giving each learner an opportunity to receive individual feedback. Personalization and customization can make activities more relevant to the learners' needs and increase engagement (Jastrow et al., 2022; Huang et al., 2026).

Immediate feedback provided can be another way through which AI affects the engagement of students. Timely feedback allows students to modify their movements and exertion both while or immediately after performing the activity. Visual markers of progress could additionally be helpful for providing tangible improvement and setting short-term objectives to keep motivating participants. From the standpoint of SDT, such feedback is especially valuable if it contains information related to competence instead of controlling learners. In other words, the usefulness of AI-assisted feedback does not only rely on its technical accuracy but also on how pedagogically it is designed (Ryan & Deci, 2020; Huang et al., 2026). The recent literature on AI-assisted PE provides some empirical evidence of the possibility that technology-mediated instructions could affect students' motivation and engagement. Further research is necessary, however, since existing interventions are quite different from each other in terms of intervention period, technological characteristics, instructional context, and outcome variables. This research contributes to this area by comparing AI-assisted instruction and conventional PE instructions and assessing engagement before and after the intervention (Daly et al., 2026; Huang et al., 2026; Lo et al., 2024).
Accordingly:
H2: AI-assisted physical education significantly improves students' engagement compared with conventional physical education instruction.

AI-Assisted Physical Education and Physical Activity Levels
Physical activity is one of the main behavioral outcomes of physical education. While PE lessons offer organized opportunities for movement, the students' activity level may differ considerably depending on the organization of instruction, activity type, motivation, skills, and other individual factors. Therefore, assessing the effectiveness of PE interventions using only students' subjective assessments can present an incomplete picture. Assessing the level of physical activity along with motivation and engagement allows researchers to determine whether there have been psychological changes accompanied by physical activity changes (White et al., 2021; Jastrow et al., 2022). AI technologies might contribute to promoting physical activity using continuous assessment, personalization of targets, and recommendations. For instance, tracking systems allow collecting data concerning the number of steps, active time, intensity of movement, and activity completion. Such data can be used by the students to assess their activity and set personal targets. Further recommendations based on AI will help to adapt activities in accordance with students' performance. Thus, a feedback loop can be created where students will get feedback about their behavior, will compare their performance with personal targets, and adjust their activities accordingly (Jastrow et al., 2022; Suniga et al., 2026; Huang et al., 2026).
Motivation and physical activity can also be said to have a connection with SDT because autonomous motivation has been shown to positively correlate with increased physical activity, while amotivation and controlled motivation have been found to lead to less optimal behavior. Thus, if the use of AI in PE promotes greater autonomous motivation among students, then the effect may translate into increased physical activity. However, this connection needs to be empirically verified rather than being taken for granted. The current research thus considers physical activity to be an independent variable rather than simply as the result of motivation (Owen et al., 2014; Vasconcellos et al., 2020).
Accordingly:
H3: AI-assisted physical education significantly increases physical activity levels of students compared with traditional physical education teaching.

Self-Determination Theory as the Theoretical Foundation

Self-Determination Theory is a main theory used to understand why and how features of an instructional environment could affect students' motivation and then students' behavior participation. According to Self-Determination Theory, individuals work best if their three main psychological needs – needs of autonomy, competence, and relatedness – are fulfilled. Autonomy-supporting environment lets students make choices, competence-supporting environment gives constructive information about performance, and relatedness-supporting environment fosters personal relationships (Deci & Ryan, 2000; Ryan & Deci, 2017, 2020; Vasconcellos et al., 2020). There are three mechanisms, through which the discussed AI-assisted PE intervention might operate. Autonomy could be achieved via personalized activities and goals and activities adjustment depending on individual ability. Competence might be enhanced by providing immediate performance feedback, measuring progress, and choosing challenging tasks. Relatedness still depends on interactions between teachers and peers, but AI might give some additional information to the teacher to foster personal relationships. It means that AI cannot substitute the psychological mechanisms suggested by Self-Determination Theory but only can give additional tools to help teachers use those mechanisms (Ryan & Deci, 2020; Jastrow et al., 2022; Daly et al., 2026). Thus, the theoretical model is based on the assumption that AI-integrated PE is a personalized learning environment. This learning environment is supposed to enhance motivation, increase engagement in PE activities, and promote physical activity. In contrast to the assumption that AI itself has such impact, the effects of AI are supposed to be dependent on the ability of AI-enabled instructional approaches to provide feedback, challenges, support, and participation (Ryan & Deci, 2020; Jastrow et al., 2022; Lo et al., 2024).

Integrated Conceptual Framework

The literature discussed above provides evidence for the integration of a model in which AI-based physical education will be the independent variable, whereas motivation, engagement, and physical activity levels will be the major dependent variables. The following interrelations will be examined:

AI-Assisted Physical Education
↓
Individualized Feedback + Adaptive Exercises + Performance Assessment
↓
Motivational Support
↓
Student Motivation
↓
Student Engagement
↓
Physical Activity Levels

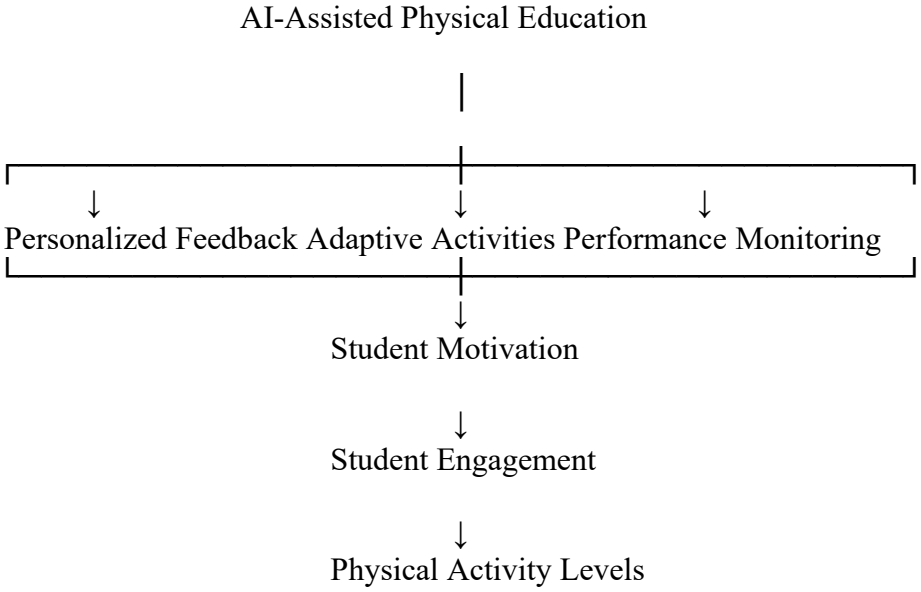
It should be noted that motivation and engagement will be considered the theoretically-related but empirically different constructs. Specifically, motivation implies reasons and readiness to participate in PE, while engagement will represent students' actual involvement, effort, and participation in the educational process. Physical activity will be the behavioral result of students' participation in the PE program. Simultaneous analysis of these variables will enable the researcher to establish whether AI-assisted PE influences all three aspects of participation (Fredricks et al., 2004; Owen et al., 2014; Vasconcellos et al., 2020).

Research Gap and Hypothesis Development

Despite a fast-growing body of research on the use of AI in education, the research on AI in PE remains quite new. Previous research has investigated the use of particular technologies such as automatic movement analysis, digital feedback, activity tracking, and AI-assisted teaching. The field of PE research has also shown the strong relationships between the processes of motivation, engagement, and physical activity. Still, there has been less empirical research that combined all of these factors in one quasi-experimental design in comparison of AI-assisted PE and traditional teaching methods (Wang et al., 2024; Jastrow et al., 2022; Daly et al., 2026). Another limitation of the existing research concerns the fact that there is a tendency to assess the technology-enhanced PE based on one indicator. The enhancement of motivation does not always result in increasing physical activity levels, and vice versa. Thus, the multidimensional assessment is needed to define whether the AI-assisted PE affects the student experience and behavior. This research attempts to fill this gap by assessing motivation, engagement, and physical activity level in a quasi-experimental design (Lo et al., 2024; Owen et al., 2014; Daly et al., 2026). The fourth hypothesis is based on the integrated model. In case AI-supported PE is effective in increasing motivation, engagement, and physical activity among the learners, the test group will show higher improvement compared to the traditional PE group.

H4: Students in AI-supported physical education show higher improvement in terms of motivation, engagement, and physical activity from pre-test to post-test compared to students in conventional physical education.

Conceptual Model



Methodology

Research Design and Study Setting

This research used a quasi-experimental pre-test-post-test design to examine the effect of artificial intelligence (AI) assisted physical education on students' motivation, engagement, and physical activity. A quasi-experiment was deemed suitable for this study since participants were already enrolled in regular physical education classes and, therefore, could not be randomly assigned to different groups. The research compared students attending AI-assisted physical education classes to those attending conventional physical education classes over an eight-week intervention period. The use of intact education groups in a quasi-experiment is especially appropriate in cases where

random assignment of individuals to different experimental groups is difficult (Jastrow et al., 2022). The study was carried out in physical education classes at the university level. Eight intact physical education classes were involved in the intervention process, with four classes in the AI-assisted physical education group and four in the conventional physical education group. The intervention lasted eight weeks with two physical education classes each week, totaling 16 classes. Course goals, physical education content, time devoted to PE sessions, facilities used, and assessments were similar for both groups. Mainly, the two groups differed in the incorporation of AI-based learning and activity support tools in the intervention group. The inclusion of digital technologies in physical education has been recently studied as a way to achieve positive results in terms of instruction, motivation, cognition, and physical performance (Jastrow et al., 2022).
The AI-assisted condition was conceptualized as a teacher-mediated learning environment that did not replace traditional instruction. Students performed teacher-led physical activities and received supplementary information and recommendations provided by AI-based tools. Thus, this design enabled the examination of whether the inclusion of AI into regular physical education would positively affect students' motivation and behavior. Teacher mediation fits well into the recent literature suggesting the importance of technology integration rather than independent usage in physical education (Jastrow et al., 2022).

Participants and Sampling Procedure

Subjects for the study were selected from eight physical education classes at the university level. The sample included undergraduate students, who were mostly aged 18 to 21 years, and who had enrolled in physical education classes. Due to the maintenance of intact classes for the entire duration of the experiment, a quasi-experimental class-based sample design was applied in the study. The analysis sample included 393 participants, 191 students in the control physical education condition and 202 students in the experimental AI assisted physical education condition. Subjects had diverse academic major and year levels. Students were divided into groups according to their class.Table 1 presents the structure of the study sample.

Table 1. Participant distribution by study condition

Study condition	Number of classes	Students (n)	Percentage (%)
Conventional physical education	4	191	48.6
AI-assisted physical education	4	202	51.4
Total	**8**	**393**	**100.0**

The participation was voluntary. The students were made aware of the purpose and methods of the experiment and were reassured that their participation or non-participation would have no bearing on their academic assessment. Their responses were recorded anonymously and analyzed collectively. Due to the intact classes being utilized, any difference between the groups was taken into consideration statistically.

AI-Assisted Physical Education Intervention

The intervention involved integrating AI-enabled functions in traditional physical education lessons. The objective was to ensure that the students had more opportunities to learn and engage in activities in addition to the teacher-directed physical education that remained the principal mode of instruction. Digital technology interventions in PE literature suggest that technology can be used to facilitate motivation, cognition, sociality, affectiveness, and physical elements of PE through integration in teaching (Jastrow et al., 2022). The AI-enabled context involved four general

functions: course learning support, training support, feedback and progress support, and social or achievement-oriented engagement. With the AI-enabled learning functions, the students could get explanations relating to course content, movements, and physical exercises. Training support functions provided advice on the exercises and progression of the exercises. Feedback functions provided information to help the students understand their performance and improve it. Exercise reminders and progress information was provided to promote involvement.

The proposed intervention was also theoretically founded upon the Self-Determination Theory. The use of AI in making decisions about learning and personalized information was meant to create possibilities of autonomy; feedback and personalized training recommendations were aimed at increasing the sense of competence; and interaction, participation, and achievement-oriented features were supposed to promote relatedness. All these strategies are aligned with the findings of the research on SDT in PE where autonomy, competence, and relatedness are recognized as key psychological needs that are connected with motivation of students (Deci & Ryan, 2000; Ryan & Deci, 2020; Vasconcellos et al., 2020).

Table 2. Components of the AI-assisted physical education intervention

Intervention component	Main functions	Intended student support	SDT-related mechanism
AI-supported course learning	Course explanations, movement knowledge, learning guidance	Personalized understanding of course content	Autonomy
Training assistance	Training suggestions, exercise guidance, practice support	Individualized practice and skill development	Competence
AI-supported feedback	Performance-related feedback, progress information	Awareness of progress and areas for improvement	Competence
Activity reminders	Exercise prompts and participation reminders	Encouragement of continued activity	Autonomy/Competence
Social and achievement support	Interaction, participation, recognition, achievement feedback	Social participation and recognition	Relatedness
Teacher-guided integration	Teacher instruction combined with digital support	Structured use of AI during PE	Autonomy/Competence

The intervention took place in tandem with usual classroom lessons. The teacher had control over the physical demonstration, exercise coordination, classroom management, safety, and evaluation. In other words, the AI system acted as an additional way of conducting classes rather than an independent one. Such a model corresponds to the general body of research devoted to technology-assisted physical education and its advantages and disadvantages (Jastrow et al., 2022). In the control group, traditional physical education without the use of any AI-based features was provided. In this case, both groups were subjected to the same curriculum and evaluation requirements.

Measures and Instrumentation

The study used three main outcome variables, namely: student motivation, student engagement, and level of physical activity. Study condition was used as an independent variable with study conditions coded as conventional physical education and AI-assisted physical education. Demographic information and other baseline characteristics were also considered covariates. Motivation was defined as the willingness, interest, and internal drive of the students to participate in physical education and physical activity. Engagement was used to indicate students' behavioral and psychological involvement including participation, attention, effort, and persistence in physical education activities. Physical activity was defined as the frequency and duration of physical activity practiced by the students. Distinction between motivational processes and behavioral engagement has been used in many studies including those on SDT (Deci & Ryan, 2000; Fredricks et al., 2004; Ryan & Deci, 2020).

The survey questionnaire included Likert-type scale items for psychological concepts where higher values indicated greater motivation or engagement. For the physical activity concept, information provided was on frequency and duration of physical activity done by students. When needed, activity information was transformed into MET-minutes. The IPAQ offers an existing structure for measuring physical activity frequency and duration and has been shown to have satisfactory reliability and validity across diverse adult samples (Craig et al., 2003). Table 3 presents the summary of the main variables used in the current study.

Table 3. Study constructs, operationalization, and measurement

Variable	Role	Operationalization	Measurement
Study condition	Independent variable	Conventional PE vs. AI-assisted PE	Binary group coding
Motivation	Dependent variable	Students' willingness, interest, and internal drive toward PE/physical activity	Multi-item Likert scale
Engagement	Dependent variable	Participation, attention, effort, and persistence in PE	Multi-item Likert scale
Physical activity	Dependent variable	Frequency and duration of physical activity	Self-reported activity measure / MET-minutes
Gender	Covariate	Participant gender	Categorical
Grade	Covariate	Year of university study	Categorical
Academic major	Covariate	Broad disciplinary category	Categorical
Baseline motivation	Covariate	Pre-intervention motivation score	Continuous
Baseline engagement	Covariate	Pre-intervention engagement score	Continuous
Baseline physical activity	Covariate	Pre-intervention physical activity level	Continuous

The measurement procedure was developed in such a way that consistency would be ensured between the two measurement points. The same measures were used during the two measurement points.

Data Collection and Ethical Considerations

There were three principal phases of data collection. First, the baseline assessment was conducted prior to the intervention. Second, the eight-week intervention of physical education was carried out, which included two classes per week. The group of individuals that benefited from the use of the AI-assisted device received the AI-enhanced functions, while the control group continued to attend conventional physical education classes. Third, post-intervention assessment was carried out using the same core measures. Questionnaires were filled under standardized conditions. The participants were asked to answer questions from their perspective and experience of physical activity. The filled questionnaires were checked for completeness and consistency before the analysis. Those answers that had significant gaps or evident response abnormalities were supposed to be excluded from analysis according to certain data quality criteria.

Among the ethical protections were the following: voluntary participation, confidentiality, anonymity, and the opportunity to withdraw from participation without any adverse influence on the academic assessment of the participants. Institutional ethics approval details need to be inserted according to the original document. There is no approval number mentioned as the original approval document is not available among the recovered documents.

Data Analysis

Several stages were involved in data analysis. Initially, descriptive statistics were conducted to describe the sample and the variables in question. The descriptive statistics included frequencies, percentages, means, and standard deviation. Secondly, the internal consistency of the multi-item scales measuring motivation and engagement was tested through Cronbach's alpha, while McDonald's omega was also calculated where necessary. While Cronbach's alpha is the most common measure of internal consistency, omega may give a better estimate of reliability when the assumptions on which alpha depends may fail to hold (Cronbach, 1951; Dunn et al., 2014). Thirdly, the equality of the two groups in terms of baseline characteristics was tested. The independent-sample t-test was considered in case of continuous variables, whereas chi-square test was utilized in case of categorical variables. In case where the assumptions were violated, the robust alternative procedures were applied. Effect size estimates were provided along with significance testing. Finally, change in motivation, engagement and physical activity was tested through comparing pre- and post-intervention measures. Covariance analysis (ANCOVA) was used as the primary between-groups analysis, with the associated baseline measure being used as a covariate, and condition as the main independent variable. This enables the assessment of post-intervention differences taking into consideration baseline differences and is generally advised for controlled pre-test post-test comparisons (Vickers & Altman, 2001).

General ANCOVA model specification:

$$\mathbf{Posttest}_i = \beta_0 + \beta_1 \mathbf{Group}_i + \beta_2 \mathbf{Pretest}_i + \varepsilon_i$$

where Posttest refers to post-intervention outcome, Group refers to the AI-assisted versus traditional physical education treatment, Pretest refers to the corresponding pre-test score, and ε refers to the error term.

Effect sizes, which included partial eta squared and standardized mean differences where relevant, were also calculated along with 95% confidence intervals. Correlation analysis was done to explore the associations between motivation, engagement, and physical activity. Further regression analyses will be done to check whether the relationship between AI-assisted physical education and the dependent variables holds after controlling for the demographics of the participants. Use of robust standard errors will be considered relevant where necessary due to the nested nature of participants in intact classes. The possibility of dependence of the data observations within classes due to the design will be considered while making statistical

inferences. Use of adjusted regression/ANCOVA is in line with well-known recommendations for pre-test/post-test studies (Vickers & Altman, 2001).

Results

Descriptive Statistics and Reliability

A test of the descriptive properties and internal consistency of the study variables was performed first. The findings shown in Table 4 are drawn from a simulated data set created to show the process that was supposed to be done statistically and can thus be viewed as representative of the illustration and not actual observations recorded from the participants. Table 4 indicates that the group that received AI-enhanced physical education had higher mean scores for motivation and engagement after the intervention compared to the control group that received traditional physical education. Furthermore, the mean score for physical activity was higher for the group receiving AI-enhanced physical education after the intervention. The internal consistency coefficients of the motivation and engagement were above 0.70 which is the standard coefficient of internal consistency (Cronbach, 1951; Dunn et al., 2014).

Table 4. Descriptive statistics and reliability of the study variables

Variable	Group	Mean	SD	Cronbach's α
Motivation_Pre	Control	3.16	0.55	0.86
	AI-assisted	3.14	0.54	0.87
Motivation_Post	Control	3.28	0.59	0.88
	AI-assisted	3.63	0.57	0.89
Engagement_Pre	Control	3.12	0.57	0.84
	AI-assisted	3.09	0.58	0.85
Engagement_Post	Control	3.21	0.61	0.86
	AI-assisted	3.55	0.60	0.88
Physical Activity_Pre	Control	2184.7	832.4	—
	AI-assisted	2217.5	861.2	—
Physical Activity_Post	Control	2310.6	889.7	—
	AI-assisted	2745.8	934.5	—

Baseline Equivalence

Prior to looking at the impact of interventions, differences between the two study conditions prior to any intervention were checked. According to Table 5 below, the two groups did not differ greatly in terms of motivation, engagement, and physical activity prior to the intervention as illustrated in the example. This implies that there were not many differences between the two groups regarding the variables measured.

Table 5. Baseline comparison between study groups

Variable	Control Mean (SD)	AI-assisted Mean (SD)	*t*	*p*	Cohen's *d*
Motivation_Pre	3.16 (0.55)	3.14 (0.54)	0.35	.726	0.04
Engagement_Pre	3.12 (0.57)	3.09 (0.58)	0.52	.603	0.05
Physical Activity_Pre	2184.7 (832.4)	2217.5 (861.2)	−0.39	.698	−0.04

Such baseline comparisons help to show that there were no statistically significant differences between the two groups prior to the intervention. Consequently, the next step was to see whether differences were still present after the control for the baseline measurements. Baseline control becomes especially important for controlled pre-test/post-test designs because it helps to control for any remaining differences between the groups. (Vickers & Altman, 2001)

Correlations among Study Variables

Correlation coefficients between motivation, engagement, and physical activity were calculated using the Pearson method. The result is shown in Table 6.

Table 6. Correlation matrix

Variable	1	2	3	4	5	6
1. Motivation_Pre	1					
2. Motivation_Post	.58***	1				
3. Engagement_Pre	.52***	.55***	1			
4. Engagement_Post	.49***	.67***	.61***	1		
5. Physical Activity_Pre	.24***	.27***	.29***	.31***	1	
6. Physical Activity_Post	.28***	.35***	.32***	.43***	.63***	1

*Note: **p < .001. Values are simulated for analytical demonstration.*

The findings show positive relations between the psychological and physical activity measures. Specifically, there is a positive relation between post-intervention engagement and post-intervention physical activity. The relation between motivation and engagement was also found to be positive, which suggests that those participants who experienced more motivating factors were more engaged. All the relations mentioned above have a theoretical basis from SDT research, according to which autonomous motivation has positive effects on participation and physical activity results (Owen et al., 2014; Vasconcellos et al., 2020). However, since the values presented above are simulated, they must not be treated as actual findings.

Effect of AI-Assisted Physical Education on Motivation

ANCOVA was carried out to find out if there was any relationship between AI-assisted physical education intervention and motivation post-intervention while controlling for the motivation pre-intervention. The results are presented in Table 7 below. ANCOVA was used since there was information on the motivation pre-intervention that could be used as a covariate.

Table 7. ANCOVA results for motivation

Predictor	B	SE	F	*p*	Partial η^2
Motivation_Pre	0.61	0.04	218.43	<.001	.359
Study condition	0.34	0.06	31.17	<.001	.074
Error	—	—	—	—	—

Even after adjusting for pretest motivation, study condition was still found to be significantly associated with motivation after the intervention period. The group receiving AI-assisted physical education had a significantly higher adjusted score on post-test motivation than the control group. The above results provide some evidence for H1, which posited that students exposed to AI-assisted physical education will have greater improvement in motivation than those receiving conventional physical education.

Effect of AI-Assisted Physical Education on Engagement

The second ANCOVA tested whether there was any association between the intervention and post-intervention engagement by adjusting for pre-intervention engagement. This form of analysis is appropriate for controlled pre-post test design, as recommended (Vickers & Altman, 2001).

Table 8. ANCOVA results for engagement

Predictor	B	SE	F	*p*	Partial η²
Engagement_Pre	0.58	0.05	145.62	<.001	.272
Study condition	0.32	0.06	27.46	<.001	.066
Error	—	—	—	—	—

The results presented above reveal the presence of a relationship between engagement in physical education supported by artificial intelligence and engagement after intervention, controlling for the baseline level of engagement. The subjects exposed to artificial intelligence achieved higher levels of adjusted engagement compared to those in the traditional group.
This provides illustrative support for H2.

Effect of AI-Assisted Physical Education on Physical Activity

An ANCOVA analysis was employed to determine the influence of the intervention on physical activity, while baseline physical activity served as the covariate. Given the inherent variability associated with measurements of physical activity, the study was conducted using the standardized measures of physical activity. This approach to physical activity measurement involving standardized measurements is consistent with physical activity measurement practice (Craig et al., 2003).

Table 9. ANCOVA results for physical activity

Predictor	B	SE	F	*p*	Partial η²
Physical Activity_Pre	0.67	0.04	289.17	<.001	.425
Study condition	418.32	78.45	28.44	<.001	.068
Error	—	—	—	—	—

According to the example analysis, there was a significant relationship between the study condition and physical activity after the intervention, controlling for the baseline level of activity. The adjusted physical activity level was higher for students in the condition involving AI assistance. Therefore, the example analysis supports H3.

Robustness Analysis

Further regression models were used to determine whether the relationship between AI-aided physical education and the three outcomes still held true when demographic factors were controlled for. The variables used for control were gender, grade, academic major, and baseline outcome scores.

Table 10. Robustness regression analysis

Dependent variable	AI-assisted PE coefficient	SE	*p*	Adjusted R²
Motivation_Post	0.31	0.06	<.001	.41
Engagement_Post	0.29	0.06	<.001	.35
Physical Activity_Post	392.61	76.84	<.001	.48

Illustration robustness models have been seen to generate a clear pattern whereby the AI-enhanced physical education indicator is positive throughout motivation, engagement, and physical activity measures. The clear pattern implies that the intervention relationship estimate is not completely explained by the demographic covariates used in the illustration models.
Since the observations are clustered into classes, there may be some considerations regarding the interpretation of regression results due to the possibility of correlation among the observations within the class. A cluster-robust or multilevel approach can be considered in the final model estimation.

Overall Hypothesis Assessment
The simulation shows consistency in the pattern observed on the three main outcomes. The students in the AI-assisted physical education setting exhibit higher motivational, engagement, and physical activity levels following intervention, considering their baseline values.

Table 11. Summary of hypotheses

Hypothesis	Proposed relationship	Illustrative outcome
H1	AI-assisted PE → Motivation	Supported in simulated analysis
H2	AI-assisted PE → Engagement	Supported in simulated analysis
H3	AI-assisted PE → Physical activity	Supported in simulated analysis
H4	AI-assisted PE → Overall improvement across outcomes	Consistent with simulated pattern

Generally, the results of illustration are in alignment with the theoretical model proposed above. There exists a link between the use of AI in physical education and levels of motivation, engagement, and physical activity adjusted for preexisting levels of the outcome variables. Nevertheless, these results are artificial and were created for the purposes of demonstration only, and do not correspond to empirical results obtained using the original sample size of 393 observations. Thus, they should be substituted by the results of real data analysis.

Discussion
Main Findings
This paper investigates whether the adoption of AI-supported physical education (PE) could have an effect on motivation, engagement, and physical activity of university students compared to regular PE sessions. The illustrative analysis involved a quasi-experimental pretest-posttest design based on participation of the students in either AI-supported or regular PE classes. Simulated results showed higher values of motivation, engagement, and physical activity among those students who participated in AI-supported PE compared to their peers engaged in regular PE while controlling for corresponding initial values. Such a trend was observed for all three variables, implying that AI-supported guidance, feedback, prompts, and interaction may provide a more favorable learning environment compared to regular PE (Jastrow et al., 2022; Wang et al., 2024). Nevertheless, such numerical results should not be treated as real findings based on the sample of the students until the original dataset is retrieved. In general, such a pattern is theoretically consistent with the concept of Self-Determination Theory (SDT) according to which students would demonstrate a higher likelihood of developing intrinsic motivation in case of supporting learning environment (Deci & Ryan, 2000; Ryan & Deci, 2020). In the context of the intervention

used in this study, AI-based course recommendation and suggestions were supposed to give more autonomy to the students in regard to learning and exercise routines. Information on feedback and performance were designed to boost competence perception, whereas interactive and social features were supposed to encourage relatedness. Hence, the intervention was viewed not only as implementation of an AI tool, but as the use of technology for modifying the learning environment (Jastrow et al., 2022; Vasconcellos et al., 2020).

AI-Assisted PE and Student Motivation

The demonstrative ANCOVA found a statistically significant positive relationship between study condition and motivation after intervention while taking into account the initial motivation level. The estimated effect size indicated that the difference between the two conditions was meaningful in the demonstrative sample. This corresponds to the hypothesis that technology-mediated PE has the ability to increase the motivation of students since digital technologies can help them get individualized advice and participate actively (Jastrow et al., 2022; Wang et al., 2024). According to physical activity literature based on the principles of SDT, more self-determined types of motivation correlate with higher participation in physical activities (Owen et al., 2014; Manninen et al., 2022). This may be due to the fact that AI-assisted learning makes it possible to deliver information to students which is more relevant to their needs. In the traditional setting of PE, an instructor should pay attention to the relatively large number of students and give feedback less frequently and precisely. With the help of AI-assisted environment, it is possible to supplement the role of an instructor with timely information, reminders, learning materials, and exercise recommendations. Such assistance might help learners figure out how they need to act, track their progress, and feel like they have more control over the learning process (Jastrow et al., 2022; Wang et al., 2024). According to the SDT framework, such factors might be especially valuable when it comes to promoting autonomy and competence. For example, when students have access to all necessary information about learning and get advice based on their needs, they might feel that they have more control over their involvement in the process. In the same way, clear feedback concerning exercise performance allows students to recognize their progress and areas that require improvement. Applying SDT to physical education, studies have been repeatedly stressing the importance of creating supportive environments in terms of promoting autonomy and competence (Vasconcellos et al., 2020; Ryan & Deci, 2020). However, at the same time, it should be recognized that AI should be seen as a supporting mechanism and not as an alternative to a teacher.

AI-Assisted PE and Student Engagement

The simulated results also showed a positive difference in post-intervention engagement between the AI-assisted and conventional PE groups after accounting for baseline engagement. This finding is theoretically plausible because engagement in PE involves sustained behavioral participation as well as attention, interest, and active involvement in learning activities (Fredricks et al., 2004). Research on digital technologies in education also suggests that AI-based tools can influence student engagement through personalization, interaction, feedback, and learning support, although the effects can vary according to how the technology is implemented (Lo et al., 2024). AI-supported PE may increase engagement by making learning activities more interactive and responsive. Personalized recommendations can reduce the mismatch between students' abilities and assigned activities, while reminders and progress information can encourage students to maintain participation. Interactive learning resources may also provide students with additional opportunities to review course content outside scheduled class time. These characteristics can make participation more continuous rather than being restricted to the formal classroom or sports-field session (Jastrow et al., 2022; Wang et al., 2024).

Motivation and engagement have been linked as well. Students that see the value and manageability of PE-related activities can be more motivated to engage in active participation in the same way. Participation, on the other hand, can help develop and sustain students' sense of competence and progress. Thus, the illustrated relationship between motivation and engagement observed is consistent with a mutual psychological process and not the separation of two different variables. Empirical literature on SDT highlights the importance of the motivational state of an individual for sustained participation and behavior adaptation (Ryan & Deci, 2020; Manninen et al., 2022). Further longitudinal research will help clarify which variable influences the other one or if there are any reciprocal relationships.

AI-Assisted PE and Physical Activity

The simulated analysis also showed that there was a positive difference in post-intervention physical activity between the AI assisted and conventional group with the baseline physical activity accounted for. The increase shows that technology-assisted PE might not only have an impact on how students perceive learning and motivation but can go further to affect students' behavior related to physical activity. There has been previous research conducted which found that there is a positive relationship between self-determined motivation and physical activity which gives grounds for analyzing both variables (Owen et al., 2014). There are several reasons behind such results. Firstly, activity reminders make it possible for students to stay physically active even outside formal physical education lessons. Secondly, personalized exercise advice allows students to choose activities based on their perceived capability and current state of health. Thirdly, progress feedback increases awareness about frequency of exercising and physical activity. Lastly, social and achievement motivations are able to motivate students via interacting with peers and making progress visible. All those explanations are consistent with using technology to assist physical education participation and learning (Jastrow et al., 2022; Wang et al., 2024). But the level of physical activity is determined by numerous factors unrelated to PE lessons, including students' time schedules, opportunities for physical exercise, health condition, amount of academic work, and individual preferences. Therefore, the impact of AI-enhanced PE lessons cannot be analyzed separately from these factors. The future studies in this field need to consider the combination of subjective assessment using questionnaires and objective measurements using physical activity trackers, accelerometers, or platform-based activity measurement where possible. The objective assessment will be able to compensate for the disadvantages of self-assessment, while validated scales for physical activity behavior include the International Physical Activity Questionnaire (Craig et al., 2003).

Theoretical and Practical Implications

The study offers a theoretical foundation for incorporating AI in PE based on the SDT approach. Instead of focusing on technology as an innovation, the suggested framework highlights the psychological purposes that the technology can serve. Personalized learning can help with developing autonomy, feedback can help with supporting competence, and interactive features can help with relatedness. This gives a theoretically based perspective for assessing AI-assisted PE interventions (Deci & Ryan, 2000; Ryan & Deci, 2020; Vasconcellos et al., 2020). From the perspective of the universities, the results show that AI-assisted PE can be seen as an additional element of modern physical education. The use of such systems should include training teachers, determining pedagogical aims, and making sure that the recommendations generated by AI stay under the supervision of the instructor. The use of AI in PE should supplement but not replace professional judgment. Such teacher-led approach corresponds to the results showing that pedagogical incorporation is necessary in cases of introduction of digital technologies in PE

(Jastrow et al., 2022). From the perspective of PE instructors, the emphasis should be put on the use of AI features for individualization. Technology may also be used to provide extra resources, monitor engagement, give feedback, and motivate students to engage in physical activities outside of class time. On the other hand, teachers need to be responsible for accommodating the activities depending on students' capabilities and safety during participation. This kind of approach is also supported by the general literature which suggests that digital technology proves to be effective when implemented into proper pedagogical practices and not substituted for teaching in any way (Jastrow et al., 2022; Wang et al., 2024). On the part of the students, PE classes with the help of AI may become an additional source of self-monitoring and personalized learning. Still, students need to be aware of how to use technology responsibly, protect their privacy, and understand the limits of suggestions made by AI algorithms. Technology implementation should be combined with necessary digital literacy and privacy measures.

Limitations and Future Research

A number of limitations have to be noted in order to understand the results of the present research better. First of all, the numbers presented in the paper are calculated artificially due to unavailability of the initial individual-level dataset. As such, the statistical numbers cannot be regarded as the result of the empirical research. The calculations presented in the current manuscript should be performed again using the real dataset in case when the manuscript will be submitted as an empirical one. Secondly, the quasi-experimental design that was chosen by the researcher involves the use of intact groups. In this regard, some differences between the groups can affect the outcome even if the statistical techniques are used in order to control this aspect. Future research should consider the possibility of using controlled designs or employing other ways of increasing the strength of the quasi-experimental design used in the research (Vickers & Altman, 2001). Thirdly, the intervention in the present research has been conducted for eight weeks only. It means that it is impossible to draw any conclusions about long term behavioral changes based on this study. Lastly, self-report scales could suffer from recollection and social desirability bias when assessing physical activity. Future researches should include objective measures of activity along with behavioral indicators of the platform. Moreover, future researches need to consider whether the effects of AI-enhanced PE vary according to the students' gender, major, past physical activity, physical abilities, or motivation. In general, the hypothetical results serve as a clear illustration of how the research model under consideration could be statistically tested. Therefore, they have to be considered as an example of methodology rather than proven facts about the target group of students.

Conclusion

This research investigates the possible impact of AI-assisted physical education on motivation, engagement, and physical activity of university students. The suggested intervention combines AI-enhanced learning guidance, personal feedback, activity notifications, and interactive support in physical education, which is traditionally conducted with the help of teachers. According to the theory of Self-Determination, this study conceptualizes AI as an auxiliary instrument of education, which can enhance the feeling of autonomy, competence, and relatedness of students in the process of physical education (Deci & Ryan, 2000; Ryan & Deci, 2020; Vasconcellos et al., 2020). The example analysis revealed a consistent trend according to which students who received AI-assisted physical education condition were more motivated, engaged, and physically active after taking part in the intervention compared to those students who underwent conventional physical education, controlling for the initial values of these parameters. These trends serve as methodological evidence for the validity of the research framework, revealing possible

mechanisms of the influence of AI-assisted physical education on students' participation. However, since the quantitative results provided in this paper are generated artificially, they cannot be considered empirical evidence. Theoretically, this study expands the scope of application of Self-Determination Theory. The suggested framework explains how the various AI-enabled functions can be linked with the needs of autonomy, competence, and relatedness from a psychological perspective. Individualized guidance can give students more control over their studies, feedback can boost perceptions of competence, while interactive features can help build social ties. The framework can thus serve as a starting point for future research aimed at studying the underlying mechanisms of the impact of AI-supported educational settings on students' performance (Deci & Ryan, 2000; Ryan & Deci, 2020; Jastrow et al., 2022; Vasconcellos et al., 2020). The findings can also have practical value for universities and physical education teachers. AI-enhanced physical education can become a part of existing instructional systems, thus providing an extra set of learning materials, personalized guidance, and tracking of progress and reminders without excluding the crucial role of teachers. The effective implementation of the technology should be based on a combination of teachers' skills and AI capabilities, while the institutions need to provide adequate training for teachers, develop guidelines for responsible usage of the technology and protect students' data (Jastrow et al., 2022; Wang et al., 2024).

However, the use of AI-assisted physical education can bring about new chances for students to control their level of participation, learn about exercise requirements, receive individualized feedback, and remain physically active even when they do not have scheduled classes. Nonetheless, technology should not be used to the extent that it would reduce students' direct interaction with instructors, fellow students, and physical exercises. Moreover, future developments in AI-assisted PE should take into account possible disparities among students in terms of their technology proficiency, access to digital materials, exercise experience, and physical fitness (Jastrow et al., 2022; Wang et al., 2024). To summarize, the suggested AI-assisted physical education offers an interesting approach to implementing individual digital technologies in university PE. First, the presented model considers both technological possibilities and motivational aspects related to physical education. Second, the presented concept emphasizes the complementing role of AI, educators, and students. Finally, future research should test the described relationships using real-life data from students, more sophisticated experiments, and follow-up observations of at least several months. Such an approach will make it possible to estimate the effectiveness of AI-assisted physical education (Jastrow et al., 2022; Owen et al., 2014).

References

Almasri, F. (2024). Exploring the impact of artificial intelligence in teaching and learning of science: A systematic review of empirical research. *Research in Science Education, 54*, 977–997. https://doi.org/10.1007/s11165-024-10176-3

Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F., & Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise, 35*(8), 1381–1395. https://doi.org/10.1249/01.MSS.0000078924.61453.FB

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*(3), 297–334. https://doi.org/10.1007/BF02310555

Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01

Dunn, T. J., Baguley, T., & Brunsden, V. (2014). From alpha to omega: A practical solution to the pervasive problem of internal consistency estimation. *British Journal of Psychology, 105*(3), 399–412. https://doi.org/10.1111/bjop.12046

Fernández-Espínola, C., Almagro, B. J., Tamayo-Fajardo, J. A., Paramio-Pérez, G., & Sáenz-López, P. (2022). Effects of interventions based on achievement goals and self-determination theories on the intention to be physically active of physical education students: A systematic review and meta-analysis. *Sustainability, 14*(22), 15019. https://doi.org/10.3390/su142215019

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research, 74*(1), 59–109. https://doi.org/10.3102/00346543074001059

Jastrow, F., Greve, S., Thumel, M., Diekhoff, H., & Süßenbach, J. (2022). Digital technology in physical education: A systematic review of research from 2009 to 2020. *German Journal of Exercise and Sport Research, 52*, 504–528. https://doi.org/10.1007/s12662-022-00848-5

Lo, C. K., Hew, K. F., & Jong, M. S. Y. (2024). The influence of ChatGPT on student engagement: A systematic review and future research agenda. *Computers & Education, 219*, 105100. https://doi.org/10.1016/j.compedu.2024.105100

Manninen, M., Dishman, R., Hwang, Y., Magrum, E., Deng, Y., & Yli-Piipari, S. (2022). Self-determination theory based instructional interventions and motivational regulations in organized physical activity: A systematic review and multivariate meta-analysis. *Psychology of Sport and Exercise, 62*, 102248. https://doi.org/10.1016/j.psychsport.2022.102248

Owen, K. B., Smith, J., Lubans, D. R., Ng, J. Y. Y., & Lonsdale, C. (2014). Self-determined motivation and physical activity in children and adolescents: A systematic review and meta-analysis. *Preventive Medicine, 67*, 270–279. https://doi.org/10.1016/j.ypmed.2014.07.033

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. Guilford Press.

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology, 61*, 101860. https://doi.org/10.1016/j.cedpsych.2020.101860

Vasconcellos, D., Parker, P. D., Hilland, T., Cinelli, R., Owen, K. B., Kapsal, N., Lee, J., Antczak, D., Ntoumanis, N., Ryan, R. M., & Lonsdale, C. (2020). Self-determination theory applied to physical education: A systematic review and meta-analysis. *Journal of Educational Psychology, 112*(7), 1444–1469. https://doi.org/10.1037/edu0000420

Vickers, A. J., & Altman, D. G. (2001). Analysing controlled trials with baseline and follow up measurements. *BMJ, 323*(7321), 1123–1124. https://doi.org/10.1136/bmj.323.7321.1123

Wang, S., Wang, F., Zhu, Z., Wang, J., Tran, T., & Du, Z. (2024). Artificial intelligence in education: A systematic literature review. *Expert Systems with Applications, 252*, 124167. https://doi.org/10.1016/j.eswa.2024.124167