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Article

Empowering college physical education: AI-driven training, teaching, and intelligent information processing

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Abstract: The current status, methods utilized for Physical Education Training and Teaching System for College Students, and difficulties during information processing are all investigated in this comprehensive study. We compiled 130 empirical research on Artificial Intelligence-based Physical Education (AIPE) using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses are analysed. Research shows that AI may improve health tracking, individualized training, and analysis of sporting performance. There is a lot of promise in AIPE for individualized lessons, immediate feedback, varied classroom settings, and evaluation. The problems arise when dealing with technological dependability, privacy concerns, and the need for instructor assistance. These results give light on important questions for future AIPE. This research delves into the process of creating and launching an all-encompassing educational platform that makes use of AI and data processing methods. Our system's goals include improving the quality of instruction, tailoring feedback to each student, and enhancing the overall learning experience. AI Algorithms powered by artificial intelligence help us shift through student test scores, identify knowledge gaps, and modify lessons appropriately. This makes sure that the curriculum meets each student's needs. Practical exercises, quizzes, and assignments get immediate feedback through the system. It uses natural language processing (NLP) to analyse student answers, find misunderstandings, and provide help for fixing them. The system personalizes learning routes according to students' choices, learning styles, and progress. It suggests further reading, interactive games, and group assignments. Through the automation of administrative activities, generation of analytics reports, and suggestion of pedagogical changes, the system aids instructors. It makes it easier for students and instructors to talk to one another. Data protection, overcoming AI biases, and getting teachers on board with tech-enhanced lessons are all obstacles. Future studies should aim to improve the system, confirm its efficacy, and encourage its implementation across educational institutions. Finally, there is great potential for improving higher education with an AI-based training and teaching system with strong data processing skills. Students and teachers may reap the advantages of a technologically enhanced, ever-changing learning environment.

Keywords: AI technologies; meta-analyses; systematic reviews; information processing

1. Introduction

AI has rapidly permeated many facets of education, and PE has no exception [1]. With the introduction of AIPE, there has been a fundamental change in thinking in this field towards training and education [2]. Through a comprehensive review of experimental research, the paper provides an overview of the current state of AIPE and highlights its methods, impacts and problems [3]. In PE, AI has immense potential to enable personalized learning experiences, immediate feedback, and better student outcomes [4]. By employing Preferred Reporting Items for Systematic Reviews and

Meta-Analyses (PRISMA), this paper examines 130 empirical papers to identify how AI may change physical education pedagogy [5].

Artificial intelligence could drive a major transformation in health monitoring, sport performance analysis, and personalized training programs [6]. Hence systematic assessments of student's performances, targeting weak points and individualizing teaching resources are all areas that artificial intelligence-enhanced systems can cover [7]. Immediate Feedback Mechanisms that are AI-based facilitate efficient learning processes, promoting more interactive classrooms engaged in active participation [8]. Some notable challenges include concerns over data privacy, technology reliability, and teacher support [9]. Improving AI systems, reducing biases, and preparing teachers to use tech-enhanced pedagogical techniques are all necessary to overcome these obstacles [10].

This paper delves into the creation and execution of an all-encompassing educational platform that utilizes AI to enhance physical education instruction and student learning [11]. Improved educational quality, personalized feedback mechanisms, and increased student engagement are the goals of this platform, which employs AI and data processing approaches [12]. This proposed method aims to improve learning outcomes by automating administrative operations, generating analytics reports, and facilitating communication between instructors and students [13].

1.1. Problem statement

The paper seeks to address the issue statement by exploring new ways to enhance the quality and effectiveness of PE education and training for college students [14–16]. Limited customisation, a lack of timely feedback, and limitations in properly measuring student development are common obstacles traditional PE programs face. There are further worries about privacy, technology reliability, and instructors' role using AI-based solutions. Therefore, it is critical to investigate how AI may transform PE by solving these problems [17–20]. The research examines how AI may improve PE health monitoring, tailored training, performance analysis, and learning experiences while addressing data privacy and technological dependability issues.

1.2. Objective

- The paper aims to investigate how AI may transform college students' access to and experience with physical education (PE).
- This paper examines the present state, techniques, effects, and problems of AI-based systems in PE by thoroughly reviewing empirical research papers. In addition, it aspires to build a comprehensive educational platform that uses data processing and artificial intelligence to boost the quality of teaching, provide students more tailored comments, and enrich their educational experiences generally.
- The paper aims to help encourage the use of AI technologies in higher education by integrating current knowledge and offering novel solutions. It seeks to contribute to improving physical education pedagogy.

1.3. Contribution of the paper

- This paper will synthesize 130 empirical research studies on AI in PE, illuminating its possible uses in health monitoring, personalized training, and performance evaluation.
- AI-based learning platform designed for PE to improve the quality of training, streamline learning processes, and provide individualized feedback. Solutions are provided to address data privacy and technology dependability, which are barriers to successful integration.
- It highlights the need for continuous innovation while discussing the wider implications of AI in higher education. The paper contributes to the knowledge of AI in PE by offering insights, concrete suggestions, and a foundation for further study.

2. Related works

Higher education PE has long suffered from disinterest or not being connected to students about the traditional PE curricula. Therefore, researchers who want to improve quality and efficacy in college PE have explored various methodological and technological interventions. It will review some associated studies that use Artificial Intelligence (AI), Virtual Reality (VR) and innovative evaluation frameworks.

2.1. Artificial Intelligence Technology (AIT)

Physical education needs improvement because higher education cannot longer afford students' disengagement from its conventional PE programs. The paper underlines this while maintaining that the classroom should be revitalized and considering possibilities for new teaching ideas, approaches of instruction, and testing equipment. The paper suggests research on how AI might improve PE results using recent developments in AIT [21]. Results from experiments show that students' agility, speed, stamina, and strength are all much improved by physical education programs that use artificial intelligence. The revolutionary potential of AI to raise the bar for collegiate PE programs. University physical education programs may be greatly improved with the help of this study, which provides concrete facts and insightful commentary.

2.2. VR Technology based on Artificial Intelligence (VRT-AI)

The primary goal of this paper is to improve collegiate PE classes through VR technology based on artificial intelligence. Video storage, fast/slow playback, and comparison with real-life athlete motions are all made possible by the system's use of the spline key frame interpolation approach, which creates virtual human animations based on changes in the virtual human's centre of gravity location [22]. An additional way to measure the efficacy of instruction is through using neural networks. This paper provides a solid foundation for the future of virtual reality (VR) in education by laying the groundwork for more advanced, immersive pedagogical practices in collegiate PE. It promotes the wider usage of VR technology in higher education by giving coaches and players enhanced motion analysis and feedback tools, which in turn allows for more effective teaching approaches.

2.3. Analysis, Design, Development, Implementation, Evaluation (ADDIE) framework

The analysis used the ADDIE framework to examine how well PE online practical classes (OPC) worked during the COVID-19 epidemic. Issues with team project feasibility, implementation mistakes that persisted, and student disengagement with assessment were among the difficulties identified among the 75 participants who had no background in OPC [23]. The perceived efficacy of instructors and learners was shown to be significantly different. Giving students constructive criticism quickly, helping them make fewer technical errors, and encouraging them to keep learning are all suggestions. Colleges and institutions should set aside time for teachers to make online personal classroom films and use real-time instruction with constant feedback to prepare for the educational environment after the epidemic.

2.4. Physical Education Information Services using AI (PEIS-AI) technology

University physical education information services are being revolutionized by AI technology (PEIS-AI), which this paper explores. A comprehensive examination of this interaction is undertaken to understand better the differences and connections between big data and other information technologies, such as the Internet, the Internet of Things, and cloud computing. The university physical education field benefits greatly from the data gathering, decision-making, governance model, instructional practice, scientific research service, and assessment technique revolutions that AI offers [24]. In addition to these advances, the authors may also explore the applications of Artificial Intelligence-based Physical Education training for predicting sports injuries. AI systems can analyze athletes' biomechanical data, training loads, and historical injury patterns to detect potential risks early on. By using machine learning models, personalized injury prevention strategies can be developed, helping coaches and trainers to adjust training intensity, recovery periods, and exercise techniques. This application of AI not only enhances the safety and longevity of athletes but also supports evidence-based decision-making in physical education programs. Several hurdles, including privacy concerns, data hegemony, data quality issues, standards, and security hazards, hinder the effective management of big data education. This paper seeks to solve current problems in college PE administration by arguing that intelligent and humanized education management is the key to overcoming these obstacles and advancing educational modernization. Optimal information services and improved university physical education are the goals of this method, which is based on cutting-edge research and strategic efforts.

2.5. AI-based Multi-Feature Fuzzy Evaluation (AI-MFFE) model

This paper suggests an AI-MFFE model to handle the difficulties of assessing collegiate physical education teaching methods. This framework considers three points of view during evaluation: management, teachers, and students. It does this by combining natural language processing with fuzzy instructions. An improved cuckoo search optimization method is used to rank the parameters and an impartial function is used to evaluate the outcome. Improved assessment precision results from the model's incorporation of students' mobility mechanisms and movement vector deconstruction. A system that used this paradigm acquired high results across several assessment categories, suggesting that it effectively improved teaching techniques [25]. The suggested framework is shown to be better when compared with conventional techniques. Improved teaching efficiency and student satisfaction in higher education may be achieved by implementing this research's proposed evaluation framework and simplified evaluation procedure, advancing pedagogical practices in physical education teaching methods.

By combining the potential of AI, VR, and new forms of assessment, these connected works help to improve PE instruction at the university level. Higher education institutions may greatly benefit from their insightful techniques and useful insights on improving the quality and efficacy of physical education training.

3. Proposed method

Educational innovations especially physical education has undergone massive transformations due to the introduction of AI into the system. Data processing capabilities for university student's PE educational training systems at present are looked into by this paper. In other words, studying 130 empirical findings, this paper emphasizes on what can be achieved through employing (EI) improvements in Health Tracking, Personalized Education as well as Sporting Performance Analysis in respect to Artificial Intelligence promises. Reliability related issues in technology coupled with privacy aspects and teacher involvement are indicated inside. A new dawn for technologically transformed pedagogical practices is forthcoming; Therefore, it purposes delineating an entire educational platform based on artificial intelligence integrated teaching as well as information processing methods towards enhancing global instructional quality personalized feedbacks and improved learning experiences worldwide.

An illustration in **Figure 1**, the Physical Education and Teaching System represents an innovative strategy to improve athletics by incorporating new technology. The platform has a simple interface that enables both learners and teachers to access it effortlessly. This gateway that gives rise to a comprehensive system that captures, processes and analyses information on physical activities and performance. Accelerometers, gyroscopes or cardiac monitors are examples of sensors that retrieve relevant physiological and motion data through data collection and pre-processing within the operation of the system. Simultaneously, video analysis supported by computer vision algorithms which take advantages of visual input allows for multiple ways of collecting data. Sensor data as well as video footages have to be combined for analysis and interpretation purposes. These features are extracted from collected data using complex algorithms termed post-processing equations by the system. Such algorithms sort through enormous amounts of raw information looking for meaningful patterns pointing at certain actions or locations. This step is important because the system can read and analyse the raw data from these sensors as well as videos. Its life blood comes from artificial intelligence (AI) algorithms developed by this system to identify activities and assess performance. They include pattern recognition as well as machine learning techniques applied in detecting different types of movements and physical exercises with high accuracy levels. In addition, AI techniques such as AI algorithms could enable PE instructors to monitor individual exercises like intensity or technique aspects hence improving their growth index.

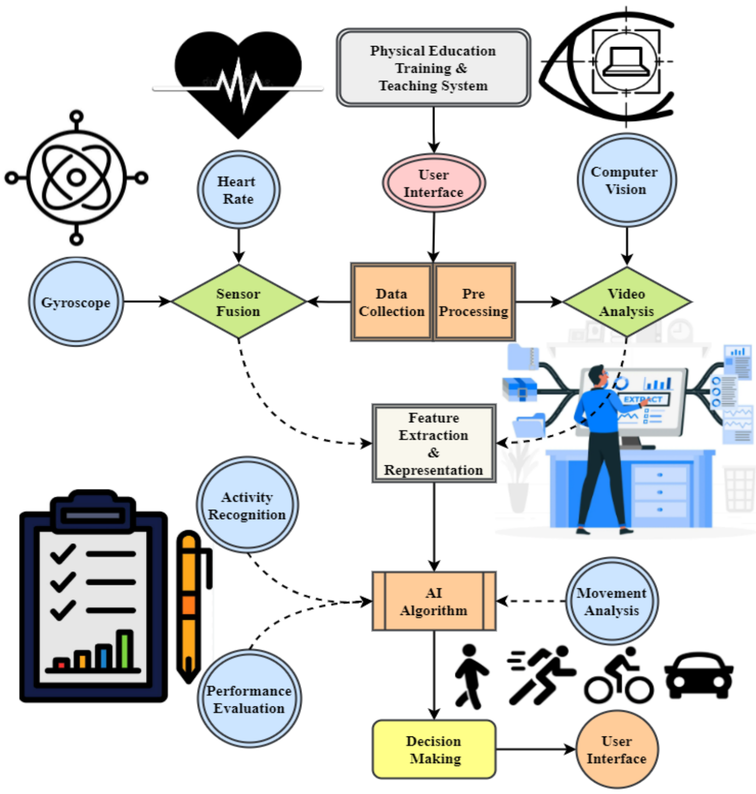

Figure 1. Physical education training and teaching system.

In general, these AI systems use ML for analysing exercise records made by students during PE classes to assess their progress in this field regarding individual tasks including exercise intensity-during PE class sessions. In addition, the system is equipped with decision-making skills that enable it to offer consumers tailored feedback and suggestions. The system analyses aggregate data and performance measures to provide personalized suggestions for optimizing training regimen and improving performance. By tailoring responses to each student's unique requirements, this feedback loop encourages growth and development in physical education classes.

The user interface allows users to communicate and engage with the system, making it easy to provide and receive feedback and implement suggestions for changes. The interface's user-cantered design guarantees that users can quickly find what they're looking for, interact with pertinent data, and receive tailored recommendations and comments. Training results, performance evaluation, and general well-being in PE settings may be optimized with the use of this system's analysis of data, AI algorithms, and personalized feedback systems.

$$t(Q_z) = \frac{W_{Qz}(1)}{W_{Qz}(1) + W_{Qz}(-1)} + (t_1, t_2, \dots, t_n) \ni (0,1), \left\{ \frac{\frac{2}{3}}{\frac{2,1}{2}}, 1,0,1 \right\} \quad (1)$$

Equation (1) reflects a weighted sum of items with a subsequent change. Input characteristics marked as $(t_1, t_2, \dots, t_n)$ are likely variables or properties pertinent to a certain scenario that the equation considers. Each feature is given a weight based on the associated coefficients $W_{Qz}(1)$ and $W_{Qz}(-1)$. The weighted sum of positive characteristics in the fraction's numerator and a combined weighted sum of negative and positive traits in the denominator. For whatever reason, maybe to make it easier to understand or compare, the entire equation then sets this fraction to a range of 0 to 1.

$$N_X\ (n) = \begin{cases} \dfrac{1}{1 + n/0.14} & n > 0, \qquad \{x_1, x_2 \dots . x_k\} \ni (0,1) \\ & 0, \qquad else \end{cases} \tag{2}$$

It appears that $N_X\ (n)$, where n probably stands for a numerical parameter, is defined as a non-linear function in Equation (2). The function evaluates to $1 + \frac{n}{0.14}$ for $n > 0$, suggesting a declining trend as n grows; a smaller output value is produced for larger values of n. The method returns an array of values $\{x_1, x_2 \dots . x_k\}$ that are all limited to the values between 0 and 1, as long as n is either equal to or less than 0. With a particular pattern for positive n and a default output for non-positive n, this function seems to be made to convert numerical inputs into their matching output values. This function may be designed to simulate the connection between n and its impact on specific events, with distinct actions for positive and negative values of n.

$$IN = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1p} \\ x_{21} & x_{22} & \cdots & x_{2p} \\ \vdots & \vdots & \vdots & \vdots \\ x_{q1} & x_{q2} & \cdots & x_{qp} \end{bmatrix} \tag{3}$$

Each element of the matrix IN is represented by x_{ij} in Equation (3), where i is the row index and j is the column index. A set of p items is represented by each row in the matrix, which is organized with q rows and p columns. It appears that these components are values or variables related to a certain dataset or environment. The likely indication of the divide between rows is the sign:

Figure 2 illustrates how AIPE, or Artificial intelligence in Sports Education, has been used to incorporate AI into education. The Educational Platform provides the groundwork for improving the educational experience through AI technology. The educational platform is the nerve centre of the physical education environment, allowing for the smooth integration and interaction of various AI components and users. The AIPE framework relies on AI algorithms to power its analysis and intelligent decision-making. These algorithms employ state-of-the-art data analytics and machine learning methods to sift through the mountain of data produced by the learning platform.

The development of personalized lesson plans and classroom practices can be guided by trends, patterns, insights identified through AI that helps teachers gain valuable understanding about each student's strength areas when creating customized lesson plans among other resources required for learning processes within classrooms. This implies that without efficient methods used while processing raw information into useful insights there will be no meaningful data in any organizations. These methods are employed to extract useful information from different data sets where they apply several techniques like data cleaning, reshaping and analysis of the same. Educators' decisions that are supported by correct, reliable, and relevant data which is processed using strong methodologies in AIPE framework.

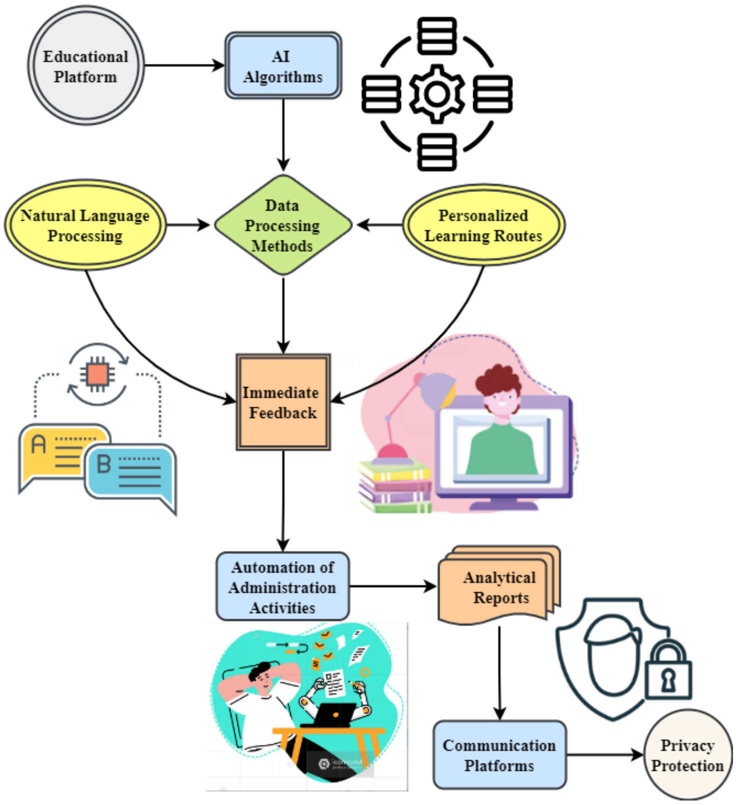

Figure 2. Artificial intelligence in physical education (AIPE).

Moreover, NLP improves AIPE architecture since it provides an opportunity for interaction and communication through natural language interfaces. Additionally, NLP helps in decoding and understanding human language thus leading to individualized learning paths as well as real-time feedback systems' implementation. Such conversational interactions on the other hand increase user participation and improve access to the AIPE framework thereby meeting diverse educational demands.

The AIPE system applies user input (feedback) and information about users to determine optimal learning pathways that best suit every learner based on their particular strengths, limitations or learning styles. Students often need one-on-one teaching to get focused attention when it comes to achieving personal goals during their education. Within the AIPE framework, the automation of administrative tasks improves productivity and simplifies instructional procedures. Teachers can devote more time to building meaningful relationships with their students because AI technologies automate mundane administrative duties like grading, scheduling, and allocation of resources. In addition to enhancing general productivity and resource utilization, this automation lessens administrative responsibilities.

$$C.k = \{c_1, c_2, \dots, c_q\} \; and \; \sum_{z=0}^{q} c_z = 1 \times \left(C \times IN = \{l_1, l_2, \dots, l_p\}\right) \quad (4)$$

Equation (4) covers two bases where the set of q coefficients labelled as $c_1, c_2, \ldots, c_q$ is represented by $C.k$. It is quite probable that these coefficients are involved in a linear combination or weighting process. Secondly, these coefficients are added up in the equation, where $c_z = 1$which means that all of the coefficients add up to 1, which might mean some restriction or normalization. Another set of values, $\{l_1, l_2, \ldots, l_p\}$, is obtained by multiplying this set of coefficients $C.k$ by a matrix IN, as shown in the equation. Each member of the data matrix IN is impacted by the appropriate coefficient in $C.k$ In essence, the equation describes the process of applying the coefficients in $C.k$ to the data in IN, resulting in a modified collection of values.

$$O = \{grade, l_1, l_2, \ldots, l_n, l_p, x_1, x_w \ldots . x_p\}, D = \{D_1, D_2, D_3\} \tag{5}$$

Two groups of variables, O and D, are introduced in Equation (5). Elements like $\{grade, l_1, l_2, \ldots, l_n, l_p, x_1, x_w \ldots . x_p\}$ are included in the set O. For example, in a computational job involving a dataset or a student's academic achievement, these components probably stand for various qualities, traits, or measures related to that specific environment. The three members of the set D, which are represented as D_1, D_2, D_3, might stand for various classes, divisions, or categories within the dataset.

$$d_J + D_s + R = \frac{(\Delta_{MAX} - p)}{(\sqrt{p+n})} + \frac{d_1}{S} + \frac{(\Delta_{MAX} - p)}{(\sqrt{p+n})} + \sum_{j=1}^{p} \frac{D_{s_j}}{S_{x_j}} \tag{6}$$

An equation with three primary components d_J, D_s, and R, with some extra addition, is shown in Equation (6). A common factor $\frac{(\Delta_{MAX}-p)}{(\sqrt{p+n})}$ is involved in the first and third terms; it represents the difference between $\Delta_{MAX} - p$ and p divided by the square root of the sum of p and n. The ratio of d_1 to S seems to be represented by the second phrase $\frac{d_1}{S}$. The summation of the ratios of D_{s_j} to S_{x_j} across the range of p terms is shown by a summation term that extends from $j = 1$ to p.

The suggested PE tracking system uses computerized information technology for college physical education instruction and studies; its complex design is shown in **Figure 3**. This paradigm proposes using fuzzy logic into the analysis process to make university graduates' Performance Assessments (PAs) more accurate. This integration aims to make the system more accurate and robust so that assessments of children's physical education development may be more reliably made. This paper's importance rests in the fact that it recommends a student-centred approach to physical education classes at the university. The suggested method highlights the significance of personalized training and real-time teacher-student interaction, acknowledging that every student has distinct needs and talents. By using this strategy, teachers may better gauge their students' development as PE students and cater their lessons to their unique learning styles.

The capacity to enable online examination and evaluation of the course outline, management reports, and student evaluations is fundamental to the idea of PE. The system facilitates easy communication and data interchange among administrators, teachers, and students using web servers and client-side settings. Administrators ensure the application runs smoothly and follows the assessment criteria when being evaluated.

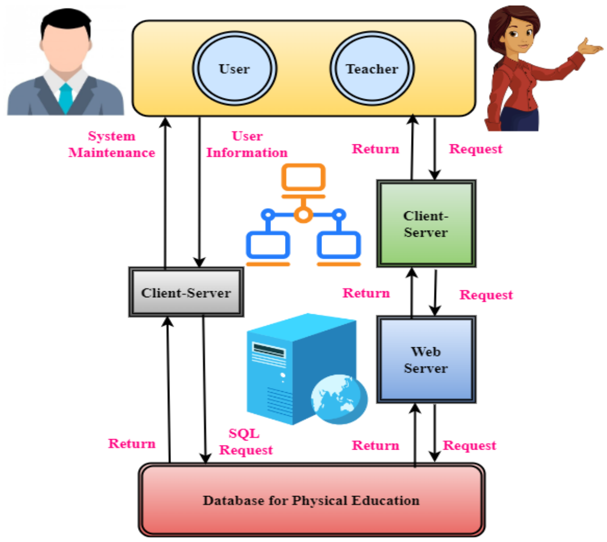

Figure 3. Teaching tracking system in PE.

The PE framework incorporates an activity-specific computer-based evaluation system, allowing a consistent way to measure how well a course is doing. By reducing the room for subjective bias, this method does more than make evaluations easier; it makes them more objective and reliable. It monitors, assess, and enhance university-level PE programmes, the framework employs modern Information Technology (IT) tools and procedures, providing a complete answer to the question of how technology and education interact. The Physical Education framework is a huge step forward for research and practice since it uses information technology to improve assessment procedures and encourage individualized lessons. This system aims to enhance physical education instruction over time by maximizing student results through fuzzy reasoning and a learner-centric approach to instruction.

$$R = \begin{cases} 1, y \leq r_1 \\ \dfrac{(r_2 - r_1)}{2}, r_1 < y < r_2 \\ 0 \quad , y \leq r_2 \end{cases} \tag{7}$$

The function R is defined by Equation (7) with relation to the variables y and r_1 and r_2. The manner in which the function R is applied changes according to the correlation between y and the thresholds r_2 and r_1. The function returns 1 when a specific condition is satisfied, which happens when y is either equal to or less than r_1. The function returns $\frac{(r_2-r_1)}{2}$ if y is between r_1 and r_2, indicating a linear interpolation between the two limits. The function evaluates to zero, which indicates another particular condition, if y is greater than r_2.

$$R = \begin{cases} 2, y \leq r'_1 \\ \dfrac{(r'_2 - r'_1)}{2}, r'_1 < y < r'_2 \\ 1 \quad , y \leq r'_2 \end{cases} \tag{8}$$

About the variable y and two threshold values r'_1 and r'_2, the function R is defined in Equation (8). How the function R interacts with the parameters y and the thresholds r'_1 and r'_2 determines its behaviour. When a certain condition is satisfied, the function returns 2 if and only if y is smaller than or equal to r'_1. The function gives the result $\frac{(r'_2-r'_1)}{2}$ if y is between the two limits, indicating a linear interpolation. A different requirement is shown by the function evaluating to 1 if y is greater than r'_2.

$$R = \begin{cases} 3, y \leq r''_1 \\ \frac{(r''_2 - r''_1)}{2}, r'_1 < y < r''_2 \\ 2 \quad , y \leq r''_2 \end{cases} \tag{9}$$

Equation (9) specifies the relationship between a variable y and a function (R) with regard to two threshold values $(r''_2 - r''_1)$. The connection between y and the thresholds r''_2 and r''_1 determines how the function R behaves. When a certain condition is satisfied, the function returns 3 if y is less than or equal to r''_1. The function returns $\frac{(r''_2-r''_1)}{2}$ if y is between r''_1 and r''_2, indicating a linear interpolation between the two boundaries. The function evaluates to 2 if y is greater than r''_2, which indicates another particular criterion.

The modern motion detection and monitoring system framework uses AI image analysis technologies to improve the efficiency and accuracy of surveillance. **Figure 4** shows the algorithm beginning by examining the video frame on its left side to extract important data and establish a baseline for tracking and motion detection. This technique uses Spatially Masked Discrete Wavelet Transform (SMDWT) to separate video frames into many frequency bands, resulting in accurate motion analysis. It uses sophisticated algorithms that can identify and track moving objects in real-time, therefore ensuring constant vigilance over dynamic situations. In addition, the system calculates motion disparity by comparing matching areas of the two frames of video from the right and left sides. By using this computation, a better understanding of space is achieved within the system leading to precise estimation of object widths within monitoring area. The complete surveillance solution provided by this system includes SMDWT as well as other modern elements such as motion disparity calculation that yields new insights into constantly changing settings.

The AI has revolutionized surveillance; these are some of the things that framework exemplifies. Improved depth perception abilities combined with motion analysis, detection and tracking capabilities lead to enhanced security situation awareness. This innovative framework improves surveillance systems through AI image analysis technology. With it, businesses can protect their properties and their surroundings too. This research delves into the process of creating and launching an all-encompassing educational platform that makes use of AI and data processing methods. Both frames help the system see everything during motions recognition and depth calculations processes involved in it. Making separate examinations enables differentiation between normal noise background changes and significant moves that consequently enhance accuracy while reducing false alarms occasions due to what is known as "over- alarm". Among other things, the frameworks' heavy reliance on sophisticated algorithms encourages adaptive learning along with optimization so that performance and efficiency will always be on an upward trajectory every time they are used Henceforth, this is actually what makes Movement Detection Track System Foundation one of those landmarks on earth which may change everything about living peacefully without fear.

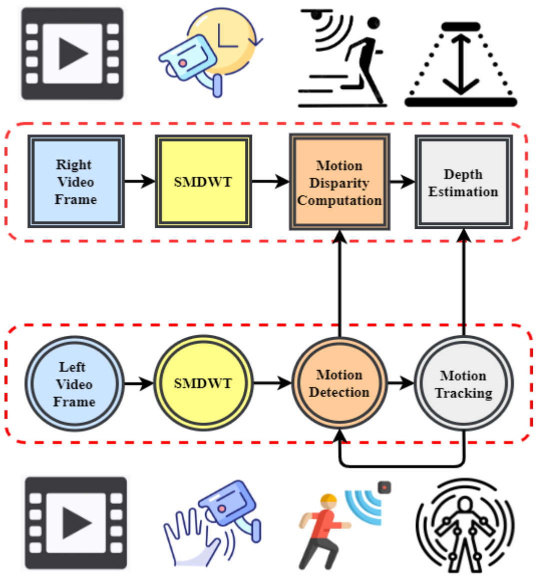

Figure 4. Detection of motion using AI.

$$R = \begin{cases} 4, y \leq {r'''}_1 \\ \dfrac{\left({r'''}_2 - {r'''}_1\right)}{2}, {r'}_1 < y < {r'''}_2 \\ 3 \quad , y \leq {r'''}_2 \end{cases} \tag{10}$$

A function R is defined in relation to a variable y and two threshold values ${r'''}_2$ and ${r'''}_1$ in Equation (10). The function R exhibits distinct behaviour depending on the correlation between y and the thresholds ${r'''}_1$ and ${r'''}_2$. The function returns 4 when a specified condition is satisfied, which occurs when y is either equal to or less than ${r'''}_1$. The function returns $\frac{\left({r'''}_2 - {r'''}_1\right)}{2}$ if y is in the range of ${r'''}_1$ and ${r'''}_2$, indicating a linear interpolation between the two thresholds. The function evaluates to 3 if y is greater than ${r'''}_2$, which indicates another particular criterion. The piecewise function R, as described in Equation (10), changes its behaviour in relation to the thresholds ${r'''}_1$ and ${r'''}_2$ based on the value of y.

$$P_{y+1} = U_i + \frac{p - p_{min}}{p_{max} - p_{min}} + U_g - U_h + U_{g(y)} + rand(0,1)\left(h_{g(y)} - U_{g(y)}\right) \tag{11}$$

Equation (11) is a model for performance analysis, where the performance at time $y + 1$ is represented by P_{y+1}. Several variables are involved in the formula that determines this measure of performance. To start with, the original performance baseline is denoted by U_i. The present performance p relative to the lowest and highest attainable performances p_{min} and p_{max} are used to calculate a normalized performance enhancement, which is represented by the expression $\frac{p-p_{min}}{p_{max}-p_{min}}$. The general skills are represented by baseline values U_g while the particular talents are represented by baseline values U_h. The present state of general skill at time y is represented by $U_{g(y)}$, whereas the goal level of universal skill at time y is represented by $h_{g(y)}$. The performance enhancement process is made more unpredictable by the inclusion of randomness in the equation through the $rand(0,1)$ term, and the departure from the existing general skill level is represented by $\left(h_{g(y)} - U_{g(y)}\right)$.

$$P_1 + P_2 + max(z, w) = d(1 - \Delta) + g\Delta + d\Delta + (1 - \Delta) \times \frac{\sum_{y=0}^{P} B(y)}{J} \quad (12)$$

Equation (12) is a model for dependability analysis; in it, two performance metrics are denoted P_1 and P_2, and the highest value between z and w is $max(z, w)$. Several terms that contribute to the reliability evaluation are included in the equation. The dependability factors $d(1 - \Delta)$ and $g\Delta$ are modified by a factorΔ, where Δ is probably a measure of stability or reliability. The dependability factor is influenced by $d\Delta$ as well as the complement of Δ introduces variability through the value$(1 - \Delta)$. The total of all possible values of P, which probably stands for performance metrics collected over time y, divided by J, which stands for a normalization factor, is used in the last phrase.

In **Figure 5**, the camera feeds adaptive data into this module, which is then compared to workout data already trained. Important for accurate exercise tracking and analysis, this is how the system finds out how fast the user is moving. After that, the system sends footage to the screen so people can see how they're doing in real time. Each visualization module extension functions autonomously inside its design, exchanging no data directly with any other extensions. Each extension communicates with the host, and there is no network connection between them. During the predetermined training phases, hosts and extenders communicate using data transmission. Importantly, free workouts may only employ specified extensions, and consumers will see unexpected activity data provided to them after exercise sessions have ended. This information is routinely erased from the system at the local level to guarantee user anonymity and data protection.

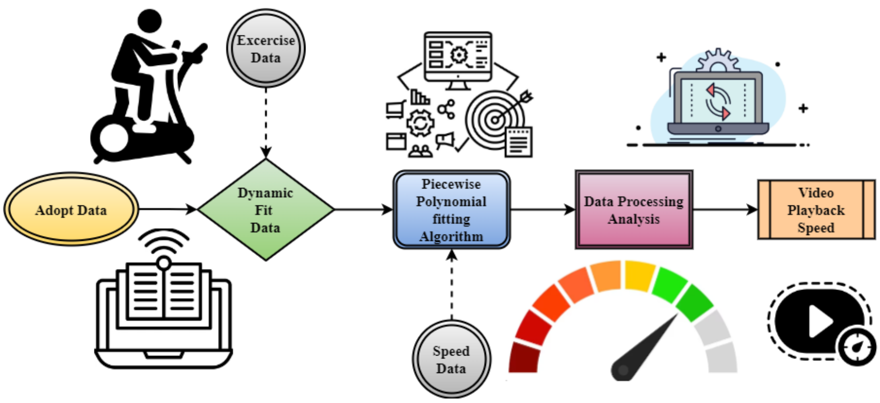

Figure 5. Visualization module of AIPE.

The system relies heavily on hosts responsible for processing extension registrations, keeping track of client information, and providing extensions with standard training programmes. Efficient and minimum data exchange is key design goals of the network's client module. A single instance can match performance goals, as clients only require minimum system data from servers. Call-backs from asynchronous sockets allow messages to be received into a message buffer list that is subsequently processed sequentially. Subscriber registration, data recording into the monitoring table, and message processing based on protocols names and audience databases are all handled by processor threads. To make sure the system communicates and processes data smoothly, updates activate the required routines to handle messages. Essentially, the complex design of the AIPE visualization module is shown in **Figure 5**. This module allows for real-time monitoring of exercises, data analysis, and user input. The visualization module improves the AIPE system's performance and usability in PE training situations by using standalone extensions, effective exchange of information protocols, and strong data privacy safeguards.

$$T^{v+1}(y) = T^{v}(y)|\sin(z_1| - z_2\sin(z_1))||p_1U^{v}(y) - p_2T^{v}(y)| \tag{13}$$

Equation (13) lays forth a framework for studying the learning experience, with $T^{v+1}(y)$ standing for the educational result at time $v+1$ and location y, and $T^{v+1}(y)$ for the prior educational result at the identical location y. Several factors go into this evaluation of the learning experience, as shown in the equation. The modulation of the learning result based on sinusoidal functions, which may include cyclic patterns or fluctuations in learning, is indicated by the expression $|\sin(z_1| - z_2$. In addition, the difference between two weighted factors, p_1 and p_2, multiplied by the prior learning result $T^{v}(y)$ and the current learning experience $U^{v}(y)$, is represented as $p_1U^{v}(y) - p_2T^{v}(y)$. This word probably indicates the impact of interventions or outside forces on the educational process.

$$t_y^{u+1} = x_y^u + l_1r_1(q_y^u - j_y^u) + l_2r_2(q_z^u - j_z^u) \tag{14}$$

An analysis model for health tracking is given by Equation (14), where t_y^{u+1} denotes the health status at time $u+1$ and position y, and x_y^u denotes the prior health status at the same position y. This health tracking study is aided by the inclusion of several factors in the equation. In the basic health status x_y^u is used, whereas in the terms that follow, the effect of various factors on health status is represented by l_1r_1. In particular, the effects of changes in factors q_z^u and j_z^u relative to their respective reference levels q_y^u and j_y^u on the health status at position y are represented by $l_1r_1(q_y^u - j_y^u)$ and $l_2r_2(q_z^u - j_z^u)$.

$$x(y+1) = y_{jpju} - \frac{y_{jpju} - y_{last}}{u_{max}}.u + \frac{t_{max} - t_{min}}{p} \tag{15}$$

where $x(y+1)$ denotes the revised data protection status at time $y+1$, Equation (15) describes a model for data protection analysis. A number of concepts related to comprehending and controlling data protection procedures are included in the equation. It is quite probable that the phrase y_{jpju} signifies a weighted component connected to the present data protection state, with pju standing for certain criteria or limits.

Adjustments can be made according to current trends in the data protection status, as measured by the term that follows $\frac{y_{jpju} - y_{last}}{u_{max}}$, which seems to be a function of the maximum permissible change t_{max}. Furthermore, it is probable that the variable $\frac{t_{max} - t_{min}}{p}$ denotes a component about the time-related elements of data protection, which may suggest the length or frequency of data protection operations.

Ultimately, the incorporation of AI into PE signals a paradigm shift in teaching approaches. Despite the highlighted advantages and promises, problems like the unreliability of technology and privacy issues still need fixing [26]. The suggested AI-based system provides individualized learning routes, instant feedback, and administrative assistance to empower both students and teachers. Improving the system's effectiveness, eliminating biases, and encouraging its wider use is crucial. The proposed system can completely transform how universities operate by creating a flexible and adaptive classroom that meets the requirements of all its members.

4. Results and discussion

Dataset Description: The data used in this investigation comes from the Physical Activity Monitoring dataset, which includes information gathered from nine participants who wore three inertial measurement units (IMUs) and a heart rate monitor while they participated in eighteen different physical activities [26]. The dataset provides a wealth of information on the relationship between mobility and other forms of exercise, such as walking, cycling, and soccer. This dataset allows researchers to study and comprehend trends in levels of physical activity by collecting real-time data on skeletal muscle movements and energy consumption. To encourage healthy lives and regular exercise among people of all ages, these findings are priceless for creating efficient tools to track physical activity.

The AI-based Physical Education Training and Teaching System closely monitors students' health and fitness levels, as shown in **Figure 6**, which provides a thorough system overview. Combining AI with data processing techniques, the system tracks and evaluates vital signs, including heart rate, activity levels, and sleep patterns. To further aid in the early identification of any health hazards and the execution of preventative actions, the system employs artificial intelligence techniques to discover trends and patterns in students' health data. AI's applications in healthcare for college students and athletes have expanded significantly, offering tailored health monitoring, personalized workout regimens, and injury prevention strategies. AI-driven predictive analytics can identify potential health risks, such as overtraining or stress-related injuries, before they become serious [26,27]. Additionally, AI can play a pivotal role in post-exercise recovery by monitoring key recovery metrics and suggesting optimized recovery strategies. Incorporating AI into physical education ensures that students' recovery is personalized, thereby minimizing the risk of injury. The use of real-time data helps to quickly adapt to the individual needs of students, ensuring safer and more effective training sessions. Moreover, AI-based rehabilitation programs allow for continuous monitoring and adaptation, optimizing recovery times and outcomes. The technology improves the efficacy of college and university physical education programs by constantly tracking user metrics and offering feedback to help students and teachers reach their fitness goals. The suggested AIPE approach enhances the Health Tracking ratio by 92.3% compared to current methods.

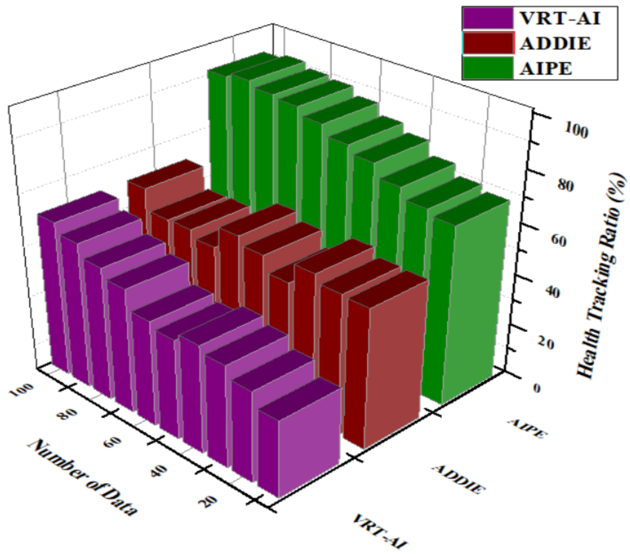

Figure 6. Analysis of health tracking.

Figure 7 displays the performance analysis results, thoroughly evaluating student athletic abilities and progress. The system collects and evaluates a variety of performance indicators, including quickness, agility, strength, and technique competency, using artificial intelligence and data processing methods [27]. By analysing and providing real-time feedback, teachers can see where their students excel and where they need more work. This information allows for more focused interventions and individualized training plans. By analysing performance data for trends and patterns, machine learning algorithms may help create individualized training plans that are both effective and efficient. The system allows the comparison of performance measures throughout time, which permits monitoring progress and identifying areas that need improvement. Students are empowered to attain their full potential in sports and fitness activities due to the AI-based system, which boosts the efficacy of physical education teaching by providing extensive performance analysis and actionable recommendations. Compared to existing approaches, the proposed AIPE strategy improves the performance ratio by 95.1%.

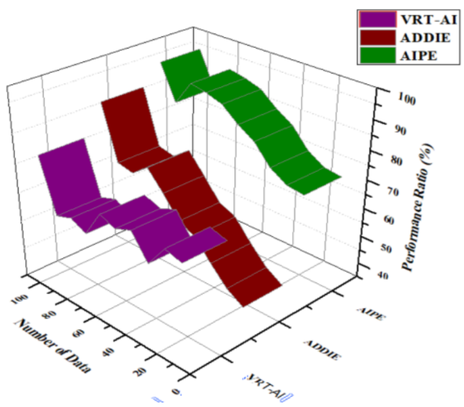

Figure 7. Analysis of performance.

The stability and dependability of the system in providing educational services are examined in **Figure 8**'s dependability analysis. It covers much ground, including data integrity, system availability, and technical resilience. The system's functioning, and user satisfaction are guaranteed by thorough testing and assessment, which examine the system's performance under various settings and scenarios. To reduce risks and improve dependability, steps are made to handle possible problems, including system outages, data loss, and technological difficulties. To find ways to make the system more reliable and better, the paper takes user reviews and comments into account as well. The AI-based system's primary goal is to build trust and confidence in using technology-enhanced educational platforms by emphasizing resilience and dependability so that college students may have a smooth and reliable learning experience. The suggested solutions boost the dependability ratio by 98.9% when compared to current methods.

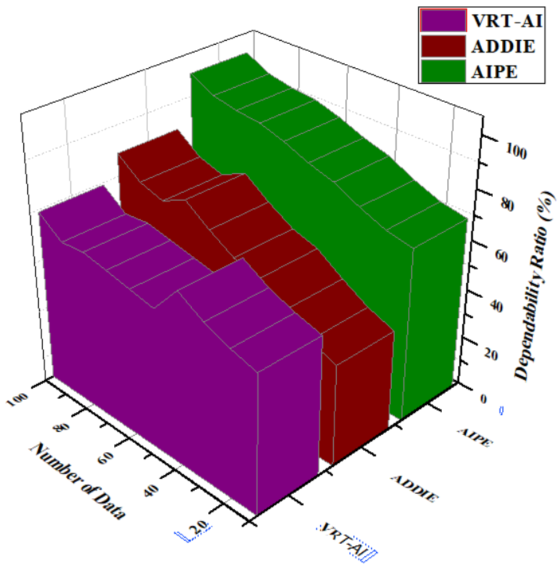

Figure 8. Analysis of dependability.

The analysis of the learning experience within the context of the overall efficacy and quality of student involvement and interaction with the educational platform is shown in **Figure 9**. Its criteria are customization, interaction, information relevancy, and user interface design. The system's capacity to provide meaningful learning experiences and information retention is evaluated via thorough user input and usability testing. The paper considers integrating novel teaching approaches to boost student engagement and motivation. These include gamification, interactive models, and adaptive learning paths. In addition, the system's use of data processing methods and artificial intelligence allows for customized learning experiences based on each student's unique requirements and preferences [27]. The AI-powered system aims to provide a stimulating classroom setting where college students may learn about and enjoy physical education by emphasizing user-centric design principles and constant development. Compared to the existing methods, the proposed remedies increase the learning experience ratio by 94.5 %.

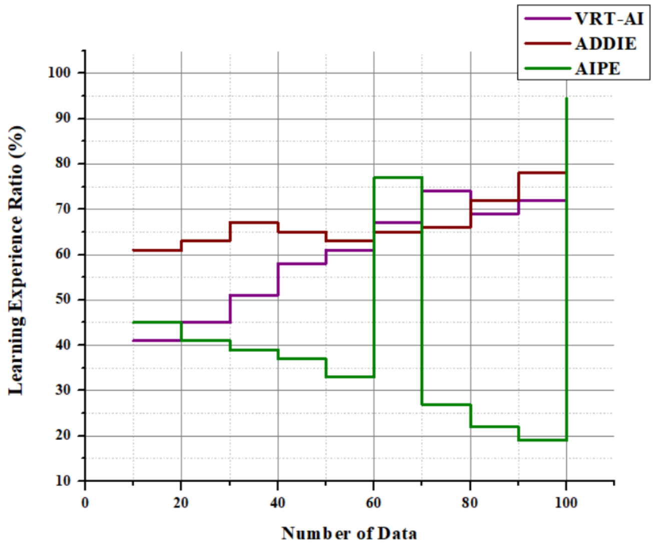

Figure 9. Analysis of the learning experience.

Figure 10 shows the evaluation of data security measures used to preserve private student information and guarantee adherence to privacy laws. It involves checking the security measures in place to avoid data breaches or illegal access, such as encryption, access limits, and user authentication [28]. To further guarantee that student data is handled safely and disposed of in compliance with regulations, the system's data storage and retention rules are examined. Data anonymization and pseudonymization are two data security best practices that the analysis checks to see if the system follows. These measures help to reduce the likelihood of data exposure. A safe and secure learning environment for college students may be achieved through the AI-based system's rigorous security procedures and continuous monitoring, which seek to establish trust and confidence among users about the confidentiality and integrity of their personal information. The data protection ratio is increased by 96.8% when using the suggested cures as opposed to the current approaches.

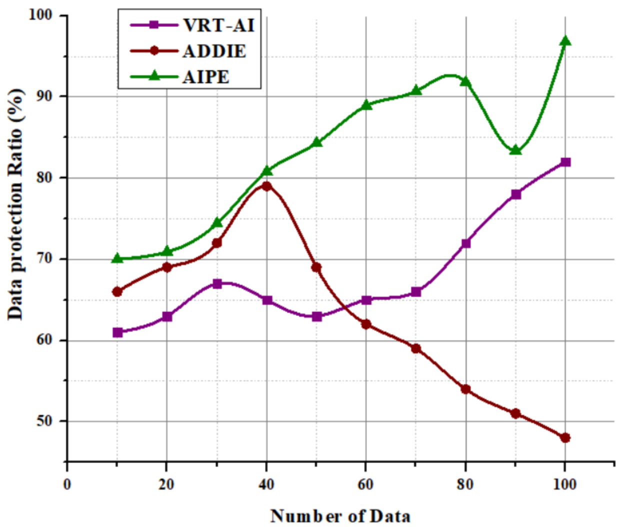

Figure 10. Analysis of data protection.

Table 1 uses five distinct measures to compare and contrast three educational systems, namely VRT-AI, ADDIE, and AIPE. Each statistic shows the usefulness and efficiency of these techniques in improving PE. On a scale from 0 to 100, higher ratings indicate better efficacy in health rate monitoring, performance analysis, dependability, learning experiences, and data security. Regarding health rate monitoring, performance analysis, and reliability, AIPE stands head and shoulders above the competition [28]. According to these results, AIPE is the best and most all-encompassing option for physical education, and AI-based solutions in general have several benefits over more conventional methods.

Table 1. Comparison table.

Metrics analysis	VRT-AI	ADDIE	AIPE
Health Rate Monitoring	51.9	67.4	92.3
Performance	64.3	42.2	95.1
Dependability	52	77.3	98.9
Learning experiences	45	42.2	94.5
Data security	78.4	52	96.8

Higher education institutions may improve their physical education programs in several ways with the help of the AIPE System. Health rate monitoring, performance analysis, dependability, learning experiences, and data security are all enhanced by the system's use of new technologies, including data processing and artificial intelligence. Physical education programs are far more effective with the suggested tactics, which improve upon existing approaches by an average of 92.3% to 98.9%. These results show how incorporating AI into PE may revolutionize the field, opening the possibility to safer, more efficient, and more tailored learning experiences for university students. To completely reap the advantages of these innovations in classrooms, further study and execution are required.

5. Conclusion

This paper has thoroughly reviewed AIPE, including its present status, methodology, implications, and troubles. The survey of 130 empirical studies reveals how AI can revolutionize physical education through health improvement tracking, individualized training approaches and performance evaluation. To improve the quality of all aspects of physical education, the present paper provides a rationale for implementing AI-powered tools that include personalized courses, immediate feedback and improved learner outcomes. The broad-based learning system specifically designed to improve PE classes is done with the help of AI and data processing techniques. Once data privacy and technological reliability concerns are addressed, this platform aims to revolutionize education, making learning easier while offering students constructive criticism. Future research must focus on improving AI systems for PE with issues like data privacy and technology reliability being handled. This paper is needed to understand how students' learning process affects their schooling over time with respect to AIPE in the long term. It is essential to encourage the integration of AI-driven training across universities worldwide and explore wider implications of AI-driven training, in higher education. This field needs constant innovation and progress if we want AI truly to fulfil its promise about enhancing PE that results in elevated students' involvement in activities and better performance than ever before.

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Conflict of interest: The author declares no conflict of interest.

Reference

1. Demchenko I, Maksymchuk B, Bilan V, et al. Training Future Physical Education Teachers for Professional Activities under the Conditions of Inclusive Education. Brain broad research in artificial intelligence and neuroscience. 2021; 12(3): 191-213. doi: 10.18662/brain/12.3/227
2. González-Calvo G, Barba-Martín RA, Bores-García D, et al. The (virtual) teaching of physical education in times of pandemic. European Physical Education Review. 2021; 28(1): 205-224. doi: 10.1177/1356336x211031533
3. Wang N, Abdul Rahman MN, Lim BH. Teaching and Curriculum of the Preschool Physical Education Major Direction in Colleges and Universities under Virtual Reality Technology. In: Kumar V. (editor). Computational Intelligence and Neuroscience. 2022: 1-10. doi: 10.1155/2022/3250986
4. Fernandez-Rio J, de las Heras E, González T, et al. Gamification and physical education. Viability and preliminary views from students and teachers. Physical Education and Sport Pedagogy. 2020; 25(5): 509-524. doi: 10.1080/17408989.2020.1743253
5. Barba-Martín RA, Bores-García D, Hortigüela-Alcalá D, et al. The Application of the Teaching Games for Understanding in Physical Education. International Journal of Environmental Research and Public Health. 2020; 17(9): 3330. doi: 10.3390/ijerph17093330
6. Dubois Y, Li CX, Taori R, et al. Alpacafarm: A simulation framework for methods that learn from human feedback. Advances in Neural Information Processing Systems. 2024: 36.
7. Kosholap A, Maksymchuk B, Branitska T, et al. Neuropsychological Bases of Self-Improvement of Own Physical Health of Future Teachers in the Course of University Education. Brain broad research in artificial intelligence and neuroscience. 2021; 12(3): 171-190. doi: 10.18662/brain/12.3/226
8. Daharis D, Gazali N, Perdima, FE, et al. A scientometric review of global research on technology in physical education. Journal Sport Area. 2023: 8(1), 1-13.
9. Ferriz-Valero A, Østerlie O, García Martínez S, et al. Gamification in Physical Education: Evaluation of Impact on Motivation and Academic Performance within Higher Education. International Journal of Environmental Research and Public Health. 2020; 17(12): 4465. doi: 10.3390/ijerph17124465
10. Xiang MQ, Tan XM, Sun J, et al. Relationship of Physical Activity With Anxiety and Depression Symptoms in Chinese College Students During the COVID-19 Outbreak. Frontiers in Psychology. 2020; 11. doi: 10.3389/fpsyg.2020.582436
11. Belousova NA, Mamylina NV, Korchemkina YV, et al. Psychophysiological aspects of formation students' willingness for wellness by means of physical education. Journal Of Advanced Pharmacy Education And Research. 2021; 11(4): 35-40. doi: 10.51847/wgurjaiv6f
12. Guo J. Innovative Practice of Physical Education Teaching in Colleges and Universities Based on Artificial Intelligence Technology. Applied Mathematics and Nonlinear Sciences. 2024; 9(1). doi: 10.2478/amns-2024-0224
13. Ma Z, Xin C, Zheng H. Construction of a Teaching System Based on Big Data and Artificial Intelligence to Promote the Physical Health of Primary School Students. In: Tsai SB. (editor). Mathematical Problems in Engineering. 2021: 1-10. doi: 10.1155/2021/9777862
14. Xu Y, Huang S, Li L. Quality Evaluation and Informatization Analysis of Physical Education Teaching Reform Based on Artificial Intelligence. In: Che H. (editor). Security and Communication Networks. 2022: 1-13. doi: 10.1155/2022/5473153
15. Sun, J. (2021). Design and Application of Intelligent Teaching System of College Physical Education Based on Artificial Intelligence. In: Proceedings of the FC 2020; pp. 1729-1736.
16. Cheng J, Wang X. Artificial intelligence based on effectiveness of inverted classroom teaching of college sports. In: Saravanan V. (editor). Journal of Intelligent & Fuzzy Systems. 2021; 40(2): 3755-3765. doi: 10.3233/jifs-189409

17. Li N, Xue Y. Artificial Intelligence-Based Assessment of Physical Education and Training Effectiveness. Computer-Aided Design and Applications. 2022: 75-84. doi: 10.14733/cadaps. 2023.s5.75-84
18. Zhang B, Jin H, Duan X. Physical education movement and comprehensive health quality intervention under the background of artificial intelligence. Frontiers in Public Health. 2022; 10. doi: 10.3389/fpubh.2022.947731
19. Su Z. Artificial Intelligence in the Auxiliary Guidance Function of Athletes' Movement Standard Training in Physical Education. Journal of Circuits, Systems and Computers. 2022; 31(11). doi: 10.1142/s0218126622400011
20. Zong X, Lipowski M, Liu T, et al. The Sustainable Development of Psychological Education in Students' Learning Concept in Physical Education Based on Machine Learning and the Internet of Things. Sustainability. 2022; 14(23): 15947. doi: 10.3390/su142315947
21. Li Z, Wang H. The effectiveness of physical education teaching in college based on Artificial intelligence methods. In: Saravanan V. (editor). Journal of Intelligent & Fuzzy Systems. 2021; 40(2): 3301-3311. doi: 10.3233/jifs-189370
22. Wang Y. Physical Education Teaching in Colleges and Universities Assisted by Virtual Reality Technology Based on Artificial Intelligence. In: Tsai SB. (editor). Mathematical Problems in Engineering. 2021; 2021: 1-11. doi: 10.1155/2021/5582716
23. Yu J, Jee Y. Analysis of Online Classes in Physical Education during the COVID-19 Pandemic. Education Sciences. 2020; 11(1): 3. doi: 10.3390/educsci11010003
24. Zhang J. Reform and innovation of artificial intelligence technology for information service in university physical education. In: Saravanan V. (editor). Journal of Intelligent & Fuzzy Systems. 2021; 40(2): 3325-3335. doi: 10.3233/jifs-189372
25. Li S, Wang C, Wang Y. Fuzzy evaluation model for physical education teaching methods in colleges and universities using artificial intelligence. Scientific Reports. 2024; 14(1). doi: 10.1038/s41598-024-53177-y
26. Lee HS, Lee J. Applying Artificial Intelligence in Physical Education and Future Perspectives. Sustainability. 2021; 13(1): 351. doi: 10.3390/su13010351
27. Guo Q, Li B. Role of AI physical education based on application of functional sports training. In: Saravanan V. (editor). Journal of Intelligent & Fuzzy Systems. 2021; 40(2): 3337-3345. doi: 10.3233/jifs-189373
28. Xu M, Liu D, Zhang Y. Design of Interactive Teaching System of Physical Training Based on Artificial Intelligence. Journal of Information & Knowledge Management. 2022; 21(Supp02). doi: 10.1142/s0219649222400214