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Information technology innovation in sports learning: understanding global trends and challenges
Innovación en tecnología de la información en el aprendizaje deportivo: comprensión de las tendencias y desafíos globales

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Abstract. This study examines global trends and challenges using information technology innovations in sports learning. The research method used is a systematic literature study with the prism model, which includes the search for scientific literature in the Scopus database from 2019-2024. The results showed that the main trend in the use of IT in sports learning includes increased interest in technology such as fitness tracking, sports training applications, online learning, virtual reality, augmented reality, deep learning, and the Internet of Things (IoT). The positive impact of this trend includes increased effectiveness, interactivity, and personalization of sports learning. However, the global challenges faced include lack of resources, technical barriers, ineffective integration in the curriculum, and security and accessibility issues. To overcome this challenge, collaboration is needed between researchers, practitioners, and policymakers to create a more responsive and digit-connected sports education environment. By utilizing IT innovation effectively, sports learning can improve effectiveness, accessibility, and personalization worldwide.
Keywords: Innovation, information technology, sports learning, trends, global challenges

Resumen. Este estudio examina las tendencias y desafíos globales que utilizan las innovaciones de la tecnología de la información en el aprendizaje deportivo. The used research methodology is a systematic literature review using the prisma model, which includes a search for scientific literature in the Scopus database for the period 2019-2024. Los resultados mostraron que la principal tendencia en el uso de TI en el aprendizaje deportivo incluye un mayor interés en tecnologías como el seguimiento del estado físico, aplicaciones de entrenamiento deportivo, aprendizaje en línea, realidad virtual, realidad aumentada, aprendizaje profundo e Internet de las cosas (IoT). El impacto positivo de esta tendencia incluye una mayor eficacia, interactividad, y personalización del aprendizaje deportivo. Sin embargo, los desafíos globales que enfrentan incluyen la falta de recursos, barreras técnicas, una integración ineficaz en el plan de estudios, y problemas de seguridad y accesibilidad. Para superar este desafío, se necesita la colaboración entre investigadores, profesionales, y formuladores de políticas para crear un entorno de educación deportiva más receptivo y conectado digitalmente. Al utilizar eficazmente la innovación de TI, el aprendizaje deportivo puede mejorar la eficacia, la accesibilidad, y la personalización en todo el mundo.
Palabras clave: Innovación, Tecnologías de la Información, Aprendizaje Deportivo, tendencias, desafíos globales.

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Introduction

Since ancient times, sports have been an important part of human life. The community considers sports to have a very important role to this day (Parry, 2023). Exercise not only has a positive impact on one's physical health but also has a positive impact on their mental and social welfare (Walsh et al., 2022). Sports are about physical exercise, and sports have developed into a way to strengthen physical, create a healthy soul, and expand social networks, ranging from morning running in the park to professional soccer matches at the stadium (Wibowo & Indrayana, 2019). Therefore, it is very important to understand the benefits and benefits of sports, as well as the role of sports in making people healthy, tough, and competitive in everyday life.

Sports are very important for someone's education and development (Millet et al., 2019). Sports have a broadly positive effect on participants' physical, mental, and social development and are an important component of the school curriculum (Swartz, 2023; Varmus et al., 2021). Physical exercise improves health and physical strength, reduces the risk of obesity, increases endurance, and increases motor skills and coordination needed for daily life (Sutula, 2018). Exercise also positively affects mental health by reducing stress, improving emotional well-being, and improving sleep quality (Turola et al., 2016). Sports will help students respect differences, overcome difficulties, and work together to achieve common goals through the competition and teamwork process (Assmann et al., 2017). Therefore, sport is not only about physical fitness, but sport is also an important means of building character, honing skills, and preparing people to face life's challenges with a positive and resilient attitude.

The rapid development of information technology (IT) has changed many things, including education (Lazarev et al., 2023). With progress in information technology, there are many possibilities to increase learning efficiency, convenience, and quality (Chaerowati & Ibrahim, 2019). With information technology, education is no longer limited by time and space (Al-Taai, 2022). Various online learning platforms, mobile applications, and learning management systems have allowed broader access to education, learning time flexibility, and personalization of learning experiences. In addition, learning methods that are more interactive, interesting, and adaptive have been created thanks to integrating information technology into the learning process (Provodina et al., 2021). Students can be involved in deeper learning and experience based on the help of tools such as virtual reality, simulation, and multimedia. In addition, information technology makes fast feedback and real-time tracking of learning progress possible. This technology also allows learning methods tailored to students' unique

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needs. Therefore, there is great potential to increase the accessibility, quality, and efficiency of education worldwide.

Although information technology (IT) has great potential to improve the quality of sports learning, the world still lacks it. UNESCO collected data in 2022 that only 37 percent of teachers worldwide use IT in learning (UNESCO, 2023). One of the real problems faced in 2022-2023 is a digital gap, where internet access and IT devices continue to be the main obstacle, especially in developing countries. This problem is shown by the World Bank study in 2023, which shows that only 40% of students in developing countries have internet access in their homes. In addition, the lack of teacher training is also a problem; according to a survey conducted by the International Society for Technology in Education (ISTE) in 2022, only 45% of teachers worldwide feel ready to use IT in their learning (Klein, 2023). In addition, infrastructure limitations are also a problem, with only 25% of schools in developing countries that have sufficient computers for all students in 2023. In addition, attitudes and cultures that oppose the use of information technology in learning are also a problem. These attitudes and cultures were revealed in a study conducted by UNESCO in 2022 which shows that some parents and teachers continue to believe that technology can interfere with the teaching and learning process. Therefore, it is important to continue increasing IT use in sports learning by working with the government, schools, teachers, and parents to ensure that all students have the same access to IT and can use it optimally. As a result, lack of use of IT in sports learning can result in decreased student interest and motivation, decreased learning achievement, and decreased modern skills development.

To receive relevant and effective education in a technology-driven era, students must understand global trends and issues related to using Information Technology (IT) in sports learning. Increased internet access, the development of online learning platforms, and technology adoption, such as virtual reality and artificial intelligence, show that using technology in sports learning can increase accessibility, interactiveness, and educational efficiency. The case study results of the "Athlete Intel" project leverages advanced technology and artificial intelligence to improve athletic performance, safety, and mental health, as shown by its case study results. This project creates a comprehensive database to store data on various athletic entities. An analytical engine then analyzes this data to generate user insights (Sattaburuth & Wannapiroon, 2021). Technology has demonstrably made sports more inclusive for people with diverse abilities (Donati et al., 2023). Advanced prosthetic devices and specialized wheelchairs enhance the performance of athletes with disabilities (Perla et al., 2023). AI-based training applications and virtual reality platforms empower individuals with various physical limitations to train and compete in environments tailored to their needs. Additionally, tracking and sensor technology provides real-time feedback, allowing athletes to optimize their technique and minimize the risk of injury (Shytikova et al., 2022).

While technology brings advancements to sports, it also raises concerns about athlete data privacy (Greene et al., 2023). Wearable devices and health apps collect a significant amount of personal data, including health information, performance metrics, and location data (Ioannidou & Sklavos, 2021). To address this, robust and transparent privacy policies are essential to safeguard athlete data. Athletes and their teams need clear information about the types of data collected, how it's used, and their rights regarding access and control. By combining technological innovation with strong privacy policies, we can ensure that advancements in sports technology have a positive impact while protecting athletes' rights and privacy (Jia & Fan, 2021).

However, along with this positive development, several obstacles must be overcome. One of the main problems is digital inequality, where people do not have the same access to IT infrastructure worldwide. In addition, there are two main obstacles faced. The first is the teacher's fear of cultural changes in schools, and the second is the lack of instructions about the use of technology. Therefore, education and sports leaders need to understand and overcome this problem with appropriate policies, good training, and a school culture supporting innovation. Therefore, understanding the trends and challenges related to the use of IT in sports learning will help bring better changes and build a more flexible, competitive, and inclusive future sports education.

Method

Types of research

This study uses a qualitative method with a systematic approach to the Literature Review (SLR). Systematic literature Review is defined as the process of identifying, assessing, and interpreting all available research evidence to provide answers to specific research questions (Ayubi et al., 2024; Firmansyah et al., 2023). Systematic Literature Review Research Methods used follow the flow of the prism model. The prism model stands for Preferred Reporting Items for Systematic Reviews and Meta-Analyses (Silva et al., 2024). Structured steps in the prism model allow researchers to reduce bias and ensure that the relevant literature selection and evaluation process is objectively conducted (Azevedo et al., 2022; Suryadi et al., 2024). Research using the Prisma model provides a deep and comprehensive picture of the latest progress, challenges, and opportunities in sports learning. This method will also help find global trends and problems that can be the subject of research and development in the future.

Inclusion and Exclusion Criteria

The writing and exclusion criteria are determined to obtain relevant research data following the objectives. At this stage, the researcher determines which articles are worthy of selection and which are excluded. The following are the inclusion and exclusion criteria for a literature review of IT innovation research in sports learning focusing on global trends and challenges.

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Table 1.
Criteria for Inclusion and Exclusion

Inclusion criteria	Exclusion criteria
Discuss the theme of IT innovation in sports learning	Irrelevant to sports learning
Focus on global trends.	Not discussing IT innovations.
Discussion of challenges in the use of information technology	Not discussing global trends or challenges
Types of Publications: Scientific Articles Indexed in JCR dan Scopus Database	Not a scientific article
Range Year: 2019 - 2024	Publication below 2019

Table 1 above shows the criteria specified in this study. By using the inclusion and exclusion criteria, it is expected to be able to filter out relevant and useful scientific articles in conducting literature reviews about IT innovation in sports learning with a focus on global trends and challenges faced.

Research strategy and flow

The strategy and flow used in this study are by searching the JCR dan Scopus database from 2019-2024. The keywords used to find a suber are "Information and Technology and Sports and Learning." To get specific data, researchers read the abstract and complete text from the publication in depth. Researchers analyze data content after being collected to find trends and problems in using information technology in sports learning. The following is the flow of research that follows the prism procedure.

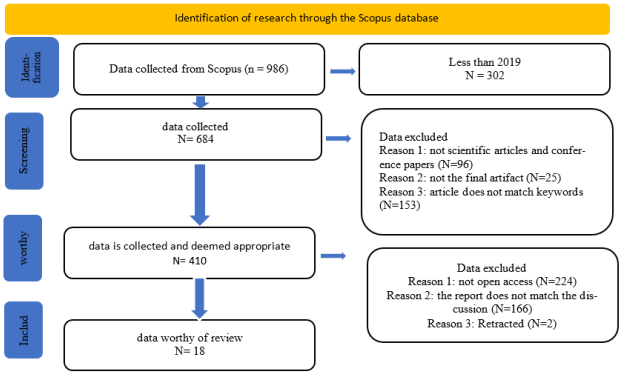

Figure 1. Prism structure

The prism flow of the data obtained shows that the total data that can be stated to be analyzed meets the requirements of 18 articles. Of the 18 manuscripts obtained by Selnjutnay, global trends and challenges in using information technology in sports learning were analyzed.

Data analysis

Content analysis is carried out in this research. Content analysis is a method used to analyze text data such as written texts, books, articles, reports, and spoken texts, such as audio and video recordings. Content analysis begins with data preparation, which includes changing the data format to make it easier to read and understand. Next, the coding process begins by assigning a code to each piece of data that is relevant to the themes and categories that have been identified, which can be in the form of words, phrases, or symbols. Some software used to carry out data analysis is Biblioshiny and NVivo 14 for Windows.

Research result

Data analysis

In the period from 2019 to 2024, 18 documents have been identified. The annual growth of bibliometric data reached 18.92%, indicating significant activity in research and publications during the period. Analysis revealed that there were only nine single writings. Additional analysis showed that the average age of the documents was 1.9 years, indicating the continued actuality of the observed literature. Furthermore, each document was cited an average of 7.15 times, highlighting the level of recognition and impact that scientific work receives within the research community.

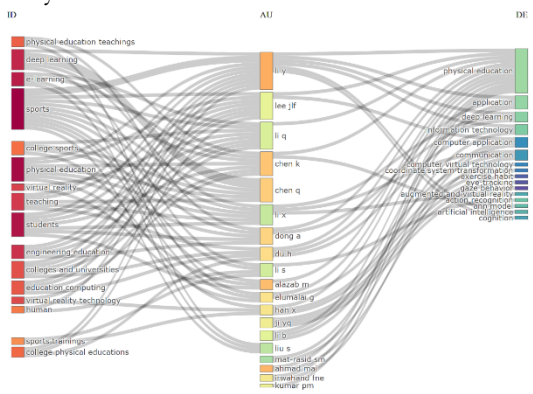

Figure 2. Plot of three areas of IT innovation in sports learning

The plot of the three areas found in this research is the relationship between title, author, and keywords. From the existing picture, it appears that the dominant title is about sports, and the author who produces a lot of studies is LI Y, while the keyword that often appears is physics education.

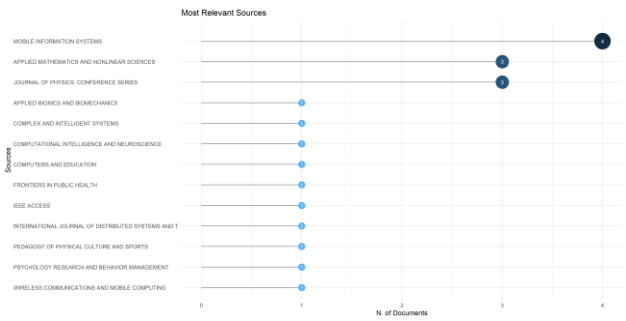

Figure 3. Relevant sources

The data obtained shows that the relevant sources that publish the most are related to information technology innovation in sports learning, namely the mobile information system, with four articles published during 2019-2024. The next publisher, Applied Mathematics and Nonlinear Science, and the Journal of Physics Conferences Series published three articles, and the rest published 1 article.

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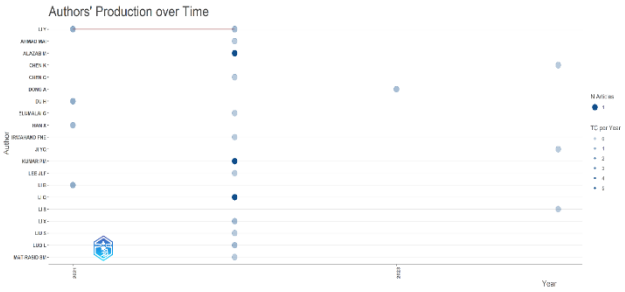

Figure 4. Productivity over time

The data obtained shows that 14 authors studied innovations regarding information technology in sports learning. The data obtained shows that Alzab M, Kumar PM, and LiQ published publications on innovation in sports learning in 2022. The data obtained also shows several citations in the last three years.

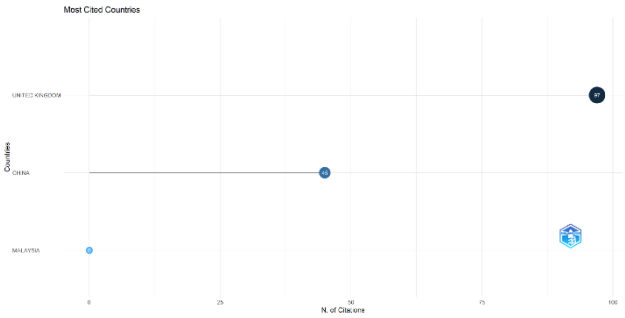

Figure 5. Most citation countries

From the data analysis, it was found that England, China, and Malaysia had the most citations. England had 97 citations, and China had 45 citations.

Figure 6. Topic trends in the last five years

There are various information technology trends in the sports sector. Based on the picture above, the trends that are currently developing are as follows: First, around 8% of students are interested in sports technology, which includes fitness trackers, movement sensors, and sports training applications. Second, around 5% of students are interested in E-learning, including online learning platforms, simulations, and gamification. Third, about 3% of students are interested in Virtual Reality Technology, such as VR headsets, VR rooms, and VR applications. Fourth, around 35% of students are interested in Computing, including programming, artificial intelligence, and machine learning. Fifth, around 10% of students are interested in Physical Education, such as fitness apps, activity-tracking devices, and wearable technology. Sixth, about 3% of students are interested in Teaching, including online learning platforms, smart classroom technology, and assessment tools. Seventh, about 5% of students are interested in Deep Learning, which uses artificial neural networks to learn patterns from data. Eighth, around 3% of students are interested in the Internet of Things (IoT), a network of devices connected to the Internet that can communicate. Around 5% of students are interested in educational engineering, a combination of engineering and educational science that aims to develop more effective educational technology. Finally, about 1% of students are interested in action recognition, a technology that can recognize human body movements and postures.

From 2021 to 2023, there will be a growing trend of interest in deep learning. In 2021, the term frequency reached 5.0, increased to 7.5 in 2022, and reached 10.0 in 2023. Concurrently, interest in Sports showed a stable trend from 2021 to 2023. In 2021 the term frequency reached 7.5, rising slightly to 8.0 in 2022 and 2023. However, interest in the Student topic decreased from 2021 to 2023. In 2021 the term frequency reached 12.5, dropping to 10.0 in 2022 and 7.5 in 2023. Likewise, interest in Physical Education showed stability from 2021 to 2023, with term frequency reaching 7.5 in 2021, increasing slightly to 8.0 in 2022 and 2023. Meanwhile, interest in Virtual Reality Technology and Virtual Reality Technology shows an increasing trend from 2021 to 2023. 2021 term frequency reached 3.0, increasing to 5.0 in 2022 and 7.5 in 2023. The same thing happened in engineering education, with an increasing interest trend from 2021 to 2023. 2021 term frequency reached 5.0, increasing to 7.5 in 2022 and 10.0 in 2023.

Table 2.
Article analysis

Name & year	Title	Publisher	Result	trend	challenge
(Luo, 2022)	A Sports Digital Training System Based on Middle and Bottom Visual Information	Hindawi Limited	Creation of an athlete movement analysis system using visual information. The system compares the movements of amateur and professional athletes. Features include video segmentation, speed calculation, and motion	The popularity of physical exercise in China is increasing yearly, fueling the need for technological solutions in sports training due to limited resources. This popularity of physical is reflected in the trend towards digitizing sports training with the introduc-	The lack of sports resources in central and western China results in the region's lack of a comprehensive physical education teaching system. Technical challenges arise in collecting and analyzing visual information of athletes' movements.

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			tracking.	tion of advanced digital training systems.	
(J. Wang, 2022)	Application of 5G Internet of Things Technology in the Design of Physical Education Platform	Hindawi Limited	The new sports network education platform combines the Internet of Things (IoT), wireless technology, and IT solutions with conventional campus networks. Research findings show that the structured platform makes physical education materials easier to understand and interactive, improving higher education quality.	Digitalization and modernization in education, especially in physical education, are reflected in this research. This research uses cutting-edge technologies such as 5G and the Internet of Things in education and combines information technology and conventional learning approaches.	Traditional physical education platforms, which do not support real-time data collection and analysis, hinder the integration of new technologies such as 5G and the Internet of Things into existing educational infrastructure.
(Y. Zhang & Tsai, 2021)	Application of Adaptive Virtual Reality with AI-Enabled Techniques in Modern Sports Training	Hindawi Limited	This research leverages the technology's advantages by developing a virtual reality-based sports training framework and motion capture algorithm. The results showed that using virtual reality technology to train tennis is better than traditional methods.	There is a growing interest in applying virtual reality technology in modern sports training. This research shows that virtual reality technology can increase training effectiveness and students' motivation to practice.	Ensuring virtual reality technology can be integrated into sports training environments and easily accessed by coaches and athletes. Another challenge is ensuring that the algorithms and systems developed can accurately record and analyze athlete movements in real time to provide useful feedback.
(Yao, 2024)	Constructing a Guarantee System for Physical Education Teaching Reform and Innovation in the Digital Era	Sciendo	Virtual reality (VR) technology was used in this study to record movements taught in physical education. In digital sports teaching, teaching materials are created through synthetic motion and video editing, supported by statistical analysis to study and analyze the teacher.	This research trend shows the increasing use of virtual reality technology in sports teaching, focusing on human movement modeling and the production of digital teaching materials.	One of the main challenges is ensuring that the algorithms and systems developed can accurately recognize human movements in virtual reality environments. In addition, this research highlights the challenges of integrating this technology into the sports teaching process effectively and holistically.
(Zhao, 2023)	A Hybrid Deep Learning-Based Intelligent System for Sports Action Recognition via Visual Knowledge Discovery	IEEE	This research develops an intelligent system based on deep learning to recognize sports actions through graphic representations of the human skeleton, hypergraph convolutional networks, and recurrent neural network structures.	Research trends show increasing interest in developing artificial intelligence-based sports action recognition systems, especially with deep learning technology, to understand body movements in sports.	One of the main challenges is ensuring the accuracy and reliability of sports action recognition systems, especially in the face of complex human movement variations. Additionally, using personal data by research groups may pose challenges regarding data privacy and security.
(Soltani & Morice, 2020)	Augmented reality tools for sports education and training	Elsevier Ltd	This research shows that various AR approaches can be used in sports learning and improving the spectator experience. However, the research also highlights the limitations of current AR systems in training and provides suggestions for designing more effective training scenarios.	Research trends show increasing interest in understanding the potential of AR in sports education and practice, reflecting efforts to improve experiences and outcomes with AR technology.	The main challenge is ensuring the AR system provides additional information relevant to the sport and can be integrated well into training and competition environments. It is also necessary to overcome the technical and design limitations of AR so that it is optimal in a sports context.
(Meng, 2021)	College Physical Education Teaching Aided by Virtual Reality Technology	Hindawi Limited	This research aims to improve the quality of physical education in higher education by implementing Virtual Reality Technology (VRT) using the Internet of Things and 5G technology. The results show that VRT successfully reduced security incidents, influenced teaching philosophy, and increased students' interest and independence in sports.	Research shows increasing interest in using technologies such as VRT, IoT, and 5G to improve the quality of physical education in higher education, reflecting efforts to keep up with technological developments in the context of sports education.	The main challenge is to effectively integrate VRT, IoT, and 5G technologies in physical education in higher education and understand their impact on Physical Education teachers, students, and the overall quality of sports education.
(Y. Li & Li, 2022)	The Artificial Intelligence System for the Generation of Sports Education Guidance Model and Physical Fitness Evaluation Under Deep Learning	Frontiers Media SA.	This research uses a deep learning application model in education and sports guidance and an analysis of physical fitness in units A and B residents. The results show increased and very good physical scores after exercise therapy.	Research trends show increasing interest in using deep learning in sports education and physical fitness management for better healthcare.	Key challenges include ensuring the accuracy of deep learning models in physical fitness analysis and customized exercise programs and addressing data security, privacy, and technology accessibility for all.
(B. Wang, 2022)	College Calisthenics Teaching Based on Information Technology	Hindawi Limited	Information technology in teaching aerobics increases students' interest in independent learning and their understanding of aerobic movements. This Information technology improves basic physical qualities such as push-ups, jumping rope,	The study aims to enhance the integration of information technology in aeronautical learning methods, thereby improving the quality of aviation education and providing more interactive and beneficial learning experiences for students.	The main challenge is demonstrating that information technology integration in aviation education can effectively integrate traditional teaching methods while demonstrating that students possess the necessary skills and knowledge.

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			and flexibility compared to traditional teaching methods.		
(Yuan et al., 2024)	Effects of Exercise Habits and Gender on Sports e-Learning Behavior: Evidence from an Eye-Tracking Study	Dove Medical Press Ltd	Participants who exercised showed better results in the number of fixations, duration, and pupil diameter than those who did not exercise. Men tend to process video information better, with lower cognitive load and better learning outcomes. However, there was no interaction between exercise and gender for all indicators studied.	Research trends show increasing interest in understanding intrinsic factors such as exercise habits and gender in the context of sports e-learning. This research reflects an effort to understand more deeply the factors that influence the effectiveness of sports e-learning.	The main challenge is understanding the complexity of the interactions between intrinsic factors such as exercise habits and gender in sports e-learning. Considering the diversity of participants, there is also a need to integrate these findings into inclusive and effective curriculum design.
(Q. Li et al., 2022)	IoT-assisted physical education training network virtualization and resource management using a deep reinforcement learning system	Springer	The experimental analysis results show that the proposed solution monitors physical activity better than conventional systems, with a high accuracy ratio and low error rate.	Research trends highlight growing interest in applying IoT technology to monitor and train physical activity. These efforts include integrating the latest technologies, such as IoT and deep learning, in physical education to promote health and efficiency.	The main challenge is to ensure the reliability and accuracy of the IoT-based physical activity monitoring system and ensure its wide adoption by students and educational institutions. Attention to privacy and data security when using IoT technology in physical education is also important.
(Z. Zhang & Li, 2024)	A Study on the Development of Professional Training in Physical Education in Colleges and Universities under Information Technology	Sciendo	The results of the quantitative analysis show that the proposed method effectively increases students' active learning interest in sports training.	Research trends show increasing interest in integrating technology, such as VR, in college sports training. This research reflects an effort to utilize the latest technology to increase the effectiveness and efficiency of sports training in educational settings.	One of the main challenges is ensuring that the proposed technology can be widely implemented and accessible to a wide range of educational institutions. In addition, it is also important to continuously monitor and evaluate the impact of using VR technology in the context of sports training and ensure that the technology can improve overall training results.
(Han, 2021)	Discuss the application of computer virtual reality technology in college sports training	IOP Publishing Ltd	Computer virtual reality technology is also starting to be used in sports training, such as diving or trampoline, intending to help athletes increase the precision of movements and reduce risks in daily training.	Research trends indicate increasing interest in integrating computer virtual reality technology in sports training to improve the effectiveness and safety of athletes' workouts.	Key challenges include developing virtual reality systems that are easily accessible to sports teams and ensuring their effectiveness in improving athlete performance and safety. In addition, attention to data security and privacy is also important when using this technology in sports training.
(Dong, 2023)	Analysis of the Steps of Physical Education Teaching Based on Deep Learning	IGI Global	The experimental results show the effectiveness of an intelligent sports development system based on the Internet of Things (IoT) and artificial intelligence (AI).	Research highlights increasing interest in combining IoT and AI technologies in PE teaching, enabling real-time monitoring of students' physical activity. This effort aims to improve the effectiveness of sports teaching and student welfare.	Key challenges include efficiently integrating and analyzing data from wearable devices and sensors and ensuring system accessibility and security for coaches and students.
(Irwahand et al., 2022)	Perceived barriers to adopting information and communication technology in physical education	Iermakov Sergii Sidorovich	Cluster analysis identified three teacher profiles: cluster 1 (ICT expert) with 44 teachers, cluster 2 (moderate competence in ICT) with 41 teachers, and cluster 3 (low competence in ICT) with 27 teachers. The results show seven of the twelve technological barriers are significant among the clusters.	Research trends highlight the importance of overcoming barriers to using ICT in physical education, emphasizing the need for adequate technological infrastructure, pedagogical support, and curriculum design that supports the effective use of ICT.	The main challenge is overcoming barriers such as a lack of technical resources and pedagogical support and negative perceptions of the benefits of using ICT in learning. Confronting these barriers is important for curriculum development, teacher training, and student participation in technology-based school environments.
(Zheng & Chen, 2024)	Innovative Practice of Physical Education Teaching in Colleges and Universities in the Context of "Digital" Education	Sciendo	Applying the Artificial Neural Network (ANN) model in processing student movement data helps explore student movement data in more depth. The research findings also showed a significant increase in learning motivation and satisfaction among students who followed the flipped classroom teaching mode.	Research trends highlight the use of digital information technology in supporting innovation in physical education teaching in higher education. The flipped classroom teaching mode is increasingly developing as an effective learning method, especially in increasing student participation and improving learning outcomes.	One of the challenges in this research is the effective integration of digital information technology and flipped classroom teaching methods with real needs in physical education learning in higher education. This challenge involves curriculum adjustments, technology development, and teacher training to ensure the successful implementation of this new teaching model.
(Du et al., 2021)	Research on the Application of Information Technology in College Physical Education	IOP Publishing Ltd	Research also highlights the importance of utilizing information technology to integrate physical learning resources from various online sources, including university public course videos, online sports	Research trends highlight an increasing focus on using information technology to enhance physical education learning in higher education. Many institutions are starting to integrate online physical learning resources into their curriculum to enhance the student learning	The main challenge is ensuring quality and relevant online physical learning resources are available. Collaboration between educational institutions, technology developers, and physical teachers is needed. A learning environment that supports active student participation is

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			courses, and physical learning resources shared online.	experience.	also important.
(Wu, 2020)	Sports application practice and innovation based on computer-aided information technology	IOP Publishing Ltd	The research results show that using computer-assisted information technology in physical education can increase students' interest in learning and trigger a thirst for knowledge. However, research tends to focus on strengthening traditional physical education with information technology as a tool without deep enough penetration into the teaching elements.	Research trends show increasing interest in integrating modern information technology in physical education learning in schools. Research increasingly emphasizes integrating information technology into teaching elements, not just as an additional tool.	The main challenge in this research is to increase the systematization and focus of research on the use of information technology in physical education in schools. More comprehensive research is needed, and it should focus on theoretical analysis to understand the impact and potential of information technology in improving physical education learning in schools.

Physical education trends emphasize the broader use of technology as part of traditional teaching. Research shows increasing interest in leveraging technologies such as virtual reality, the Internet of Things (IoT), and deep learning to improve sports learning outcomes. To illustrate, digital platforms, virtual reality (VR), and augmented reality (AR) have enabled new methods for interactive teaching and analysis of athlete movements. Although this technology promises better results and a better learning experience, several problems must be overcome. This technology includes incorporating it into existing curricula, ensuring resource availability, and addressing technical and data security issues. For technology to become widely used, it is important to consider the needs and readiness of end users, including teachers and students.

One of the main challenges in using technology in physical education is ensuring that the new system is technically effective and adaptable to today's educational environment. This system requires adequate technological infrastructure, teacher training, and curriculum adjustments. Additionally, it is important to prioritize data security and privacy when using technologies such as the Internet of Things (IoT) and AI. Efforts are also needed to overcome challenges such as lack of technical resources, appropriate pedagogical support, and negative views about the benefits of technology in learning. Technology can only improve the quality and accessibility of physical education and create a more effective and inclusive learning environment for all students.

Discussion

The world of sports learning has experienced a new era thanks to advances in information technology (Fadhilah et al., 2021). These advances have changed how we view, access, and implement exercise training and instruction (Reyaz et al., 2023). Technologies such as virtual reality, the Internet of Things (IoT), artificial intelligence (AI), and multimedia enable sports learning to transcend the limitations of time and space (Atzori et al., 2010; Singh et al., 2014). Students and athletes can now access various interactive and diverse learning resources, receive real-time feedback, and participate in more immersive and individualized learning experiences (Баштовенко & Рубан, 2023; Клопов & Клопова, 2023). While we see the benefits of these innovations, we must address issues such as effective integration within the curriculum, data security, accessibility, and a strong understanding of how best to utilize these technologies to enhance overall PE learning.

Case study results about the "Athlete Intel" project aimed at leveraging advanced technology and artificial intelligence to improve athletic performance, safety, and mental health. This project involves the creation of a comprehensive database that stores data on various athletic entities. This data is then analyzed using an analytical engine to generate insights for users (Sattaburuth & Wannapiroon, 2021). Technology plays an important role in making sports more inclusive for individuals with varying abilities (Donati et al., 2023). Advanced prosthetic devices and specialized wheelchairs are designed to improve the performance of athletes with disabilities (Perla et al., 2023). Artificial intelligence (AI)--based training applications and virtual reality platforms enable individuals with physical limitations to train and compete in an environment tailored to their needs. Additionally, tracking and sensor technology provides real-time feedback, helping athletes optimize their technique and reduce the risk of injury (Shytikova et al., 2022). However, using technology in sports also raises challenges regarding athlete data privacy (Greene et al., 2023). Wearable devices and health apps collect a lot of personal data, including health, performance, and location data (Ioannidou & Sklavos, 2021). Therefore, a transparent and essential privacy policy is needed to protect athlete data. Athletes and teams must be clearly informed about the types of data collected, the purposes for which it is used, and their rights to access and control such information. By combining technological innovation and strict privacy policies, we can ensure that advances in sports technology have a positive impact without compromising athletes' rights and privacy (Jia & Fan, 2021).

The use of digital technology in sports learning has increased due to several key trends. One of them is using various technological devices such as fitness trackers, movement sensors, and applications designed to teach sports, as well as online learning platforms, gamification, and simulations (Pashaie & Sotiriadou, 2023). In addition, there is increasing interest in the use of virtual reality (VR) and augmented reality (AR) technologies in sports training to improve the quality of learning and improve the student experience. In addition, there is also increasing interest in applying deep learning in sports learning, especially in terms of body movement recognition, sports action analysis, and physical fitness evaluation (Watson II & Coker-Cranney,

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2018). These trends have quite diverse effects and benefits. For example, the use of information technologies such as virtual reality (VR), augmented reality (AR), and deep learning can improve learning outcomes by providing a more interactive and comprehensive learning experience (Woods et al., 2021). Digital technology can also increase students' desire to participate in sports by making it more interesting and enjoyable (Ratten, 2019). In addition, IoT in sports learning allows better monitoring and evaluation of students' physical activity.

A digital sports training system developed in China utilizes information technology to analyze athletes' movements (Zhong et al., 2022). This digital sport is an example of an attempt to use information technology to increase the efficiency of sports learning. In research conducted in Malaysia on the challenges of secondary school teachers in the use of information and communication technology in physical education, the research emphasized that technologies such as virtual reality, augmented reality, and deep learning have been used in sports training in various higher education institutions around the world, which shows progress in the use of technology to improve the quality of learning (Zakaria et al., 2022).

The relevant research above is in line with findings regarding global trends in the use of technology in physical education, which have shown significant increases in recent years. One of the main trends is the use of advanced technologies such as virtual reality (VR), the Internet of Things (IoT), and deep learning. Digital platforms, VR, and augmented reality (AR) are becoming increasingly popular interactive teaching methods and are also being used for athlete movement analysis. In addition, there is increasing interest in research on using information technology in sports learning. However, several challenges must be overcome to implement this trend effectively.

Apart from that, various challenges also arise in using technology in physical education, such as a lack of sports resources, especially in some regions, and technical problems in collecting and analyzing visual information on athletes' movements. Integrating the system into modern sporting practices is also a challenge, alongside ensuring the system is easy to use and accessible to its intended audience. Incorporating new technologies into existing curricula requires strategic thinking and ensuring adequate resources are available. In addition, data security and privacy aspects are also important concerns, along with the need to consider the readiness of end users to face new technologies. In ensuring successful implementation, it is important to provide adequate technological infrastructure, provide teacher training, and adapt the curriculum as needed.

The implications of global trends and challenges of information technology innovation in sports learning raise various aspects that must be considered carefully. On the one hand, technology promises to improve the quality of learning with more interactive and analytical methods, increase accessibility to sports education, and create a more interesting learning experience for students. However, challenges such as the digital divide, over-reliance on technology, and data security and privacy issues must be addressed. In addition, the lack of pedagogical support and high implementation costs also influence the effectiveness of using technology in sports learning. Therefore, implementing information technology in sports learning must be based on a careful and integrated approach, considering the needs and readiness of all parties involved, from students to teachers and policymakers. Thus, technology can be used optimally to improve the quality of sports learning without losing the essence of physical education itself.

Conclusion

This research examines global trends and challenges in the use of information technology (IT) in sports learning. The results of the analysis show that the application of IT has a significant impact on sports education. Information technology offers great potential to improve the quality of learning, increase accessibility, and create more engaging learning experiences. However, challenges such as the digital divide, over-reliance on technology, data security and privacy issues, and high implementation costs need to be addressed. Therefore, a careful and integrated approach is needed to adopt IT in sports learning. This approach must involve strategic thinking that considers the needs and readiness of all parties involved, from students to teachers and policymakers. Thus, technology can be used optimally to improve the quality of sports learning without losing the essence of physical education itself. Practical recommendations for teachers include training and professional development to improve skills in using IT in PE learning, designing and implementing innovative and engaging learning activities utilizing IT, and collaborating with colleagues and other professionals to share best practices and resources. It is recommended that coaches learn and use IT tools that can help them plan, implement, and evaluate training programs, provide constructive and data-based feedback to athletes, and utilize IT to improve communication and collaboration with athletes. Parents and other stakeholders. Policymakers are also expected to support investment in IT infrastructure and professional development for teachers and coaches, encourage research and development in the use of IT in PE learning, and develop policies and guidelines that support the responsible and ethical use of IT in PE learning. Future research could examine the long-term impact of IT use in sports learning on learning outcomes and skills development, the effectiveness of various learning models and approaches that use IT, ethical and privacy considerations in the use of data and information in sports learning environments, and the role of IT in supporting inclusive and accessible sports learning. By implementing these recommendations, it is hoped that schools can optimize the use of IT in sports learning, improve the overall quality of sports education, and prepare students to face future challenges strengthened by practical applications.

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