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The Use of Artificial Intelligence in Physical Education and Movement Development in Children

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Abstract

Purpose: This review study examines the use of artificial intelligence (AI) technologies in physical education and movement development in children over the past 10 years. Various AI applications, such as educational robots, virtual reality scenes, and personalized education programs, are discussed.
Method: Scientific studies published between 2014 and 2024 were reviewed using academic databases such as Google Scholar, PubMed, IEEE Xplore, SpringerLink, Web of Science, and Scopus. Keywords such as "artificial intelligence," "physical education," "movement development," "children," "AI in education," "virtual simulation," and "personalized learning programs" were used. Data were classified based on criteria such as student performance, feedback mechanisms, and the improvement of educational processe.
Results: Various AI applications, including educational robots, virtual reality scenes, and personalized education programs, are effective in increasing children's physical activities and supporting their movement development. AI technologies offer significant advantages in monitoring student performance and providing real-time feedback.
Conclusion: AI technologies have been found to make significant contributions to physical education and movement development in children, with great potential in monitoring student performance, providing feedback, and improving educational processes. It is also important to provide necessary training for teachers to effectively use AI technologies. Future research should focus on the integration of technologies such as augmented reality, virtual reality, and the Internet of Things.

Çocuklarda Beden Eğitimi ve Hareket Gelişiminde Yapay Zeka Kullanımı

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Özet

Amaç: Bu derleme çalışmasında, son 10 yılda çocuklarda beden eğitimi ve hareket gelişiminde yapay zeka (YZ) teknolojilerinin kullanımı incelendi. Eğitim robotları, sanal gerçeklik sahneleri ve kişiselleştirilmiş eğitim programları gibi çeşitli YZ uygulamaları ele alındı.
Gereç ve Yöntem: Google Scholar, PubMed, IEEE Xplore, SpringerLink, Web of Science ve Scopus gibi akademik veri tabanları kullanılarak 2014-2024 yılları arasında yayımlanmış bilimsel çalışmalar incelendi. "Yapay zeka," "beden eğitimi," "hareket gelişimi," "çocuklar," "YZ ile eğitim," "sanal simülasyon," "kişiselleştirilmiş öğrenme programları" gibi anahtar kelimeler kullanıldı. Veriler öğrenci performansı, geri bildirim mekanizmaları ve eğitim süreçlerinin iyileştirilmesi gibi kriterlere göre sınıflandırıldı
Bulgular: Eğitim robotları, sanal gerçeklik sahneleri ve kişiselleştirilmiş eğitim programları gibi çeşitli YZ uygulamaları, çocukların fiziksel aktivitelerini artırmada ve hareket gelişimlerini desteklemede etkili olmaktadır. YZ teknolojileri, öğrenci performansını izleme ve anlık geri bildirim sağlama konusunda önemli avantajlar sunmaktadır
Sonuç: YZ teknolojilerinin çocuklarda beden eğitimi ve hareket gelişimine önemli katkılar sağladığı, öğrenci performansını izleme, geri bildirim sağlama ve eğitim süreçlerini iyileştirme konularında büyük bir potansiyele sahip olduğu görüldü. Öğretmenlerin YZ teknolojilerini etkili bir şekilde kullanabilmeleri için gerekli eğitimlerin sağlanması ayrıca önemlidir. Gelecekteki araştırmaların artırılmış gerçeklik, sanal gerçeklik ve nesnelerin interneti gibi teknolojilerin entegrasyonuna odaklanması önerilmektedir.

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Introduction

In recent years, artificial intelligence (AI) technologies have been increasingly used in various fields. AI enables computer systems to perform tasks such as learning, problem-solving, and decision-making by mimicking human intelligence (Kaya, 2023). The use of these technologies is also growing in the field of physical education and movement development. Physical education and movement development in children are crucial for a healthy life. Therefore, the use of AI technologies in this field can help children maintain a healthy lifestyle. For example, it has been stated that ChatGPT [1] can be used in many areas such as creating personalized training programs in physical education and sports, analyzing athletes' performance, and developing interactive lesson plans, and that it has the potential to make a significant impact on the future of this field (Genç, 2023).

AI technology can be applied in educational robots, virtual reality (VR) scenes, educational content, and other aspects of physical education (Wen, 2020). For example, AI can be used to enhance students' participation in physical education in various ways. According to a report by the World Economic Forum, AI can be used to personalize learning, provide feedback, and automate routine tasks (O'Byrne, 2023). AI can also be used to create virtual physical education and sports environments that support students' personal development while helping them acquire skills and knowledge (Eswaramoorthi et al., 2022). The contributions of these technologies to physical development are generally focused on motor skills (Pérez & García, 2020). However, most of the research in this area is still in its early stages, requiring more scientific data and long-term studies. The most concrete results related to physical development have been obtained especially through VR and robotic therapy applications (Vargas & Hiller, 2017; Kramer & Carroll, 2018). Therefore, these technologies are expected to play a significant role in future education for children.

Additionally, AI technologies can monitor children's health and intervene early in health issues. Moreover, AI technologies can provide greater efficiency in the field of physical education and movement development. For instance, AI technologies can analyze children's movements to determine which movements they perform correctly and which they perform incorrectly. This allows children to develop more quickly.

Traditional physical education methods may fall short in providing educational programs tailored to each child's individual needs and abilities. Additionally, it can be challenging for teachers to continuously and thoroughly monitor students' performance. Understanding how artificial intelligence technologies can be used in children's physical education and movement development and revealing their potential to improve educational processes is crucial. This can pave the way for more widespread and effective use of AI in education in the future by ensuring that children receive education tailored to their individual needs and develop more rapidly. Therefore, this research is of great importance for both educators and students.

[1] ChatGPT is an AI chatbot developed by OpenAI that can engage in natural and meaningful conversations with users.

Method

The scientific research method of this study is a review. A review study aims to systematically examine the existing literature on a specific topic and provide a general overview of that topic (Fink, 2019).

Data Collection Process

The literature search was conducted using academic databases such as Google Scholar, PubMed, IEEE Xplore, SpringerLink, Web of Science, and Scopus. For the computer search, the following keywords were used individually or combined: 'artificial intelligence', 'physical education', 'movement development', 'children', 'AI in education', 'virtual simulation', 'personalized learning programs'.

Inclusion Criteria

Studies were included in the review if they met the following selection criteria: (1) Topic Relevance: Studies examining the effects of artificial intelligence technologies on physical education and movement development in children. (2) Publication Type: Articles published in peer-reviewed journals or conference proceedings, books, book chapters, and scientific web pages. (3) Participant Profile: Studies involving healthy and active child participants. (4) Performance Criteria: Studies evaluating performance criteria such as physiological aspects like motor skills or educational aspects. (5) Language: Studies published in English or Turkish. (6) Publication Date: Studies published between 2014 and 2024.

Analysis of Data

The collected data were systematically compiled and analyzed to evaluate the effects of AI technologies on physical education and movement development in children. The following steps were as follows: Data Collection: Gathering data from various sources using specific keywords and databases. Categorization: Organizing the data into relevant categories and grouping them based on focus areas. Thematic Analysis: Identifying common themes and patterns across different studies. Comparative Analysis: Comparing findings from different studies. Synthesis: Combining insights from various studies.

Results

Effects on Student Performance

The use of AI technologies in the field of education has rapidly increased in recent years, inspiring various studies examining their impact on student performance. This section discusses the effects of AI on education and its contributions to student performance in light of various scientific studies.

AI-supported educational applications provide personalized learning experiences, supporting the individual development of students (Toprak & Çolak, 2024). These technologies, particularly through automated assessment systems and data analytics-based personalized feedback, contribute to the improvement of student performance. For instance, it has been found that AI-supported personalized feedback increases student performance by 15% (Karaoğlan Yılmaz, 2020).

Another perspective is the potential of AI to keep students engaged and improve learning processes. This enhances student motivation and enables them to achieve their learning goals more effectively. For example, a study found that the use of AI-based learning platforms increased student participation rates by

20% (Kaynar & Sadık, 2021). These systems, which reduce the workload of educators, allow for more efficient use of time, thereby improving the experiences of both educators and students (ERIC, 2024).

Lee and Lee (2024) examined the use of AI in monitoring student performance, creating individualized educational programs, and improving teaching processes. The study provided examples of how AI benefits these areas:

- **Performance Monitoring**: Analyzes data collected during students' physical activities to provide individual performance assessments. This allows teachers to closely monitor student progress and adjust educational programs as needed.
- **Personalized Educational Programs**: Creates programs tailored to the individual needs and abilities of students, ensuring optimal development for each student.
- **Improving Teaching Processes**: Provides data to teachers to identify areas where students struggle and effective techniques, helping to continuously improve teaching methods.

AI's personalized feedback and assessment methods are highlighted as positively impacting student motivation and learning outcomes. Specifically, feedback tailored to individual needs helps students learn faster and perform better. Additionally, this feedback increases student interest in lessons and promotes higher participation rates. Detailed case studies and research findings support these points (Lee & Lee, 2024).

AI provides significant benefits in monitoring student performance, creating personalized educational programs, and improving teaching processes. These technologies are seen to positively impact learning outcomes by increasing student motivation. In conclusion, while the use of AI technologies in education offers various advantages, their potential to enhance student performance stands out as a significant area. However, more research and development are needed to use these technologies more effectively.

Teacher Roles and Education

Teacher Training and Technical Support

According to a systematic review of AI applications in physical education, AI technologies are widely used in athletic performance analysis, health monitoring, and personalized training (Zawacki-Richter et al., 2019). Additionally, AI can assist physical education teachers and students by optimizing the current structure of physical education, the design of classroom content, and processes. However, one of the main challenges in using AI in physical education is the lack of expertise among future physical education teachers in implementing AI (Lee & Lee, 2021). The cost of applications and the insufficient training of teachers in using these applications are among the primary challenges (Zhou et al., 2023). In a study by Zhou et al. (2023), it was found that AI-supported educational programs reduced teachers' workload by 30%.

Rajeena and Quraishi's (2024) study comprehensively examines the applications of artificial intelligence in monitoring and evaluating student performance. The study emphasizes that AI-supported systems significantly reduce teachers' administrative workload by automating tasks such as grading, attendance tracking, and responding to routine student inquiries, thereby allowing teachers to work more efficiently. Specifically, the automation of these tasks by AI enables teachers to gain more time to engage with students individually. Additionally, the benefits of AI technologies in providing real-time feedback,

personalized learning experiences, and early intervention for struggling students are also discussed (Rajeena & Quraishi, 2024).

In an article addressing the use of AI and big data technology in physical education (Feng Cao et al., 2022), it is stated that physical education teachers face challenges in understanding new curriculum standards, selecting teaching content, and keeping up with recent developments. To address these issues, the authors propose a smart service platform for smart sports classes in schools. The platform is designed to detect and solve students' problems in the physical education process promptly. This platform, designed to increase the reliability of PE class teaching, provides a practical foundation for reforming physical education teaching.

In conclusion, AI-powered educational technologies offer significant benefits by reducing the workload of physical education teachers and optimizing teaching processes. However, effective implementation of these technologies requires adequate teacher training and manageable costs. In the future, the integration of AI and big data technologies will enable more personalized and effective approaches in physical education. Comprehensive training programs and technical support are crucial to ensure that both teachers and students can fully benefit from these advancements.

Professional Development and Contributions of AI

AI-supported systems contribute to teachers' professional development by helping them maximize their potential in education. These systems enable teachers to effectively integrate new technologies and adopt best practices. For example, AI-based educational platforms support teachers in providing personalized learning experiences and continuously developing their professional skills (Johnson & Park, 2025). Additionally, AI-supported systems allow teachers to monitor student performance and provide personalized feedback, helping teachers better understand their students (Garcia & Martinez, 2025).

In conclusion, strengthening the technical infrastructure is necessary for AI technologies to produce reliable and accurate results. Moreover, necessary measures should be taken to ensure the privacy and security of children, and AI systems should be designed to be fair and transparent. Providing teachers with the necessary training and technical support to effectively use AI technologies is crucial. Overcoming these challenges will enable the more effective and safe use of AI in education.

Integration into the Educational Curriculum

This section discusses how AI can be integrated into the educational curriculum and the impact of this integration on student performance.

Integration of AI into the Physical Education Curriculum

Garcia and Martinez (2020) investigated the integration of AI into the physical education curriculum for young learners. They used natural language processing and machine learning techniques to monitor student performance and provide personalized educational content. AI tracked students' progress and provided detailed reports to teachers. The results showed that AI improved students' learning processes and increased their physical performance by 25%. However, more teacher training and technical support were recommended (Garcia & Martinez, 2020).

Laak and Aru's (2024) study examined the alignment of AI-supported personalized learning solutions with modern educational goals. It revealed that current technologies do not sufficiently support collaboration and cognitive engagement. However, the advantages of AI-supported systems, such as flexibility and instant feedback, were highlighted, and a hybrid model was proposed. In this model, the benefits of AI are combined with teacher guidance to provide lesson content tailored to students' individual needs. This model is described as a system where technology plays a supportive role and requires extensive changes in educational strategies (Laak & Aru, 2024).

AI monitors student performance, provides personalized educational content, and delivers detailed reports to teachers. This improves students' learning processes and allows teachers to provide more effective guidance. Additionally, the advantages of AI-supported systems, such as flexibility and instant feedback, contribute to the development of hybrid models aligned with modern educational goals. Therefore, increasing teacher training and technical support is essential for the more effective use of AI in education.

AI-Based Personalized Physical Education Programs

Kim and Park (2021) examined the effects of AI-based personalized physical education programs for children. Using deep learning and data analytics, they created educational programs tailored to students' individual needs. AI monitored student performance and provided instant feedback. The results showed that AI increased students' physical development by 30%. The authors recommended further research and implementation in this area (Kim & Park, 2021).

Katiyar et al.'s (2024) study addressed the current state and future potential of AI-supported personalized learning systems. The study presented examples of successful applications such as intelligent tutoring systems, adaptive learning platforms, learning analytics, and gamified learning environments. It emphasized that AI-supported personalized learning has the potential to enhance effectiveness, engagement, and equity in education, but careful design and responsible implementation are necessary (Katiyar et al., 2024).

AI creates educational programs tailored to students' individual needs, monitors student performance, and provides instant feedback. This supports students' physical development and has the potential to enhance effectiveness, engagement, and equity in education. However, careful design and responsible implementation of these systems are required.

Technological Innovations

This section discusses innovative approaches in educational activities using AI technologies, such as virtual simulation, virtual reality (VR[2]), augmented reality (AR[3]), and AI-supported fitness technologies.

Virtual Simulation Technology

Virtual simulation technology helps users gain experience and learn by mimicking real-world events (Clarke, 2021). Virtual simulations allow children to practice specific movements in a safe environment,

[2] VR is a technology that allows users to feel as if they are present in a computer-generated three-dimensional environment.
[3] AR enhances users' experience of their surroundings by adding digital information to the real-world environment, making it richer and more interactive.

reducing the risk of injury and improving their motor skills. For example, children can try movements like running or jumping in a virtual environment (Higgins, 2017). Higgins (2017) also emphasized that simulations can be used to analyze children's movements and provide feedback, helping teachers assess student performance and identify areas for improvement.

A study examining the use of virtual simulation technology in physical education teaching found that virtual simulation technology was 25% effective in improving students' physical skills and teaching processes. The study stated that this technology expands the educational environment, allowing students to experience different physical activities in a virtual setting, providing real-time feedback and personalized training programs to enhance student performance and motivation (Yang, 2014).

Virtual simulations can also help students understand and apply game strategies. By experiencing different game scenarios, they can develop decision-making skills. Although virtual simulations were not directly used as a research tool in a study on the decision-making styles and mental well-being levels of individual and team athletes, the findings of this study indicate the potential of virtual simulations in developing game strategies (Tekkurşun et al., 2018).

Virtual simulation technology allows children to develop motor skills in a safe environment, enhance their strategy and tactic development abilities, receive feedback by analyzing their movements, and experience innovative approaches in education. These technologies enable students to learn physical activities more effectively and enjoyably, thereby increasing their motivation and participation.

Augmented Reality (AR) Technology

Studies show that AR applications can be an efficient tool in children's education and learning processes. For example, in an AR-supported book reading application, children's learning processes were positively affected by 20% (Tanrıverdi, 2022). Additionally, Başkonuş and Çiriş's (2024) study demonstrated that combining the physical and social contributions of sports with augmented reality technology could support the academic success of individuals with learning difficulties by 15%.

A study examining how augmented reality technology is used to develop children's sports skills stated that with tools like smart glasses and mobile devices, children can receive real-time feedback to improve their sports techniques. These technologies can increase children's performance in games and exercises by 25% (Devecioğlu et al., 2021). These technologies help children improve their physical health and motor skills while playing games. Moreover, AR and VR applications motivate children to be more active by increasing their motivation during exercise. It is emphasized that such technologies make physical activity more accessible and attractive, helping children develop healthy living habits (Yüksel, 2019).

Virtual Reality (VR) Technology

Studies examining how virtual simulations can affect children's physical activity and game experiences and their potential benefits show that VR games involving physical activity have a motivating effect on individuals' exercise motivation (Kılıç, 2020). A study comparing the perceived health status of participants in virtual reality (metaverse) games and physical activity found that digital games had positive effects on participants' physical and mental health outcomes. This study also found that digital games could

motivate participation in physical activity and that there were gender differences in students' motivations (Özdemir, 2021). In a study evaluating teachers' views on the use of VR technology in physical education and sports education (Çakır & Yaman, 2022), it was stated that VR technology increased students' motivation and was effective in making learning processes more enjoyable and interactive. However, technological infrastructure deficiencies and teachers' lack of sufficient knowledge were identified as significant challenges in the effective use of VR.

AI-Supported Fitness Technologies

A study examining how AI-powered fitness technologies are shaping the future of physical education highlights the significant benefits of AI-based applications in monitoring student performance, creating exercise programs tailored to individual needs, and providing instant feedback (Smith et al., 2024). However, scientific studies on the use of AI-powered fitness technologies in children are limited. Existing research primarily focuses on the general population, with very little data specific to children. Therefore, there is an urgent need for more specialized and in-depth research on the application of AI-powered fitness technologies for children. The limited scientific literature in this area presents a significant opportunity for future studies.

In recent years, digital applications developed to increase children's physical activity levels and support their education have garnered significant interest. In this context, the applications Luca & Friends (2022) by GOFA International and GenMove, Season1 (2022) by the World Health Organization stand out.

Luca & Friends is the world's first AI-powered educational app that combines fitness, learning, and the metaverse for children. This application helps children learn English and STEM (Science, Technology, Engineering, and Mathematics) subjects in an enjoyable way while also improving their strength, endurance, and coordination through physical activities. Additionally, it enhances children's motivation through games that encourage social interaction and reward programs.

GenMove, Season1, is a digital application developed to increase children's physical activity and improve their health. Using AI-powered motion tracking technology, it offers games that develop various physical skills for children aged 8-15. This application improves children's daily physical activity levels and health while making them enjoy moving through fun and interactive games.

Both applications contribute to children's physical and mental development, helping them adopt healthy habits.

In conclusion, AI-powered fitness technologies offer significant contributions to children's physical and mental development. However, the limited scientific studies in this field highlight the need for more specialized and in-depth research focused on children. Applications like Luca & Friends and GenMove, Season1 demonstrate the potential benefits of these technologies and provide a crucial foundation for future research. Therefore, developing and examining more AI-powered fitness technologies that help children adopt healthy habits is of great importance.

Risks and Challenges in AI Applications

This section addresses the technical, ethical, and educational challenges of AI applications and offers suggestions on how to overcome these challenges.

Privacy and Data Security: It is discussed that younger generations are growing up interacting with AI algorithms, but AI and related technologies pose a risk to children's privacy and security (Perucica, 2022). While AI has great potential for children's education and health, efforts must be made to develop AI literacy and skills for future generations. Additionally, decision-makers and technology innovators must prioritize children's rights and well-being when designing AI systems. The article "AI for children" discusses how children interact with AI technologies and, despite AI's great potential for children's education and health, it poses a risk to children's privacy and security (UNICEF, 2021). The article emphasizes that AI should be designed with a priority on children's rights and well-being.

Moreover, AI models heavily depend on the quality of educational data. Errors or deficiencies in datasets can negatively affect the model's accuracy. Therefore, using high-quality and reliable data is crucial (Binns et al., 2018; Liu et al., 2020).

Ethical Challenges and Dilemmas: Ethical challenges and dilemmas related to the use of AI in education include issues such as privacy, bias, transparency, and accountability (Akgun & Greenhow, 2022). For example, the decision-making processes of algorithms may not be transparent, leading to biases and unfair outcomes. Therefore, ethical standards must be established and adhered to (Dastin, 2018; Obermeyer et al., 2019).

Algorithm Accuracy: The accuracy of AI algorithms is directly related to the training process and techniques used. Incorrect training or inappropriate algorithms can lead to faulty predictions and outcomes (Shalev-Shwartz & Ben-David, 2014).

Model Generalization Ability: The generalization ability of a model refers to how effectively it works with new data outside the training set. AI models can face the problem of overfitting, which means the model works well only with training data but fails with real-world data (Goodfellow et al., 2016).

Various strategies can be proposed to overcome the challenges in AI applications. Firstly, the accuracy of AI models can be improved by using high-quality datasets. Emphasis should be placed on data cleaning and preprocessing processes. To enhance the model's generalization ability, cross-validation and regularization techniques should be used, and overfitting should be prevented. In terms of privacy and data security, strong encryption and data anonymization techniques should be used to protect children's data, and children's rights should be prioritized when designing AI systems. To ensure transparency and accountability, the decision-making processes of algorithms should be transparent and documented. Regarding bias and fairness, continuous monitoring should be conducted to ensure algorithms make unbiased and fair decisions, and ethical standards should be followed. Educationally, programs should be organized to increase students' AI literacy, and continuous training and support should be provided to educators to effectively use AI technologies. These suggestions can help overcome the challenges in AI applications.

Conclusion

AI has made significant contributions to the field of physical education and movement development, and it holds potential for even more advanced applications in the future. AI-supported educational applications provide substantial benefits in enhancing student performance, reducing teachers' workload, and offering personalized learning experiences. Notably, AI's potential to increase student motivation and improve learning processes is creating a major transformation in education.

However, the applications of AI in physical education come with certain limitations. These limitations include data security and privacy concerns, the accuracy of algorithms, and ethical challenges such as bias. Additionally, it is essential to provide the necessary training and technical support for teachers to effectively utilize AI technologies. Overcoming these challenges will ensure the more effective and safe use of AI in education.

The contributions of AI to physical education and movement development are expected to increase, and it is believed that future studies in this area will shape the future of education. The development of sustainable educational technologies and the enhancement of AI's role in education will improve the experiences of both students and teachers, opening new horizons in education.

These findings address the potential of AI in education and the challenges encountered, providing a crucial foundation for future research and applications. The effective use of AI in education will support the individual development of students and contribute to the professional development of teachers. Therefore, further research on the role and impact of AI in education is of great importance.

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