Chapter 1

Artificial Intelligence: Historical Evolution, Conceptual Framework, and Societal Reflections

Fatih Ateş[1]

Abstract

This chapter provides a comprehensive examination of the historical development, conceptual framework, and practical applications of artificial intelligence (AI), with a particular focus on its implications in sports sciences and physical education. Beginning with the early milestones such as Turing's theoretical machine and McCarthy's coining of the term "artificial intelligence," it traces AI's evolution and integration into various sectors, including healthcare, law, and education. The chapter emphasizes AI's capabilities to reason, learn, and imitate human intelligence, along with key breakthroughs like Deep Blue, Watson, and AlphaGo, which have challenged human dominance in strategic games. Special attention is given to the application of AI, augmented reality (AR), and virtual reality (VR) technologies in physical education, where these tools enhance student motivation, personalize learning, and support motor skill development. Despite its transformative power, the chapter reveals that AI still faces notable weaknesses and criticisms particularly in areas such as ethical responsibility, data privacy, employment displacement, overreliance on algorithms, and a lack of human-centered design. These limitations highlight the need for cautious, transparent, and inclusive integration of AI technologies into education and society. The chapter also presents experimental research findings showing both the advantages and limitations of VR/AI-supported physical training. Moreover, it discusses next-generation AI tools like ChatGPT in educational planning and instruction. By combining insights from Turkish and international literature, the chapter offers original contributions to the fields of sports sciences and pedagogy. It concludes by stressing the need for responsible, ethical, and inclusive integration of AI in education, and outlines recommendations for future research and practice.

1 Research Assistant, Department of Physical Education and Sports, Faculty of Sports Sciences, Erzurum Technical University. fatih.ates@erzurum.edu.tr, ORCID: https://orcid.org/0009-0000-5510-2694

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Introduction

Since the Industrial Revolution, there have been significant advancements in the field of technology, and many labor-intensive tasks previously performed by humans are now being carried out by technologies developed to assist humanity (Liu et al., 2018). Over time, rapidly developing technologies have begun to replace humans in tasks that are difficult to perform, directly improving both performance and efficiency (Huang and Rust, 2018). One of the technological innovations that has started to replace humans is Artificial Intelligence (AI) (Agrawal et al., 2017).

One of the most significant milestones in the field of Artificial Intelligence (AI) was the introduction of the Turing Machine, developed by Alan Turing in 1937 as an intelligent computer. This groundbreaking work by Turing attracted considerable attention from other researchers who later sought to create a "thinking machine" with abilities similar to human cognition (Sharma et al., 2020). The concept of artificial intelligence was introduced by John McCarthy in 1956 at the Dortmund Conference held in Germany. In a proposal letter presented by McCarthy and six others, including himself, the term "artificial intelligence" was explicitly articulated (McCarthy et al., 2006).

According to Gondal (2018), artificial intelligence is defined as an information technology that is capable of reasoning, comprehending events, interpreting, making inferences, possessing the ability to learn, and successfully performing multiple tasks. In another definition provided by Obschonka and Audretsch (2020), artificial intelligence is described as a technology that imitates the reasoning and prediction abilities of human intelligence in solving complex problems and making decisions under changing conditions.

As can be seen, the common features among definitions of artificial intelligence include three key concepts: "the ability to reason," "the ability to solve complex problems," and "the capacity to imitate human intelligence." Artificial intelligence imitates tasks performed by humans across various fields of work and is capable of carrying out different tasks through diverse technological programs (Jarrahi, 2018). While AI was once a concept encountered only in science fiction discussions, it has now become a part of daily life in numerous fields such as education, healthcare, the military, law, agriculture, manufacturing, supply chain, and sports (Bhbosale et al., 2020). It can be stated that artificial intelligence will become increasingly prevalent in all areas in the future and bring about new transformations.

The Evolution of Artificial Intelligence and Its Reflection in Sports

One of the significant areas of application for artificial intelligence is smartphone applications (Maedche et al., 2019). Smartphone applications can easily perform tasks that individuals plan to carry out in their daily lives, and these applications can offer personalized suggestions by analyzing users' preferences (Xie et al., 2019). For example, music applications analyze users' music listening habits and provide personalized song recommendations (Gandomi and Haider, 2015).

Artificial intelligence has not only rapidly entered such domains but has also begun to compete with humankind. The first computer capable of playing chess against humans, called "Deep Blue," was developed by International Business Machines (IBM) and ended in a 1-1 draw with the world chess champion Garry Kasparov. This computer continued to be developed, and by the year 1997, "Deep Blue" succeeded in defeating Garry Kasparov, the world chess champion. Similarly, the AI computer named "Watson," also developed by IBM, managed to outperform its human competitors by a wide margin in a televised quiz show in 2011. In 2016, the artificial intelligence system named AlphaGo, developed by Google DeepMind, competed against the world Go champion Lee Sedol. AlphaGo achieved a historic victory by defeating Lee Sedol, the world Go champion, with a score of 4–1. In 2017, the AI poker bot named Libratus marked a significant milestone in the history of artificial intelligence by defeating four professional poker players (Fujita, 2020; Moravčík et al., 2017; Nowak et al., 2018; Randhawa and Jackson, 2020).

These developments can be interpreted as an indication that artificial intelligence will continue to advance and compete with humans in many fields in the future. Makridakis (2017) states that within the next twenty years, artificial intelligence will reach the level of human intelligence and become a serious competitor to humankind in every domain. Teng (2019), on the other hand, asserts that while human intelligence currently surpasses artificial intelligence, in rapidly changing environments and in the face of complex problems and tasks, AI possesses the capability to operate much faster than the human brain. The replacement of humans by artificial intelligence, both now and in the future, will take time (Agrawal et al., 2017).

In conclusion, it cannot be claimed that artificial intelligence has completely replaced human intelligence or brought an end to human superiority. In the future, if artificial intelligence reaches a superhuman level, issues such as controlling AI and the potential threat it may pose to humanity could arise.

A review of the literature reveals that there are numerous studies supporting this view (Armstrong et al., 2016; Federspiel et al., 2023; Yampolskiy, 2022).

According to the warnings of renowned physicist Stephen Hawking, artificial intelligence technology carries risks that could potentially lead to the end of humanity, and it is emphasized that these risks must be understood in a multidimensional manner (Hawking et al., 2014). With the rapid advancement of technology and the rise of artificial intelligence and automation, the automation of jobs in certain sectors and the reduced need for human labor may lead to significant consequences in terms of income inequality and unemployment (Acemoglu and Restrepo, 2018). Another important issue highlighted in a study by Li and Zhang (2017) is that artificial intelligence researchers must place sufficient emphasis on security, ethics, and privacy. These issues represent inevitable and significant challenges for the evolving and transforming nature of artificial intelligence. With the continuous advancement of AI, they argue that the importance of data security, personal privacy, and ethical considerations will increasingly grow (Fjeld et al., 2020). Due to the expanding use of artificial intelligence in high-risk domains, it is emphasized that AI systems must be designed and governed with principles of accountability, fairness, and transparency in mind (Cath, 2018). With the advancement of artificial intelligence, it can be said that issues such as competition, unemployment, income inequality, privacy, ethical violations, security, and accountability have gained increasing importance.

Next-Generation Technologies Used in Sports Sciences

With the increasing integration of artificial intelligence into our lives, concepts and applications such as augmented reality (AR) and virtual reality (VR) have become increasingly common (Farshid et al., 2018; Çabuk and Gençoğlu, 2024). Virtual reality (VR) and augmented reality (AR) are being used not only in the fields of gaming and entertainment but also increasingly in education. Through the use of augmented reality (AR) technology, sports games (e.g., screen tennis, golf, baseball, table tennis, dance, yoga) can be incorporated into physical education activities and used as instructional tools (Yu, 2022).

In physical education instruction, interest in and demand for virtual reality (VR) and augmented reality (AR)-based teaching and learning activities are rapidly increasing (Wohlgenannt et al., 2020). Augmented reality (AR) and virtual reality (VR) eliminate physical and temporal limitations, allowing students to learn within a three-dimensional environment (Lee and Lee,

2021). If artificial intelligence is used appropriately, more complex motor skills can be performed in physical education classes despite students' physical and spatial limitations (Chang et al., 2020).

However, a review of the relevant literature reveals that research on the application of artificial intelligence in the field of physical education and physical activity is limited (Xiang, 2022). The use of artificial intelligence applications in physical education can enhance learning attitudes and interest (Yang, Oh, Wang, 2020) as well as the development of motor skills (Li and Wang, 2021). The integration of AI into physical education classes, in particular, can increase students' motivation and active participation by enriching their experiences, enabling personalized learning through feedback, and making the lessons more engaging for students (Lee and Lee, 2021).

It is believed that both teachers and students may be affected in various positive or negative ways by the emergence of new software and applications resulting from technological advancements.

Applications of Artificial Intelligence in the Field of Physical Education

Technologies are significantly transforming the ways in which modern societies and individuals think, feel, move, and interact with one another. In particular, technological advancements are rapidly and profoundly altering our methods of teaching and learning, and as a result, the educational environment is evolving and improving (Chen et al., 2020).

The concept of Artificial Intelligence in Education (AIED) has emerged as a more powerful tool with the advancement of technology since it was first introduced approximately thirty years ago (Zawacki-Richter et al., 2019). However, despite its long-standing presence in our lives, this technology is still not fully understood by many educators and students (Luan et al., 2020). It can be stated that resolving this lack of understanding could bring substantial benefits. For example, AI-based learning systems offered to students can monitor their learning levels, provide personalized learning experiences, and recommend subject-relevant materials to them (Chen et al., 2020). Moreover, thanks to AI-based education, learning is no longer confined to the four walls of a classroom. Teachers can track students' performance levels, predict their current status, develop the necessary instructional materials for the lesson, and assess and grade students accordingly (Zawacki-Richter et al., 2019).

Artificial intelligence in education is being used across various fields, including medical education (Chan and Zary, 2019), mathematics education (Gadanidis, 2017), music education (Yu et al., 2023), visual arts education (Fan and Zhong, 2022), English language instruction (Kim et al., 2019), and physical education teaching (Lee and Lee, 2021). These technologies, which are especially prevalent in corporate training, are also being adopted by university students (Freina and Ott, 2015).

In the context of physical education, AI-based systems are increasingly being integrated into in-class practices (Lee and Lee, 2021). As teachers' access to technology improves, the use of artificial intelligence is rising in areas such as digital assessment tools, motor skill analysis systems, feedback mechanisms, and personalized instructional planning (Chen et al., 2020; Kamalov et al., 2023). In this transformation, next-generation AI applications such as ChatGPT and DeepSeek have become tools directly utilized in educational processes (Sallahuddin et al., 2025). However, it has been emphasized that this integration should be carried out with a responsible, ethical, and pedagogically grounded approach, and that teachers, researchers, and policymakers should work collaboratively (Adiguzel et al., 2023). Physical education teachers use these systems for purposes such as creating lesson plans, improving instructional content, providing individualized feedback to students, and enhancing the effectiveness of teaching (Qutlımuratovich, 2025; Trendowski, 2025).

The Use of Augmented and Virtual Reality in Sports Settings

With the increasing integration of artificial intelligence into our lives, concepts and applications such as augmented reality (AR) and virtual reality (VR) have become increasingly prevalent (Farshid et al., 2018; Çabuk and Ulupınar, 2025). Virtual reality (VR) and augmented reality (AR) are being used more and more not only in the fields of gaming and entertainment but also in education. By utilizing augmented reality (AR) technology, sports games (e.g., screen tennis, golf, baseball, table tennis, dance, yoga) can be incorporated into physical education activities and used as instructional tools (Yu, 2022). In physical education instruction, there is a rapidly growing interest in and demand for teaching and learning activities based on virtual reality (VR) and augmented reality (AR) (Wohlgenannt et al., 2020).

Augmented reality (AR) and virtual reality (VR) eliminate physical and temporal limitations, enabling students to learn in a three-dimensional environment (Lee and Lee, 2021). If artificial intelligence is used appropriately, more complex motor skills can be performed in physical

education classes despite students' physical and spatial limitations (Chang et al., 2020).

Ethical, Security, and Privacy Issues

In conclusion, it cannot be claimed that artificial intelligence has completely replaced human intelligence or brought an end to human superiority. In the future, if AI reaches a superhuman level, challenges may arise regarding its control and the potential threat it could pose to humanity. A review of the literature reveals that there are numerous studies supporting this perspective (Armstrong et al., 2016; Federspiel et al., 2023; Yampolskiy, 2022).

According to the warnings of renowned physicist Stephen Hawking, artificial intelligence technology carries risks that could potentially bring about the end of humanity, and it is emphasized that these risks must be understood in a multidimensional manner (Hawking et al., 2014). With the rapid advancement of technology and the increasing prevalence of artificial intelligence and automation, jobs in certain sectors may become automated, reducing the demand for human labor. As a result, this could lead to significant consequences related to income inequality and unemployment (Acemoglu and Restrepo, 2018).

Another important issue highlighted by Li and Zhang (2017) is that artificial intelligence researchers must give sufficient attention to matters of security, ethics, and privacy. These issues pose inevitable and significant challenges for the continuously evolving and transforming nature of artificial intelligence. They emphasize that with the ongoing development of AI, the importance of data security, personal privacy, and ethical considerations will continue to grow (Fjeld et al., 2020). Due to the increasing use of artificial intelligence in high-risk domains, it is emphasized that AI systems should be designed and managed with careful consideration of the principles of accountability, fairness, and transparency (Cath, 2018).

Opportunities, Limitations, and Future Perspective

The use of artificial intelligence and virtual reality technologies in sports sciences and physical education offers significant opportunities in the areas of learning, teaching, performance enhancement, motivation, and feedback processes. Various experimental studies in the literature have demonstrated that these technologies increase student engagement, provide opportunities for personalized learning, and contribute to the development of motor skills. According to some studies:

- Taşkın (2018) demonstrated that virtual reality applications improved the physical functions of elderly individuals with knee osteoarthritis and reduced their pain levels.
- Kalkan (2020) found that VR-supported instruction was effective in the development of table tennis skills.
- Çelik (2019) stated that a VR-supported virtual competition environment led to a significant improvement in the mean power component of anaerobic performance.
- Bedir and Erhan (2021) demonstrated that virtual reality-based imagery training was more effective than traditional methods.
- Turdaliyev et al. (2024) showed that VR-supported educational applications enhanced sports performance and training quality among university students.
- Hu (2025) reported that VR-based collaborative learning significantly increased students' motivation.
- Akça and Özer (2020) stated that while VR did not produce a significant difference in physical performance, it did support overall development.
- Gürbüz (2021) found in his study that the hybrid (traditional + VR) instructional model was more effective than the use of VR alone.
- In studies conducted by Geisen, Fox, and Klatt (2023), it was reported that some students had difficulty adapting to VR technology and experienced dizziness.

These findings indicate that virtual reality and artificial intelligence technologies may not directly lead to success in every context; however, when appropriately designed, they can serve as powerful learning tools.

Conclusion and Evaluation

This book chapter begins by explaining the historical development and fundamental characteristics of artificial intelligence, then discusses its current reflections across various sectors such as education, healthcare, law, agriculture, and sports (Liu et al., 2018; Bhbosale et al., 2020). The process that began with Alan Turing's Turing Machine was conceptually grounded when John McCarthy introduced the term artificial intelligence in 1956. The chapter emphasizes AI's abilities in reasoning, learning, and imitating human intelligence (Sharma et al., 2020; Gondal, 2018; Obschonka and Audretsch, 2020).

Before addressing the use of artificial intelligence in education, its progress in competing with humans was illustrated through examples such as Deep Blue, Watson, and AlphaGo (Fujita, 2020; Moravčík et al., 2017). These developments support the expectation that artificial intelligence will continue to advance in the coming years and enter into more intense competition with human intelligence (Makridakis, 2017; Teng, 2019).

However, it has been emphasized that the advancement of artificial intelligence should not be viewed solely as a technological achievement, but also as a development that brings ethical and societal risks. Stephen Hawking's warnings about the risks AI poses to humanity (Hawking et al., 2014) have been supported by concerns such as income inequality, unemployment, security, and privacy. It has been stated that AI must be managed carefully within the framework of accountability and transparency principles (Acemoglu and Restrepo, 2018; Fjeld et al., 2020; Cath, 2018).

In the field of education, artificial intelligence holds great potential, particularly in areas such as personalized learning, student monitoring, and material recommendation (Chen et al., 2020). It has also been emphasized that AI-based learning systems can be utilized by teachers for assessment and instructional planning (Zawacki-Richter et al., 2019). Examples have been provided demonstrating the use of AI in various disciplines, including medicine, mathematics, music, art, language, and physical education (Chan and Zary, 2019; Gadanidis, 2017; Fan and Zhong, 2022; Lee and Lee, 2021).

Specifically in physical education, it has been stated that artificial intelligence applications integrated with augmented reality (AR) and virtual reality (VR) technologies enhance students' motor skills, increase their motivation, and personalize the learning process (Chang et al., 2020; Yang, Oh, and Wang, 2020). However, as noted by Xiang (2022), the literature on the use of these technologies in the field of physical education remains limited.

The chapter also presents numerous examples of experimental studies from both Turkish and international literature, detailing the effects of these technologies on performance, motivation, and balance/coordination (Taşkın, 2018; Kalkan, 2020; Bedir and Erhan, 2021; Turdaliyev et al., 2024). These studies have shown that virtual reality-based training generally yields positive outcomes, although in some cases it does not differ significantly from traditional methods (Akça and Özer, 2020; Gürbüz, 2021).

In conclusion, this chapter has systematically examined the opportunities offered by artificial intelligence and next-generation technologies within the context of sports sciences and physical education. Both the opportunities and limitations have been discussed, supported by scientific findings. The pedagogical, ethical, and socioeconomic dimensions of technology have been evaluated in a holistic manner, contributing a noteworthy addition to the existing literature.

Original Contributions of This Chapter

This chapter offers original contributions to the literature on the integration of artificial intelligence, virtual reality, and next-generation technologies in education within the field of physical education and sports sciences in the following ways:

- A Conceptual and Historical Examination of Artificial Intelligence: The evolution of artificial intelligence from the Turing Machine to the present has been explained in both its technical and theoretical dimensions, and interpreted within a historical context by referencing the pioneers of the field. This approach enables a deeper understanding of the philosophical and technological foundations of artificial intelligence, even within an applied field such as physical education.
- Examination of Contemporary AI Tools in the Context of Physical Education: Widely used contemporary tools such as ChatGPT and DeepSeek have been introduced with concrete usage scenarios relevant to teachers and students. Their roles in content generation, providing feedback, and supporting research processes have been clearly articulated.
- Integration of AR/VR Technologies into Instructional Practices: Augmented reality and virtual reality applications have been evaluated in terms of their contributions to motor skill development, motivation enhancement, and the promotion of student engagement in physical education classes. The pedagogical functions of these technologies have been illustrated through example-based, activity-centered instructional scenarios.
- Integration of Turkish and International Literature: This chapter provides a multi-layered synthesis by incorporating not only a theoretical framework but also master's and doctoral theses from Turkey alongside international literature. In this way, contextual analyses are compared with universal findings, enabling a more comprehensive perspective.

- Critical Evaluation of Technological Impact: Not only the positive effects but also potential risks such as dizziness during VR use, superficial learning, and plagiarism associated with AI applications have been explicitly addressed. This reflects a balanced evaluative approach that avoids a technologically deterministic perspective.
- Emphasis on Ethics, Security, and Privacy: Ethical, security, and data privacy risks that may arise from the use of artificial intelligence in educational settings have been discussed, and literature-supported measures to address these issues have been outlined.
- Providing Guidance for Future Practice and Research Areas: By emphasizing that the application of artificial intelligence in physical education and sports sciences is still in development, this chapter offers a guiding framework for future studies covering policy recommendations, experimental design requirements, and teacher training-based practices.

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