THEORY and PRACTICE
of Physical Culture and Sports

https://tppcs.com.ua/
Vol. 3, No. 2, 2024

Received: 29.08.2024. Revised: 08.11.2024. Accepted: 12.12.2024

UDC 796.071

DOI: 10.69587/tppcs/2.2024.09

The use of interactive technologies in the physical education process

Olga Shapran*

Doctor of Pedagogy, Professor
Hryhorii Skovoroda University in Pereiaslav
08401, 30 Sukhomlynskyi Str., Pereiaslav, Ukraine
https://orcid.org/0000-0002-7514-6632

Oleksii Tkachuk

Lecturer
Hryhorii Skovoroda University in Pereiaslav
08401, 30 Sukhomlynskyi Str., Pereiaslav, Ukraine
https://orcid.org/0009-0004-5257-1240

Abstract. The study aimed to determine the impact of modern innovative tools on the effectiveness of students' physical development in the contemporary educational process. The research methodology included an experiment involving 150 students who received lessons using various interactive technologies. Methods of testing endurance, strength and flexibility were used to assess the physical fitness of students. The results of the study demonstrated that students in the experimental group achieved significant improvements in physical fitness, particularly in endurance and flexibility tests, compared to the control group. The study noted an increase in motivation and satisfaction with the learning process among students who used interactive technologies. The data obtained confirm that interactive teaching methods improve the effectiveness of physical education and can be recommended for implementation in educational practice. The introduction of interactive technologies positively affected students, increasing motivation to engage in physical education and improving overall physical fitness. Students became more involved in the training process using mobile apps to monitor their activity, as well as virtual simulators that made training interesting and accessible. This not only increased interest in physical activities but also formed stable habits of an active lifestyle among students. Technologies that tracked progress and provided individualised recommendations were particularly effective. These technologies enabled students to receive real-time feedback, which greatly increased their motivation and helped them achieve better results in physical education. The effectiveness of interactive technologies in physical education was confirmed, which shows the expediency of using such technologies by physical education teachers in their practice to increase students' motivation and improve their physical fitness

Keywords: modern education; sports training; innovations; educational methods; assessment

Introduction

The physical development of students remains an important aspect of their overall education, as it affects not only physical health but also psychological state and academic performance. Physical education in Ukrainian higher education institutions is often based on traditional teaching methods, which include standardised exercises, regulations and regular physical education classes. However, these approaches do not always incorporate the individual needs of students, their interests and current trends in physical development. The motivation of students to engage in physical activity decreases, which leads to an insufficient level of physical fitness. There is a need to introduce innovative methods aimed at improving the physical development of students. The introduction of modern interactive tools and methods, such as mobile applications for monitoring physical activity, online platforms with personalised training programmes, video tutorials and interactive games, can significantly increase interest in physical education. These innovations improve dynamics, interaction and individualised environment for physical development. It is necessary to create a physical education that develops not only physical abilities but also psychological resilience, discipline and healthy lifestyle skills. Innovative methods make the learning process more interesting and accessible. This contributes to the formation of sustainable motivation for physical education. Given these factors, research and integration of

Suggested Citation: Shapran, O., & Tkachuk, O. (2024). The use of interactive technologies in the physical education process. *Theory and Practice of Physical Culture and Sports*, 3(2), 9-18. doi: 10.69587/tppcs/2.2024.09.

*Corresponding author

innovative technologies into the educational process is essential to improve students' physical development. Solving this problem will make it possible to more effectively adapt physical education to the needs of modern youth and increase its effectiveness.

Many scholars investigated the issue of the use of interactive technologies in physical education, in particular, the study by G. Amina *et al.* (2023) identified different teaching methods in physical education that demonstrate their significant impact on motivation and effectiveness of classes. The study emphasised the importance of interactive technologies in improving the motivation of students to engage in physical education. A. Zhao (2023) emphasised that the use of new technologies encourages students to engage in physical activity more actively, due to interactive elements that make the learning process more interesting and active. X. Hu & J. Li (2024) investigated the impact of digital platforms on the individualisation of physical education. The study demonstrated that such platforms can adapt physical education programmes to the individual needs of each student, which significantly increases the effectiveness of classes. This is especially relevant in the context of different levels of physical development of students when everyone can get a programme that matches their level of training and goals. The importance of mobile applications in monitoring physical activity was studied by O.A. Isaqovich *et al.* (2024). They emphasised that mobile apps not only help students monitor their performance but also influence their motivation to exercise regularly. Users can constantly monitor their progress and adjust their training. Z. Xing & Y. Qi (2023) studied the integration of video tutorials into the educational process and their impact on improving the technical training of students. The study concluded that this method allows students to study in detail the technical aspects of exercises, which improves their practical skills. L. Jian (2024) analysed the use of gamification as a means of increasing students' interest in physical education. The author proved that game elements in the training process increase the appeal of the training process to students, contributing to their greater engagement. The effectiveness of personalised training programmes in the development of the physical performance of students was studied by Z. Lei *et al.* (2024), demonstrating that an individual approach contributes to faster and better results. D.T. Nguyen & M.T. Nguyen (2024) studied the impact of a combined approach that incorporates both traditional and innovative methods to provide a more comprehensive approach to students' physical development, which increases the overall effectiveness of the learning process.

These researchers highlighted the importance of innovative approaches in improving students' physical fitness and motivation and have proposed various methods to achieve these goals. The role of virtual reality in creating a more effective learning environment for physical education has been highlighted, although several issues remain unresolved. These include the optimal integration of innovative methods into traditional physical education systems to ensure their maximum effectiveness. The long-term impact of these technologies on students' physical development and motivation also needs to be investigated in more detail. Thus, this study aimed to identify the impact of modern innovative technologies on the formation of physical culture in students in the modern educational process. The objectives of the study are: to analyse the current state of physical development of students in Ukraine, identifying the main problems and challenges in the system of physical education; to introduce innovative methods and tools in the process of physical education of students and to assess their impact on the physical fitness and motivation of students; to conduct a comparative analysis of the results of physical fitness of students who were taught using traditional methods and innovative technologies and based on the data obtained to provide recommendations for optimising physical education.

Materials and Methods

The study was conducted among students of physical education faculties from several universities. Students were recruited from the following three universities: National University of Ukraine on Physical Education and Sport, Faculty of Physical Education; Ivan Bobersky Lviv State University of Physical Culture, Faculty of Physical Education and Sports; V.N. Karazin Kharkiv National University, Faculty of Physical Education and Sports. Each university provided students from different courses and specialisations of the Faculty of Physical Education to ensure a representative sample. The experimental study in physical education involved third- and fourth-year university students who were studying for a degree in physical education. All participants were informed about the purpose of the study and how their data would be used. This included information about confidentiality and anonymity to ensure compliance with ethical standards. Following the ethical standards of the study, participants were allowed to give their consent to participate and could withdraw at any time without giving any reason (Declaration of Helsinki, 2013).

The experiment involved 150 male students ($N = 150$) divided into two groups: experimental and control. The experimental group consisted of 75 students ($n = 75$) studying in a programme that included interactive technologies (such as online training platforms, video tutorials and mobile applications for monitoring physical activity). The control group, also consisting of 75 students ($n = 75$), continued to study using traditional physical education methods without the introduction of new technologies. The experimental part of the study included the introduction of interactive technologies (online platforms – Nike Training Club and virtual and augmented reality games FitXR) into the educational process during the second semester of the 2023-2024 academic year. The programme included the use of digital platforms to create individual training plans, video tutorials on exercise techniques, and mobile applications to monitor progress.

To evaluate the effectiveness of the methods used, measurements were taken before and after the introduction of interactive technologies that allow students to track their progress in real-time, depending on the speciality they are studying. In addition, the Google Fit and Strava mobile applications were used to motivate students to exercise regularly. The student's physical fitness was measured using standardised testing methods, including the assessment of students' physical fitness using endurance, strength and flexibility tests. Endurance tests – Cooper test (2023) (measuring the maximum distance a student can run in 12

min); running endurance test (running 800 m for women or 1,000 m for men). Strength tests – strength testing (maximum number of pull-ups on the bar or push-ups from the floor); test of maximum strength of the muscles of the lower body (squats with or without a barbell). Flexibility tests, namely of the trunk (reaching toes in a sitting position) and shoulder girdle (diagonal raising of arms behind the back). These tests were used to assess the general physical condition of students, including their endurance, strength and flexibility, and help to compare the results between the experimental and control groups before and after the introduction of interactive technologies. The results were rounded and then analysed using statistical methods to determine the impact of interactive technologies on learning outcomes in physical education.

Results

Theoretical analysis of various interactive technologies in the process of teaching physical education

Interactive technologies in physical education can significantly improve the effectiveness of the learning process and stimulate students' interest in physical activity. These technologies cover a wide range of digital tools that facilitate individualised learning, monitor progress and provide new opportunities for teachers and students. One of the most popular and relevant tools is mobile applications that can be used to track physical activity, create individual training plans, monitor progress and encourage regular exercise. MyFitnessPal, for instance, allows users to keep track of calories, activity and nutrient intake, which helps students better understand their diet and physical activity. Another popular app, Strava, provides the ability to record workouts, competitions and achievements, which increases motivation through the social aspect of the community.

Online fitness platforms also offer significant benefits. Nike Training Club, for example, offers free access to a variety of video tutorials and training programmes. This allows teachers to tailor the material to the individual needs of each student. Students can watch the lessons at the desired pace, which contributes to the flexibility of learning. Video lessons are another important component of interactive technologies in physical education. With video lessons, students watch the correct technique of performing exercises, analyse their mistakes and improve. YouTube and other platforms offer many videos demonstrating various physical exercises and techniques that students can watch several times for better learning. Interactive games make physical education more exciting and less routine. Virtual reality games allow students to train in a fun and dynamic way. These games help to develop coordination, endurance and other physical qualities, making physical education not only useful but also entertaining. Interactive technologies create new opportunities for physical activity, encourage students to play sports and provide an individual approach to learning.

Every year, new technologies are introduced into the education sector. Modern devices, such as computers, tablets and smartphones with constant access to the Internet, have become an integral part of modern life. Education is now closely linked to the latest computer technologies. Multimedia devices and communication tools are increasingly being incorporated into educational processes. However, the rapid development of technology creates new challenges for the educational system, and 3D technology is now a modern trend in educational technology that fully meets the requirements of modern education (Ye *et al.*, 2024). The use of interactive 3D environments for learning is becoming an effective means of transferring and storing knowledge for several reasons: student engagement, visualisation of abstract concepts, individual approach, and increased information retention. The use of interactive technologies in physical education significantly expands the capabilities of traditional teaching methods. They allow for a better individual approach to students, stimulate their activity, increase their interest in classes and help teachers to organise the learning process more effectively. Such technologies can be particularly useful in distance learning, where direct interaction with the teacher is not possible. With the development of technology, its role in physical education is expected to grow, creating new horizons for teachers and students.

In Ukraine, mobile apps and online platforms are the most actively used to monitor and promote physical activity. Mobile apps are particularly popular among students as they provide a convenient and easy way to track physical activity, set personal goals, and receive recommendations and reminders. Such apps allow users to keep workout diaries, track progress, and share achievements with friends or even compete with them. They are often integrated with other platforms, which can be used to utilise data from multiple sources to compile a complete overview of physical activity level. Many apps also have social interaction features that help motivate users through support and competition with other people. With these features, mobile apps have become an important tool in promoting and maintaining a healthy lifestyle among young people in Ukraine.

According to a study by the World Health Organization (2018), about 81% of adolescents worldwide did not reach the recommended level of physical activity, which is at least 60 min a day of moderate to vigorous physical activity. According to data from different countries, this figure is alarming, as insufficient physical activity can lead to health problems such as obesity, diabetes and cardiovascular disease. The integration of modern technologies, such as mobile apps and virtual training, can have a significant impact on students' physical activity levels, increasing their motivation and interest in physical education. These technologies help students to monitor their activity, receive feedback and develop sustainable exercise habits.

The world's leading countries use a range of innovative interactive technologies to improve physical education, which are not yet widespread in Ukraine (Bezkopylnyi *et al.*, 2020). One of these technologies is virtual reality, which can be used to create training programmes and simulations that motivate users to be physically active through game scenarios and virtual sports competitions. Another technology is augmented reality, which integrates digital elements into the real world to help students perform exercises with real-time technique correction. High-tech smart clothing and fitness monitors have also gained popularity; they can track numerous health and fitness parameters, such as heart rate, calorie intake and stress levels. Interactive simulators and robotic systems that adapt to the individual needs of the user are also used to create personalised training programmes. In Ukraine, these technologies

have not yet been widely adopted, and most educational institutions use traditional methods of physical education, which limits the opportunities for individualisation and modernisation of the educational process. The introduction of such advanced technologies could significantly improve the effectiveness of physical education and students' interest in physical education.

The formation of physical culture in Ukrainian universities faces several negative trends that affect the physical development of students. One of the main problems is a decrease in students' motivation to engage in physical education. This is due to the overload of the curriculum, which often leaves little time for regular physical activity. Given the heavy workload, many students consider sports to be of secondary importance and do not pay due attention to it. Another negative trend is the insufficient material and technical base at some universities. Lack of modern sports equipment, limited access to sports grounds and lack of variety in the sports activities offered reduce the attractiveness of physical education for students. In addition, modern lifestyles, characterised by a significant amount of time spent on computers and smartphones, also contribute to a decrease in physical activity among young people. The resulting physical inactivity hurts the overall health and fitness of students. The lack of active activities in everyday life and low awareness of the importance of a healthy lifestyle also contribute to these negative trends. Low motivation, insufficient material resources and a passive lifestyle are the main challenges in the development of physical education among students.

The use of innovative technologies in physical education is becoming increasingly common, as they allow for an individualised approach to learning, tracking students' progress and providing accurate recommendations to improve their physical condition. Mobile apps can offer personalised training programmes based on the individual needs and physical condition of the student. Digital technologies allow tracking not only activity but also the effectiveness of each workout. This allows teachers to tailor lessons for each student based on the data they receive. In Japan, innovative approaches to sports are based on the integration of traditional physical exercises with the latest technologies (Sports culture in Japan, 2023). One example of a technology application is the use of augmented reality in physical education. Virtual reality is used to learn and master new movements and exercises. Simulations can help comprehend the technique of performing exercises, as well as see possible mistakes in the technique. This significantly increases the efficiency of training and helps to avoid injuries. Sensors are actively used to track physical activity. Such sensors can be built into uniforms or shoes and allow trainers to obtain accurate data on motor activity. This data is analysed and used to create individual training plans.

At the same time, the use of innovative technologies in physical education in Ukraine is still underdeveloped. Although some universities and schools are beginning to use digital technologies, their use remains limited. The main problem is the lack of funding and infrastructure, which makes it difficult to integrate the latest technologies into the educational process. To improve the situation, Ukraine should address the experience of other countries and focus on developing the material and technical base of educational institutions. This includes providing schools and universities with modern equipment and developing and implementing digital platforms for monitoring and managing students' physical activity. In addition, it is important to improve the skills of physical education teachers by providing them with access to curricula that focus on the use of innovative technologies in pedagogical practice. It is necessary to consider the possibility of developing public-private partnerships in this area, attracting investments from the private sector to modernise sports infrastructure and introduce the latest technologies. Involving students in the active use of innovations through promotion and motivation could also be an important step. The introduction of innovative technologies in physical education in Ukraine can significantly improve the level of physical fitness of students and make this process more efficient.

Empirical study of the effectiveness of interactive technologies in physical education

The students in the experimental group used a range of interactive technologies to check their progress in physical education. These included online platforms (Nike Training Club) that were used to monitor their classes and progress, as well as to learn exercise techniques, review instructions as many times as necessary, and avoid injury. Virtual and augmented reality games that required active physical activity (FitXR) were used. The Cooper test is a standard endurance test that assesses the aerobic endurance of participants based on the distance they can run in 12 min. The results of the test revealed conclusions, that were used for comparing the level of physical fitness and the ability to prolonged physical activity of the experimental and control groups after a semester of the educational process using different methods (Table 1).

Table 1. Results of the study of both groups by the Cooper test

Aspect	Experimental group	Control group
Average distance	2,900 m	2,700 m
Standard deviation	150 m	180 m
Minimum distance	2,600 m	2,400 m
Maximum distance	3,200 m	3,050 m

Source: compiled by the authors

The experimental group demonstrated higher average results in this test, where participants were able to run 200 m more than the control group. This increase in average distance indicates that the use of interactive methods had a significant positive impact on their aerobic endurance. Increased aerobic endurance was the result of the systematic introduction of new training methods that focus on increasing aerobic load, developing the cardiorespiratory

system and improving running technique. It is important to note that the experimental group showed a smaller variation in results (measured by standard deviation) compared to the control group. This indicates that the new technologies affected all students in this group more evenly, increasing their endurance to a similar level. After using the new techniques, the students had a more equal level of physical fitness, which indicates their effectiveness and versatility for a wide range of participants. In the control group, there was a greater variation in results, which indicates that traditional methods are less effective or have an unequal effect on all participants. This could be attributed to the fact that some students were less sensitive to conventional methods, or that these methods did not accommodate individual physical fitness characteristics. Thus, the lower scores and higher average distance in the experimental group confirm that the new technologies are effective in providing more uniform results regardless of the initial level of students' fitness, which is important for creating equal conditions for all participants. The endurance test in running involves running a certain distance (800 m for women and 1,000 m for men) at maximum speed. This test was used to evaluate the students' ability to withstand intense physical activity at short distances (Table 2).

Table 2. Results of the study of both groups on the endurance test in running

Aspect	Experimental group	Control group
Average time	3 min 30 s	3 min 45 s
Standard deviation	20 s	25 s
Minimum time	3 min 10 s	3 min 20 s
Maximum time	3 min 50 s	4 min 05 s

Source: compiled by the authors

The results of the mentioned test demonstrated the superiority of the experimental group over the control group. The participants of the experimental group achieved an average time that was 15 s faster than the control group. This result is an important indicator, as 15 s over a short distance, such as 800 or 1,000 m, can be decisive in sports competitions, and indicates a marked increase in speed endurance among the participants in this group. Increased speed endurance can be the result of targeted training aimed at developing the ability of the body to run at maximum or submaximum speeds for a certain amount of time. This also included the use of interactive technologies in the educational process and additional endurance training that combined strength and aerobic training, interval running, sprints and other exercises that help to increase the ability of muscles to use oxygen efficiently and recover quickly between intense loads.

The standard deviation of the time in the control group was slightly higher, indicating significant differences in the performance of students in this group. This could indicate that the level of physical fitness of the students in the control group was less homogeneous. These differences were caused by several factors. The control group included students with different initial levels of physical fitness, which affected their results. Traditional training methods in the control group were not sufficiently adapted to these individual characteristics, which led to a greater variation in results. Moreover, the traditional training methods used in the control group did not provide the same level of training for all students. Consequently, some students may have benefited less from these techniques, leading to more significant differences in results.

Therefore, the faster average time in the running endurance test in the experimental group, together with the lower standard deviation, indicates that the new technologies in physical education introduced in this group not only contributed to the improvement of speed endurance but also ensured a more homogeneous level of physical fitness among the participants. In the control group, however, the dispersion of results indicates that the traditional methods did not have as strong or uniform an impact on all participants. This highlights the need to adapt training programmes to the individual needs of students to ensure more effective development of their physical capabilities. The results of the next two tests, namely the maximum number of pull-ups on the bar or push-ups from the floor (to assess the strength of the upper body) and the maximum strength of the lower body muscles (assessed through squats with or without a barbell), was also used to assess the impact of interactive teaching methods on students' physical fitness (Table 3).

Table 3. Results of strength testing of both groups

No.	Element	Experimental group	Control group
1	Average number	25 repetitions	20 repetitions
	Standard deviation	5 repetitions	6 repetitions
	Minimum number	15 repetitions	10 repetitions
	Maximum number	35 repetitions	32 repetitions
2	Average weight	80 kg	70 kg
	Standard deviation	10 kg	12 kg
	Minimum weight	60 kg	50 kg
	Maximum weight	100 kg	90 kg

Source: compiled by the authors

The results of the upper body strength test demonstrate a significant advantage of the experimental group, which used interactive technologies in the process of teaching physical education. The average number of repetitions in this group was 25, which is 5 repetitions more than in the control group. This may indicate that interactive teaching methods contributed to more effective development of upper-body muscle strength. Interactive technologies included the use of special programmes and mobile applications that allowed students to receive instant feedback on their exercise technique and correct their movements in real-time. This increased students' motivation and engagement in the training process, which led to better results. The lower standard deviation in the experimental group (5 repetitions versus 6 repetitions in the control group) also indicates a more uniform level of training among students. This indicated that the interactive technology provided a more personalised approach to training, allowing each student to train at their optimum level.

The students in the experimental group also demonstrated better results in the test of maximum lower-body muscle strength. The average weight lifted by students in this group was 10 kg more than in the control group. This suggests that the interactive technologies contributed to a better understanding and execution of the squat technique and therefore led to greater strength gains. The interactive technologies included video tutorials with detailed demonstrations of the correct squatting technique, which helped students avoid mistakes and get the most out of their training. In addition, real-time progression tracking further motivated students to improve their results. The lower standard deviation in the experimental group (10 kg compared to 12 kg in the control group) indicated that interactive training methods contributed to a more uniform strength development among all students in this group. This indicates that such technologies can be used to adapt the training process to the individual needs of each participant, providing them with optimal conditions for achieving maximum results.

The results of the strength tests demonstrated that students in the experimental group who used interactive technologies in their physical education classes achieved better results in both the upper body strength test and the lower body strength test. The higher mean scores and lower variance of the results indicate that these technologies were more effective in improving students' physical fitness than the traditional teaching methods used in the control group. These findings suggest that interactive technologies can significantly improve the effectiveness of physical education teaching by providing an individualised approach, increased student motivation and engagement, and better results in muscle strength development. This highlights the potential of interactive methods as a substantial tool for modernising and improving physical education curricula. For the final analysis of the use of interactive technologies in physical education, tests were conducted on trunk flexibility (reaching toes in a sitting position) and shoulder girdle flexibility (diagonal raising of arms behind the back). The results of these tests are presented in Table 4.

Table 4. Results of the assessment of flexibility of students in both groups

No.	Aspect	Experimental group	Control group
1	Average distance	+15 cm	+10 cm
	Standard deviation	3 cm	4 cm
	Minimum distance	+5 cm	0 cm
	Maximum distance	+25 cm	+20 cm
2	Average distance between hands	+5 cm	8 cm
	Standard deviation	2 cm	3 cm
	Minimum distance	0 cm	3 cm
	Maximum distance	+10 cm	+15 cm

Source: compiled by the authors

The results of the trunk flexibility test indicate an advantage for the experimental group, which demonstrated an average result of +15 cm, which is 5 cm more than the control group. This indicates that the interactive technologies used in the training process significantly impacted body flexibility. Interactive technologies included the use of video instructions for the correct stretches, which helped students to better understand and perform flexibility exercises. Programmes or apps could also be used to enable students to track their progress and receive real-time feedback, which contributed to better results. The smaller standard deviation in the experimental group (3 cm in contrast to 4 cm in the control group) also indicates that interactive technologies contributed to a more even development of flexibility across all students. This suggests that these technologies may have helped to create more personalised flexibility programmes that were effective for all participants in the experimental group.

The shoulder girdle flexibility test demonstrated that students in the experimental group also performed better, with an average distance of 5 cm between their hands. This suggests that interactive technologies also had a positive impact on this flexibility, helping students to better develop this important physical characteristic. These technologies included the use of specialised shoulder girdle flexibility exercises presented in the form of video tutorials and interactive instructions, which facilitated the correct execution of movements and helped students achieve better results. The smaller standard deviation in the experimental group (2 cm compared to 3 cm in the control group) indicates that the interactive technology programmes were effective for a wide range of students, providing them with a level playing

field for improving flexibility. Therefore, the results demonstrated that students in the experimental group who used interactive technologies achieved better results compared to the control group. The higher average scores and lower variance of results indicate that these technologies contributed to improved student flexibility, providing a more personalised and effective approach to physical education. This highlighted the potential of interactive technologies to enhance physical education curricula, enabling more effective learning and development of students' physical abilities.

Discussion

The results of the study demonstrated that with the increasing availability of technological solutions, such as mobile applications, and virtual and augmented reality, new opportunities are emerging to improve the efficiency and motivation of students, especially in physical education classes. Motivation is a key factor in successful learning, especially in the context of physical activity. The results of this study confirm that interactive technologies can significantly increase students' motivation to engage in physical education. According to the study, students who used interactive technologies such as fitness trackers, physical activity tracking apps, and virtual simulators demonstrated higher levels of interest and active participation in classes compared to those who engaged in traditional methods. These findings correlate with those of other researchers who have also noted the positive impact of technology on motivation to engage in physical activity, including a study by O. Bezkopylnyi *et al.* (2020) that identified the use of mobile apps to track physical activity as a way to increase students' motivation by allowing them to visualise their achievements and progress. Another researcher, S. Yadav (2024), revealed that interactive games aimed at physical activity can significantly increase children's interest in physical education, particularly among primary school students. The conclusions of these studies are confirmed by the data obtained in the current study.

Interactive technologies not only increase the motivation of students but also significantly improve technical skills and physical performance. In particular, the study demonstrated that the use of technologies such as virtual simulators and video analytics of movements allows students to master the technique of performing various physical exercises much faster. This is achieved through the ability to practice movements in a controlled environment, which repeating the exercises as many times as necessary to achieve the desired result. Such training helps students to learn the correct technique in detail and correct mistakes early on in their training. These findings are consistent with the results of a study by Y. Niu (2023), which demonstrated that the use of video analytics allows students to analyse individual movements and make the necessary adjustments, which speeds up the process of mastering the technique. Furthermore, a study by Y. Li & M. Jawis (2024) and M. Müller *et al.* (2024) confirmed that interactive technologies contribute not only to the development of technical skills but also to the improvement of physical indicators such as endurance, strength, and flexibility. This is facilitated by the ability to receive instant feedback and correct actions quickly and promptly. Therefore, interactive technologies are key to modern physical education, providing students with tools that not only make the learning process more engaging but also help them achieve high results in a shorter time. Interactive technologies also help to increase the level of interaction and collaboration among students during physical education classes. According to a study, the integration of technologies that allow students to work in teams helps to develop social skills and increase classroom cohesion. This can be achieved through technologies such as interactive games or team sports applications where each student can contribute to the overall team performance. These results are consistent with the findings of G. Lampropoulos & K. Kinshuk (2024) and C. Li *et al.* (2024), who indicated that the use of interactive technologies in team sports increases the level of interaction between students and the development of cooperation skills. Research by W. Tarng *et al.* (2024) confirmed that technologies that allow learners to participate in virtual competitions or group exercises can significantly increase social inclusion and contribute to a positive learning environment. It is important to consider the challenges associated with the introduction of interactive technologies, such as unequal access to technology and the risks of reducing direct physical activity. These aspects require additional attention from teachers and school administrators to ensure equal opportunities for all students.

However, despite the numerous advantages of interactive technologies, it is also worth noting some of the challenges and limitations associated with their implementation in the process of physical education. Other studies, such as A. Ponmalar *et al.* (2022), X. Wang (2024) and R.A. González-Rivas *et al.* (2024), highlighted the problem of the digital divide, which can hinder the effective implementation of interactive technologies in the learning process. Studies conducted by M. Kuleva (2024) and R. Zhu *et al.* (2024) noted that in conditions of limited access to technology, interactive methods may even increase the difference in physical fitness between students from different social and economic groups. Some researchers, namely J. Xu (2024), A.C. De Araújo *et al.* (2024), and N. Yannier *et al.* (2024), highlighted that excessive use of technology in physical education can lead to a decrease in the level of direct physical activity. M. Herczeg (2024) and B. Carter-Thuillier *et al.* (2024) noted that an over-reliance on interactive technologies can reduce the time students spend on outdoor activities, which can negatively affect their overall physical condition.

An important component of the successful implementation of interactive technologies in the process of teaching physical education is the correct pedagogical approach. According to the results of this study, the most effective pedagogical strategies are those that combine traditional teaching methods with interactive technologies. This maximises the benefits of both approaches and provides optimal conditions for students' development. These findings correlate with those of A. Istenič (2021) and Q. He *et al.* (2024), who emphasised the importance of combining interactive technologies with traditional teaching methods to achieve the best results in physical education. The authors noted that technologies can only be effective if they are integrated into the pedagogical process, based on the age and individual characteristics of students, as well as the specifics of the educational material. Another important

aspect is teacher training in the use of interactive technologies. The study identified that the success of technology implementation largely depends on the competence and readiness of teachers to change the educational process. Teachers with a sufficient level of technical knowledge and skills are more successful in incorporating technology into their classes, which is also confirmed by M.S. Alsaeed & M.K. Aladil (2024) and L. Ge *et al.* (2024). The use of interactive technologies in physical education has significant potential to improve the quality of education, increase student motivation and physical performance, and improve technical skills and physical performance, which contribute to the development of social skills through collaboration and interaction. The results of this study are consistent with the findings of previous studies, confirming the effectiveness of integrating technology into physical education. However, it is worth remembering that to maximise the use of technology, it is necessary to address the challenges associated with its implementation and apply individualised approaches to learning. The successful implementation of interactive technologies in physical education depends on teacher training, ensuring equal access to technology and a comprehensive approach to the integration of the latest technological tools into the learning process.

Conclusions

The use of innovative technologies in physical education is an important element of modern education, which allows not only to improve the level of physical fitness of students but also to make this process more exciting and effective. The introduction of digital platforms, apps for monitoring physical activity, and the integration of the latest technologies such as virtual reality and augmented reality can significantly improve the results of physical education. In Ukraine, the process of introducing these innovations is just beginning and faces numerous challenges, including insufficient funding and weak material and technical base of educational institutions. This limits the possibility of widespread use of modern technologies in physical education, which affects the overall level of physical education among students. To overcome these problems, it is necessary to modernise the infrastructure, provide educational institutions with modern equipment, and improve the skills of physical education teachers. Involving the private sector through public-private partnerships could be an important step to expand funding opportunities and innovations.

A comparison of the results of both groups in two different endurance tests concluded that the experimental training methods contributed to the improvement of students' physical fitness. The experimental group demonstrated better results in both the Cooper test and the running endurance test. This indicates an increase in overall endurance, both in the context of prolonged physical activity (Cooper test) and in speed and power characteristics (800/1,000 m run). The results of strength tests showed that students of the experimental group who used interactive technologies in physical education classes showed higher results in tests of upper and lower body strength. With an average distance of 5 cm between their hands, students in the experimental group outperformed students in the control group in the shoulder girdle flexibility test. The above test results demonstrate that the students of the experimental group, which used interactive technologies, outperformed the students of the control group. A promising direction is to study the economic feasibility of introducing interactive technologies in physical education. This includes estimating the costs of implementing technologies and comparing them with traditional teaching methods.

Acknowledgements

None.

Conflict of Interest

None.

References

[1] Alsaeed, M.S., & Aladil, M.K. (2024). Digital and physical interactive learning environments: Early childhood mathematics teachers' beliefs about technology through reflective writing. *Education Sciences*, 14(5), article number 517. doi: 10.3390/educsci14050517.

[2] Amina, G., Maati, S., Chakli, A., Sefri, Y., & Chafiq, N. (2023). Rapid learning in the teaching of physical education and sport. In N. Chafiq, P. Cummins, K. Al-Qatawneh & I. El Imadi (Eds.), *Navigating virtual worlds and the metaverse for enhanced e-learning* (pp. 225-233). Hershey: IGI Global Scientific Publishing. doi: 10.4018/979-8-3693-1034-2.ch011.

[3] Bezkopylnyi, O., Bazylchuk, O., Sushchenko, L., Bazylchuk, V., Dutchak, Yu., & Ostapenko, H. (2020). Peculiarities of application of interactive educational technologies in training of future teachers of physical culture to work with health protection in secondary school. *Journal of Physical Education and Sport*, 20(1), 291-297. doi: 10.7752/jpes.2020.s1040.

[4] Carter-Thuillier, B., López-Pastor, V., Gallardo-Fuentes, F., Ramirez-Campillo, R., del Río-Soto, C., & Sortwell, A. (2024). Intercultural training and attitudes of physical education teachers towards immigrant students in Chile: A multi-stakeholder perspective. *Social Sciences & Humanities Open*, 10, article number 101044. doi: 10.1016/j.ssaho.2024.101044.

[5] Cooper test. (2023). Retrieved from https://runners.com.ua/test-kupera/.

[6] De Araújo, A.C., Xavier, K.S., Moya-Mata, I., da Costa, A.Q., Canon-Buitrago, E.A., de Oliveira, B.N., & de Carvalho, R.S. (2024). Digital technology in national curricula: A dialogue among Ibero American countries. *Frontiers in Sports and Active Living*, 6, article number 1355967. doi: 10.3389/fspor.2024.1355967.

[7] Declaration of Helsinki. (2013). Retrieved from https://surl.li/rwrztk.

[8] Ge, L., Li, M., & Ning, C. (2024). Modern software and physical education: Can online training enhance gym training? *BMC Medical Education*, 24, article number 419. doi: 10.1186/s12909-024-05345-x.

[9] González-Rivas, R.A., Núñez Enriquez, O., Marttinen, R., Baena-Extremera, A., Zueck-Enríquez, M.C., & Gastélum-Cuadras, G. (2024). Including an adventure education training program in physical education teacher education programs. *Journal of Experiential Education*, 47(3), 358-379. doi: 10.1177/10538259231200583.

[10] He, Q., Chen, H., & Mo, X. (2024). Practical application of interactive AI technology based on visual analysis in the professional system of physical education in universities. *Heliyon*, 10(3), article number e24627. doi: 10.1016/j.heliyon.2024.e24627.
[11] Herczeg, M. (2024). The role of digital technologies and human-computer interaction for the future of education. *I-com*, 23(2), 239-247. doi: 10.1515/icom-2024-0008.
[12] Hu, X., & Li, J. (2024). Research on the integrated solution of physical education based on smart campus. *Advances in Physiology Education*, 48(2), 378-384. doi: 10.1152/advan.00006.2024.
[13] Isaqovich, O.A., Olimovich, M.M., Uralovich, T.B., Xolmuradovna, T.S., Ananth, C., & Kumar, T.A. (2024). Fitfuturo: Empowering tomorrow's athletes – a mobile application for future physical education preparation. In *2024 ninth international conference on science technology engineering and mathematics (ICONSTEM)* (pp. 1-6). Chennai: IEEE. doi: 10.1109/ICONSTEM60960.2024.10568641.
[14] Istenič, A. (2021). Shifting to digital during COVID-19: Are teachers empowered to give voice to students? *Educational Technology Research and Development*, 69, 43-46. doi: 10.1007/s11423-021-09956-9.
[15] Jian, L. (2024). Analysis of the quality of PE classroom teaching with multimedia technology. *International Journal of High-Speed Electronics and Systems*. doi: 10.1142/S0129156424400810.
[16] Kuleva, M. (2024). Exploring the integration of virtual reality in physical education: A comprehensive review. *Environment. Technology. Resources*, 2, 197-201. doi: 10.17770/etr2024vol2.8057.
[17] Lampropoulos, G., & Kinshuk, K. (2024). Virtual reality and gamification in education: A systematic review. *Educational Technology Research and Development*, 72, 1691-1785. doi: 10.1007/s11423-024-10351-3.
[18] Lei, Z., Zhou, H., Hu, W., Liu, G.-P., & Guan, S. (2024). Web-based digital twin communication system of power systems for training and education. *IEEE Transactions on Power Systems*, 39(2), 3592-3602. doi: 10.1109/TPWRS.2023.3308510.
[19] Li, C., Cao, Y., & Lv, J. (2024). Design and implementation of a physical education teaching and training mode management system. *Entertainment Computing*, 50, article number 100684. doi: 10.1016/j.entcom.2024.100684.
[20] Li, Y., & Jawis, M. (2024). Construction and effect of interactive teaching methods in the college badminton classroom using fuzzy-assisted virtual reality modeling: A case study in Chinese universities. *Journal of Fuzzy Extension and Applications*, 5(2), 199-222. doi: 10.22105/jfea.2024.449386.1421.
[21] Müller, M., Otero, N., & Milrad, M. (2024). Guiding the design and implementation of interactive public displays in educational settings. *Journal of Computers in Education*, 11, 823-854. doi: 10.1007/s40692-023-00280-0.
[22] Nguyen, D.T., & Nguyen, M.T. (2024). Evaluating the effectiveness of online physical education teaching toward students at Ho Chi Minh City University of Technology and Education, Vietnam. *Annals of Applied Sport Science*, 12, article number e1252. doi: 10.61186/aassjournal.1252.
[23] Niu, Y. (2023). Integrated physical education and medicine in general physical education at universities in the age of educational technologies. *BMC Medical Education*, 23, article number 466. doi: 10.1186/s12909-023-04440-9.
[24] Ponmalar, A., Uma, M., Kaviyaraj, R., & Vijay Priya, V. (2022). Augmented reality in education: An interactive way to learn. In *2022 1st international conference on computational science and technology (ICCST)* (pp. 872-877). Chennai: IEEE. doi: 10.1109/ICCST55948.2022.10040368.
[25] Sports culture in Japan. (2023). Retrieved from https://louvoyage-us.com/blogs/japanese-history-traditions/sports-culture-in-japan-the-intersection-of-tradition-innovation-and-excellence?srsltid=AfmBOorkZeLF9SLoZWloMiRLuu2kEusVgMZFx2_rvYhDHtYiFfIDt0Ye.
[26] Tarng, W., Wu, Y.-J., Ye, L.-Y., Tang, C.-W., Lu, Y.-C., Wang, T.-L., & Li, C.-L. (2024). Application of virtual reality in developing the digital twin for an integrated robot learning system. *Electronics*, 13(14), article number 2848. doi: 10.3390/electronics13142848.
[27] Wang, X. (2024). Application of interactive object model in sports teaching. *International Journal of High-Speed Electronics and Systems*. doi: 10.1142/S0129156424400871.
[28] World Health Organization. (2018). *Global action plan on physical activity 2018-2030: More active people for a healthier world*. Geneva: World Health Organization.
[29] Xing, Z., & Qi, Y. (2023). Development of creativity in physical education teachers using interactive technologies: Involvement and collaboration. *Education and Information Technologies*, 28, 5763-5777. doi: 10.1007/s10639-022-11422-9.
[30] Xu, J. (2024). Analysis and improvement of the application of playground sports posture detection technology in physical education teaching and training. *EAI Endorsed Transactions on Pervasive Health and Technology*, 10. doi: 10.4108/eetpht.10.5161.
[31] Yadav, S. (2024). Empowering educators with augmented and virtual reality: Integrating AR and VR for enhanced interactive learning environment. In J. Braman, A. Brown & M. Richards (Eds.), *Reshaping learning with next generation educational technologies* (pp. 72-86). Hershey: IGI Global Scientific Publishing. doi: 10.4018/979-8-3693-1310-7.ch005.
[32] Yannier, N., Hudson, S.E., Chang, H., & Kenneth, R.K. (2024). AI adaptivity in a mixed-reality system improves learning. *International Journal of Artificial Intelligence in Education*, 34, 1541-1558. doi: 10.1007/s40593-023-00388-5.
[33] Ye, SH., Onpium, P., & Ying, F. (2024). The effectiveness of a 3D interactive learning environment as a mechanism for sharing and retaining knowledge. *Scientific Bulletin of Mukachevo State University. Series "Pedagogy and Psychology"*, 10(2), 17-28. doi: 10.52534/msu-pp2.2024.17.

[34] Zhao, A. (2023). Restricted hidden Markov model based innovation in physical learning education with computer internet technology. *International Journal on Recent and Innovation Trends in Computing and Communication*, 11(6), 207-216. doi: 10.17762/ijritcc.v11i6s.6823.
[35] Zhu, R., Tian, X., & Xu, G. (2024). Application of multimedia man-machine interaction in college physical education teaching. *Journal of Cases on Information Technology (JCIT)*, 26(1). doi: 10.4018/JCIT.341588.

Використання інтерактивних технологій у процесі навчання фізичної культури

Ольга Шапран

Доктор педагогічних наук, професор
Університет Григорія Сковороди в Переяславі
08401, вул. Сухомлинського, 30, м. Переяслав, Україна
https://orcid.org/0000-0002-7514-6632

Олексій Ткачук

Викладач
Університет Григорія Сковороди в Переяславі
08401, вул. Сухомлинського, 30, м. Переяслав, Україна
https://orcid.org/0009-0004-5257-1240

Анотація. Метою дослідження було з'ясувати вплив сучасних інноваційних інструментів на ефективність фізичного розвитку студентів у сучасному освітньому процесі. Методологія дослідження включала експеримент, у якому взяли участь 150 студентів, які навчалися із використанням різних видів інтерактивних технологій. Для оцінки фізичної підготовленості студентів використовувалися методики тестування на витривалість, силу та гнучкість. Результати дослідження показали, що студенти експериментальної групи продемонстрували значне покращення у фізичній підготовці порівняно з контрольною групою, зокрема в тестах на витривалість та гнучкість. У дослідженні відзначалося підвищення рівня мотивації і задоволення навчальним процесом серед студентів, які використовували інтерактивні технології. Отримані дані підтверджують, що інтерактивні методи навчання позитивно впливають на ефективність фізичного виховання і можуть бути рекомендовані для впровадження в освітню практику. Впровадження інтерактивних технологій мало значний позитивний вплив на студентів, сприяючи підвищенню їхньої мотивації до занять фізичною культурою та покращенню загальної фізичної підготовки. Студенти стали більш залученими в процес тренувань завдяки використанню мобільних додатків для контролю за активністю, а також віртуальних тренажерів, які робили тренування цікавими та доступними. Це дозволило не тільки підвищити інтерес до фізичних занять, але й сформувати в студентів стійкі звички до активного способу життя. Особливо ефективними були технології, що відстежували прогрес і надавали індивідуальні рекомендації. Завдяки цим технологіям студенти мали можливість отримувати зворотний зв'язок у реальному часі, що значно підвищувало їхню мотивацію та сприяло досягненню кращих результатів у фізичному вихованні. Підтверджено ефективність інтерактивних технологій у фізичному вихованні, що показує доцільність застосування таких технологій викладачами фізичної культури у своїй практиці для підвищення мотивації студентів та покращення їхньої фізичної підготовки

Ключові слова: сучасна освіта; спортивна підготовка; інновації; освітні методики; оцінювання