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EFFECTIVENESS OF A HYBRID FORMAT OF TEACHING ATHLETIC GYMNASTICS TO STUDENTS USING MOBILE FITNESS APPLICATIONS AND DIGITAL TECHNOLOGIES

Abstract

The article presents a comparative analysis of the effectiveness of hybrid learning formats in athletic gymnastics using mobile fitness applications and digital technologies. The aim of the study was to determine the impact of a combination of full-time and distance learning on the level of physical fitness, motivation, and engagement of second-year students in the Physical Education and Sports educational program. The research methods included a pedagogical experiment, questionnaires, physical fitness testing, and analysis of fitness tracker data. The results indicate that the use of mobile applications and online platforms increases students' independent activity, improves monitoring of training loads, and enhances motivation for physical exercise. The findings demonstrate that hybrid learning is more effective than traditional teaching methods in the discipline «Theory and Methods of Athletic Gymnastics». The practical significance lies in the possibility of implementing the developed model in higher education institutions.

Keywords: athletic gymnastics, blended learning, mobile applications, digital technologies, students' physical fitness, fitness trackers.

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СТУДЕНТТЕРДІ АТЛЕТИКАЛЫҚ ГИМНАСТИКАҒА МОБИЛЬДІ ФИТНЕС-ҚОСЫМШАЛАР МЕН ЦИФРЛЫҚ ТЕХНОЛОГИЯЛАРДЫ ҚОЛДАНА ОҚЫТУДЫҢ ГИБРИДТІ ФОРМАТЫНЫҢ ТИІМДІЛІГІ

Аңдатпа

Мақалада мобильді фитнес-қосымшалар мен цифрлық технологияларды қолдану арқылы атлетикалық гимнастиканы оқытудың гибриді форматтарының тиімділігі салыстырмалы талдау жасалды. Зерттеудің мақсаты – «Дене шынықтыру және спорт» білім беру бағдарламасының екінші курс студенттерінің дене дайындық деңгейіне, мотивациясына және оқу үрдісіне қатысу белсенділігіне дәстүрлі және қашықтықтан оқытудың үйлестіре жүргізудің әсерін анықтау болды. Зерттеу барысында педагогикалық эксперимент, сауалнама жүргізу, дене дайындығын тестілеу және фитнес-трекер деректерін талдау әдістері қолданылды. Нәтижелер мобильді қосымшалар мен онлайн-

платформаларды пайдалану студенттердің өзіндік белсенділігін арттырып, жаттығу жүктемесін тиімді бақылауға мүмкіндік беретінін көрсетті. Сонымен қатар, білім алушылардың сабаққа қызығушылығы мен тұрақты мотивациясы артқаны анықталды. Алынған нәтижелер гибридіті оқыту форматының «Атлетикалық гимнастиканың теориясы мен әдістемесі» пәнін оқытудың дәстүрлі тәсілдеріне қарағанда анағұрлым тиімді екенін көрсетеді. Жұмыстың практикалық маңыздылығы ұсынылған модельді жоғары оқу орындарының білім беру үрдісіне енгізуге мүмкін екендігін көрсетеді.

Түйін сөздер: атлетикалық гимнастика, гибридіті оқыту, мобильді қосымшалар, цифрлық технологиялар, студенттердің дене дайындығы, фитнес-трекерлер.

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ЭФФЕКТИВНОСТЬ ГИБРИДНОГО ФОРМАТА ОБУЧЕНИЯ СТУДЕНТОВ АТЛЕТИЧЕСКОЙ ГИМНАСТИКЕ С ПРИМЕНЕНИЕМ МОБИЛЬНЫХ ФИТНЕС- ПРИЛОЖЕНИЙ И ЦИФРОВЫХ ТЕХНОЛОГИЙ

Аннотация

В статье представлен сравнительный анализ эффективности гибридных форматов обучения атлетической гимнастике с использованием фитнес-приложений и цифровых технологий. Цель исследования - определить влияние сочетания очного и дистанционного обучения на уровень физической подготовленности, мотивацию и вовлеченность студентов второго курса образовательной программы «Физическая культура и спорт». В ходе исследования применялись методы педагогического эксперимента, анкетирования, тестирования физической подготовленности и анализа данных фитнес-трекеров. Установлено, что использование мобильных приложений и онлайн-платформ способствует повышению самостоятельной активности обучающихся, улучшению контроля тренировочных нагрузок и формированию устойчивой мотивации к занятиям. Полученные результаты свидетельствуют о более высокой эффективности гибридного обучения по сравнению с традиционными формами преподавания дисциплины «Теория и методика атлетической гимнастики». Практическая значимость работы заключается в возможности внедрения разработанной модели в образовательный процесс учреждений высшего образования.

Ключевые слова: атлетическая гимнастика, гибридное обучение, мобильные приложения, цифровые технологии, физическая подготовка студентов, фитнес-трекеры.

Introduction. In the context of the digital transformation of higher education and the rapid development of information and communication technologies, attention is increasingly focused on finding effective pedagogical models for teaching physical education and sports. Contemporary research documents a shift from traditional forms of organizing the educational process to the integration of digital platforms, mobile applications, and remote interaction technologies. Thus, Chen et al. (2023) note that blended learning formats in physical education can increase student engagement and provide flexibility in the educational environment. According to Lupton (2021), the active use of digital technologies by young people to monitor their physical activity and health creates the preconditions for their pedagogical use in the educational process.

Research by Souza et al. (2023) shows that wearable devices and mobile fitness applications expand the possibilities for monitoring motor activity and individualizing training loads. The works of Tagimaucia et al. (2024) emphasize that the transition to online and hybrid teaching of physical education requires a revision of methodological approaches and the development of new models of interaction between teachers and students. At the same time, Peters (2025) points out the need to update the content of physical education taking into account modern social and technological challenges, which presupposes a transition from traditional sports-oriented practices to more flexible educational formats.

Accumulated scientific data indicate the emergence of a new paradigm in physical education, in which digital technologies are viewed as a tool for increasing the effectiveness of the educational process and the independent activity of students.

In recent years, the scientific literature has increasingly focused on the role of digital technologies, artificial intelligence, and data analysis in the training of athletes and students in physical education and sports. Modern research shows that the use of artificial intelligence and machine learning technologies can optimize the training process, increase the effectiveness of physical training and reduce the risk of injury, as reflected in the works of Baladaniya and Choudhary (2025), Nashwan et al. (2026), and Van Eetvelde et al. (2021).

Machine learning methods are used to predict sports injuries, assess the functional state and monitor the load of athletes, which opens up new possibilities for individualization of training programs, as noted by Ren et al. (2024). The development of real-time physical activity monitoring systems based on deep learning technologies, as noted by Reis et al. (2024), helps to increase the accuracy of monitoring the training process and allows for prompt adjustment of loads. The use of external load analysis and digital sensory data, according to Musat et al. (2024) and Meng and Qiao (2023), is also considered as an important tool for improving the effectiveness of training and preventing overfatigue. Researchers Ibáñez et al. (2022), as well as Frevel et al. (2022), note that the digitalization of sports and physical education is transforming traditional approaches to education, creating the preconditions for the introduction of personalized educational models and hybrid forms of training. In addition, according to Rommers et al. (2020) and Glebova et al. (2024), the influence of artificial intelligence and digital technologies on the development of the sports industry and the labor market requires the formation of new competencies in future specialists related to the use of digital tools in the training process. Thus, the integration of mobile fitness apps, digital platforms, and artificial intelligence elements into the educational process is seen as a key area for modernizing physical education and training specialists in the field of sports.

Despite a significant amount of research devoted to the digitalization of physical education and the use of artificial intelligence technologies in sports training, a number of aspects of the application of hybrid learning formats in the training of physical education specialists remain insufficiently studied. In particular, the scientific literature is underrepresented in studies analyzing the effectiveness of integrating mobile fitness applications and digital platforms into the teaching of athletic gymnastics in higher education settings. Limited attention has also been paid to a comparative analysis of traditional and hybrid learning models in terms of their impact on students' physical activity levels, learning motivation, and independent training activities. These circumstances determine the need for further study of the pedagogical potential of hybrid educational models in the system of training future specialists in the field of physical education and sports.

The relevance of the article is determined by the need to analyze the effectiveness of hybrid formats for teaching athletic gymnastics in the context of the digitalization of higher education and the expanding use of mobile fitness applications and online platforms in the educational process. The introduction of digital technologies into the training of physical education and sports specialists opens up new opportunities for individualizing the training process, monitoring physical activity, and increasing student motivation for independent study. Comparison of traditional and hybrid learning models allows us to identify optimal pedagogical approaches that improve the quality of professional training and foster a sustainable need for physical improvement. Assessing the potential of mobile applications and wearable devices from the perspective of modern pedagogy helps determine the prospects for their integration into the educational programs of higher education institutions.

The aim of the study is to experimentally substantiate the effectiveness of a hybrid format for teaching athletic gymnastics using mobile fitness applications in improving the level of physical fitness, motivation, and academic activity of students.

Research objectives:

1. To analyze modern scientific research on the problem of digitalization of physical education and the use of hybrid forms of teaching athletic gymnastics.

2. To develop and implement a hybrid training model for athletic gymnastics using mobile fitness applications.

3. To experimentally evaluate the effectiveness of the proposed model in the process of training students of the educational program «Physical Education and Sports».

Materials and Methods. The study was conducted at the Kazakh National University of Sports among second-year students of the educational program «Physical Education and Sports». The experiment involved 48 students who were divided into control and experimental groups.

The methodological basis of the study was formed by the principles of physical education theory, digitalization of education, and the concept of hybrid learning, which involves combining traditional in-person classes with the use of digital technologies and mobile applications.

Research methods. The study utilized a combination of complementary methods:

1. Theoretical methods: analysis and generalization of scientific and methodological literature on the problem of digitalization of physical education, the use of mobile fitness applications and hybrid forms of education.

2. Pedagogical experiment: In the experimental group, athletic gymnastics classes were conducted in a hybrid format, including: in-person training under the guidance of a teacher; independent student work using mobile fitness apps; physical activity monitoring using digital trackers; online consultations and monitoring of assignment completion. The control group studied using the traditional method.

3. Methods for assessing physical fitness: testing strength, speed-strength indicators and general endurance.

4. Survey: to determine the level of academic motivation, interest in classes and students' attitudes towards the use of mobile technologies in education.

5. Fitness tracker data analysis: assessment of physical activity volume, training frequency, and load dynamics.

6. Methods of mathematical statistics were used to process the obtained results and determine the reliability of differences between groups. The mean values of the indicators, standard deviations and the increase in results were calculated. To assess the reliability of differences between groups, Student's t-test was used at a significance level of $p \leq 0,05$. Statistical processing was performed using Microsoft Excel and SPSS software.

Organization and procedure of the study. The experiment was conducted over the course of one academic semester at the Kazakh National University of Sports. The study involved 48 second-year students of the educational program «Physical Education and Sports» aged 18–20 years. Participants were divided into control ($n = 24$) and experimental ($n = 24$) groups. In the control group, classes were conducted according to the traditional program, while in the experimental group, classes were conducted according to a developed hybrid learning model, which included the use of mobile fitness applications, online platforms, and fitness trackers for independent work.

As part of the hybrid format for athletic gymnastics training, the experimental group utilized mobile fitness apps to provide digital support for the training process and students' independent work. Since the study participants did not have wearable fitness devices (bracelets or smartwatches), only smartphone-based applications were used.

To track strength training loads and monitor the completion of training tasks, mobile training diary applications (JEFIT, FitNotes, and similar ones) were used, allowing one to record the number of training sessions, the list of exercises, the number of sets and repetitions. This provided the opportunity to analyze the dynamics of training volume and the regularity of classes in the distance learning portion.

To monitor overall physical activity, we used built-in smartphone physical activity tracking systems (Google Fit for Android devices and Apple Health for iOS devices), which allow us to record the number of steps, duration of physical activity, and the number of training sessions. These indicators were used as additional objective criteria for students' involvement in independent physical exercise outside of class.

Control of exercise technique in a remote format was carried out through video recording of students' training sessions, which were then transferred to the teacher for analysis and correction. This approach

provided feedback and made it possible to maintain methodological support for the training process in a hybrid learning environment.

The use of mobile fitness apps in combination with in-person classes has enabled the implementation of a hybrid learning model aimed at increasing student independence, training regularity, and the effectiveness of physical training.

It should be noted that the introduction of mobile fitness applications into the educational process not only ensures the organization of independent training activities, but also the development of digital self-regulation skills in students. The use of digital training diaries, automatic activity recording, and progress visualization allows students to more consciously plan their physical activity and analyze the results of their own physical activity. Such tools increase the level of responsibility for completing training tasks and promote the development of self-organization skills, which is an important component of the professional training of future specialists in the field of physical education and sports.

Results. The results of the experiment demonstrated the positive impact of a hybrid format for teaching athletic gymnastics using mobile fitness applications on students' physical fitness, academic motivation, and activity levels. Analysis of the results of testing strength, speed-strength qualities and endurance revealed positive dynamics in both groups, however, the increase in indicators in the experimental group was statistically significantly higher.

To objectively evaluate the effectiveness of the proposed model, comparative testing of physical fitness indicators was conducted in the control and experimental groups before and after the experiment. The results obtained are presented in Table 1.

Table 1 – Dynamics of physical fitness indicators of students in the control and experimental groups

Test exercises	Group	Before the experiment ($M \pm m$)	After the experiment ($M \pm m$)	Growth, %
Pull-ups on the bar (number of times)	Control	$7,8 \pm 0,4$	$8,9 \pm 0,5$	+14,1
Pull-ups on the bar (number of times)	Experimental	$7,6 \pm 0,5$	$9,8 \pm 0,4$	+28,9
Push-ups (number of reps)	Control	$28,4 \pm 1,2$	$32,1 \pm 1,4$	+13,0
Push-ups (number of reps)	Experimental	$27,9 \pm 1,3$	$36,5 \pm 1,2$	+30,8
Plank (sec)	Control	$78,5 \pm 3,1$	$89,6 \pm 3,4$	+14,1
Plank (sec)	Experimental	$77,9 \pm 2,8$	$101,4 \pm 3,0$	+30,2

As can be seen from the data in Table 1, in both groups there is a positive trend in physical fitness indicators, which indicates the effectiveness of systematic athletic gymnastics training. However, the increase in results in the experimental group was significantly higher for all test exercises.

In the pull-up test, the control group's performance increased from $7,8 \pm 0,4$ to $8,9 \pm 0,5$ times (an increase of 14,1 %), while in the experimental group it increased from $7,6 \pm 0,5$ to $9,8 \pm 0,4$ times (an increase of 28,9 %). A similar trend was revealed in the «push-ups» exercise: in the control group, the results increased from $28,4 \pm 1,2$ to $32,1 \pm 1,4$ times (13,0 %), in the experimental group - from $27,9 \pm 1,3$ to $36,5 \pm 1,2$ times (30,8 %).

The most pronounced differences were observed in the static strength endurance test («plank»). In the control group, the retention time increased from $78,5 \pm 3,1$ to $89,6 \pm 3,4$ seconds (14,1 %), while in the experimental group it increased from $77,9 \pm 2,8$ to $101,4 \pm 3,0$ seconds (30,2 %).

To assess the statistical significance of differences between the indicators of the control and experimental groups, a comparative analysis of the results was carried out using Student's t-test. Calculations made it possible to determine the reliability of the impact of the hybrid learning format on the level of physical fitness of students. The results of the statistical analysis are presented in Table 2.

Table 2 – Statistical significance of differences in physical fitness indicators of students in the control and experimental groups after the experiment

Test exercise	Student's t-test	Significance level (p)	Reliability of differences	Interpretation
Pull-ups on the bar	2,31	$\leq 0,05$	Reliable	The experimental group outperforms the control group
Push-ups	2,87	$\leq 0,05$	Reliable	A significant advantage of hybrid learning
Plank	2,65	$\leq 0,05$	Reliable	Significant improvement in strength endurance

The obtained results confirm that the use of a hybrid training format using mobile fitness applications contributes to a more significant development of students' strength and endurance qualities compared to the traditional method.

Statistical processing showed the reliability of differences between groups ($p \leq 0,05$), which indicates the effectiveness of the developed model.

The results indicate that the use of mobile fitness apps and digital training support contributes to increased student self-activity, consistent assignment completion, and more effective monitoring of training loads. Statistical processing of the data showed the reliability of differences between the groups ($p \leq 0,05$), which confirms the effectiveness of the developed model of hybrid training in athletic gymnastics.

Dynamics of academic motivation and engagement. Survey results showed a significant increase in motivation for athletic gymnastics among students in the experimental group. Following the experiment, the proportion of students demonstrating a sustained interest in physical exercise increased, their willingness to complete independent training assignments increased, and their appreciation of the importance of digital technologies in education increased.

To assess changes in students' learning motivation and engagement, a survey was conducted before and after the pedagogical experiment. Analysis of the obtained data allowed us to identify the dynamics of students' attitudes towards athletic gymnastics classes and the use of digital technologies in the educational process, which is reflected in Fig. 1.

The survey was conducted among students of the experimental group before and after the completion of the pedagogical experiment. The questionnaire used closed-ended questions reflecting the level of interest in athletic gymnastics, readiness for independent training, regularity of completing assignments, attitudes toward the use of mobile fitness applications, and an assessment of the role of digital technologies in learning. The figures shown in the figure reflect the percentage of students who selected positive answers to the corresponding questions in the questionnaire.

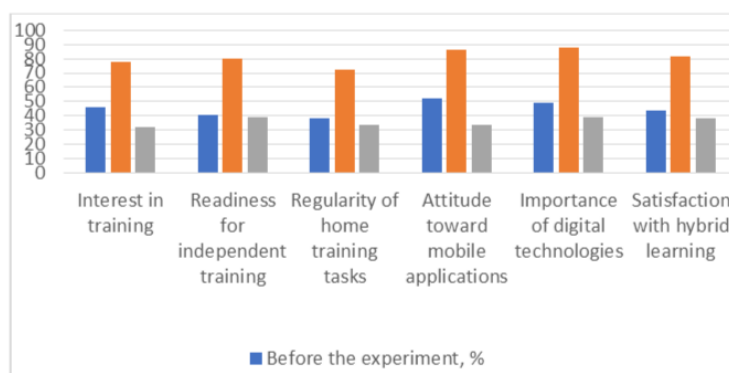


Figure 1 – Dynamics of indicators of academic motivation and involvement of students in the experimental group before and after the introduction of the hybrid format of teaching athletic gymnastics

As Figure 1 clearly demonstrates, after the introduction of the hybrid learning format, a significant increase in all indicators of student learning motivation and engagement was observed in the experimental group. Thus, the level of interest in athletic gymnastics increased from 46 % to 78 % (an increase of 32 %), readiness for independent training sessions - from 40 % to 80 % (an increase of 40 %), and the regularity of completing homework - from 38 % to 72 % (an increase of 34 %). The most significant increase was noted in the parameters of attitude towards mobile fitness applications (from 52 % to 85 %, an increase of 33 %) and assessment of the role of digital technologies in education (from 49 % to 88 %, an increase of 39 %), which indicates the formation of a stable attitude towards independent physical education and sports activities and the transition from external motivation to internal motivation.

The indicators of regularity in completing independent assignments have increased significantly, indicating an increase in discipline, responsibility, and self-control skills in educational and training activities. This may be due to the ability of mobile apps to record training results, provide reminders, and visualize progress, which enhances the feedback effect and helps form a habit of systematic exercise. At the same time, the level of satisfaction with the hybrid learning format increased from 44 % to 82 % (an increase of 38 %), indicating a positive student perception of the combination of in-person classes with digital support and remote teacher support.

The growing proportion of students demonstrating a sustained interest in athletic gymnastics confirms that the use of mobile fitness apps and online platforms is an effective means of pedagogical motivation. Digital tools provide a variety of training tasks, individualized workload, and the ability to track personal achievements, which increases students' emotional engagement in the learning process. Taken together, the data obtained indicate that the hybrid learning format not only improves physical fitness, but also develops a sustainable motivational and value-based approach to regular physical education, which is an important condition for the professional training of future specialists in the field of physical education and sports.

Most participants in the experimental group noted that the use of mobile fitness applications had a significant positive impact on the organization of their training activities and attitude towards athletic gymnastics. Students say digital tools have made the training process more structured, visual, and manageable, something that was previously difficult with traditional learning methods. The apps acted as a kind of personal assistant, providing load planning, recording completed exercises, and tracking the dynamics of results.

Students emphasized that mobile apps help them monitor their training process by allowing them to record the number of workouts, duration of sessions, volume of exercises performed, and rest intervals. Having visual statistics and training history contributed to a more conscious approach to training and an understanding of one's own physical capabilities. Furthermore, regular reminders and notifications encouraged regular exercise, creating a sustainable habit of systematic exercise even outside of class.

Students placed particular emphasis on the fact that using applications increases personal responsibility for results. The ability to independently track progress, compare current results with previous ones, and see real changes in physical fitness increased internal motivation and the desire for self-improvement. Thus, digital technologies have become a factor in the development of self-regulation and independence of students in educational and training activities.

In the control group, where classes were conducted using traditional methods without the active use of mobile applications, changes in motivation were less pronounced. Students in this group were less likely to report an increased interest in independent training and the need to systematically monitor their own results. The lack of digital support tools limited self-monitoring and reduced the level of engagement in the training process outside of teacher-led classes. This confirms that the introduction of mobile fitness applications into the hybrid learning structure contributes to the development of more sustainable learning motivation and responsibility for one's own physical fitness.

To assess changes in the level of independent physical activity of students, an analysis of data from mobile fitness applications and built-in smartphone activity monitoring systems was

conducted. A comparative analysis of the indicators of the control and experimental groups made it possible to determine the impact of the hybrid training format on the regularity of training, the total volume of physical activity, and the development of self-control skills. The results obtained are presented in Table 3.

Table 3 – Indicators of students' independent activity

Indicator	Group	Before the experiment ($M \pm m$)	After the experiment ($M \pm m$)	Growth, %
Frequency of independent training (times/week)	Control	$1,8 \pm 0,2$	$2,1 \pm 0,3$	+16,7
Frequency of independent training (times/week)	Experimental	$1,7 \pm 0,2$	$3,0 \pm 0,2$	+76,5
Total volume of physical activity (min/week)	Control	145 ± 8	162 ± 9	+11,7
Total volume of physical activity (min/week)	Experimental	148 ± 7	205 ± 8	+38,5
Regularity of task completion (%)	Control	$62,4 \pm 3,1$	$69,2 \pm 3,4$	+10,9
Regularity of task completion (%)	Experimental	$63,1 \pm 3,0$	$85,6 \pm 2,8$	+35,7
Self-control level (points)	Control	$3,2 \pm 0,2$	$3,6 \pm 0,2$	+12,5
Self-control level (points)	Experimental	$3,1 \pm 0,2$	$4,3 \pm 0,2$	+38,7

As can be seen from the data in Table 3, in the experimental group, during the period of the pedagogical experiment, a significantly more pronounced increase in the indicators of independent activity of students was recorded compared to the control group. The most significant changes were noted in the frequency of independent training outside of classes: in the experimental group, this indicator increased from $1,7 \pm 0,2$ to $3,0 \pm 0,2$ times per week (an increase of 76,5 %), while in the control group it increased only from $1,8 \pm 0,2$ to $2,1 \pm 0,3$ times per week (an increase of 16,7 %). This indicates the development of a sustainable need for regular physical activity among students who studied using the hybrid model.

Similar dynamics are observed in the indicator of the total volume of physical activity, reflecting the total time of physical activity during the week. In the experimental group, the volume of activity increased from 148 ± 7 to 205 ± 8 min/week (an increase of 38,5 %), while in the control group it increased from 145 ± 8 to 162 ± 9 min/week (an increase of 11,7 %). The use of mobile fitness apps and digital training diaries contributed to more conscious planning of activities and an even distribution of the load, while in the control group, activity remained predominantly episodic.

The increase in the indicators of regularity of completing training tasks and the level of self-control in the experimental group also turned out to be significantly higher. The regularity of completing tasks increased from $63,1 \pm 3,0$ to $85,6 \pm 2,8$ % (an increase of 35,7 %), while in the control group it increased from $62,4 \pm 3,1$ to $69,2 \pm 3,4$ % (an increase of 10,9 %). The level of self-control increased from $3,1 \pm 0,2$ to $4,3 \pm 0,2$ points (an increase of 38,7 %) compared to an increase from $3,2 \pm 0,2$ to $3,6 \pm 0,2$ points (an increase of 12,5 %) in the control group. The ability to record results, track progress, and receive feedback from the teacher increased students' responsibility for their own results and contributed to the development of self-regulation.

The data obtained confirm that the inclusion of mobile fitness applications in the hybrid learning structure not only increases the volume of independent physical activity, but also forms stable behavioral attitudes towards regular physical exercise. The obtained results also allow us to consider mobile fitness applications as a means of developing a culture of independent physical activity among students. The ability to track individual workload indicators, training duration, and physical fitness dynamics helps students develop a more responsible attitude toward their own physical condition. Furthermore, digital tools allow teachers to obtain additional information about the nature and scope of students' independent activities, which expands the possibilities for pedagogical supervision and

individualization of the educational process. This allows us to consider digital technologies as an effective tool for pedagogical support of students' independent work in physical education and sports disciplines.

Effectiveness of remote training support. The use of video recordings of exercises and online consultations ensured continuous pedagogical supervision and methodological support of the training process during distance learning. Students in the experimental group regularly recorded their performance of training exercises on video and sent the materials to the instructor, which created conditions for individual analysis of technique, identification of errors, and subsequent adjustment of exercises. This format of interaction ensured the maintenance of feedback and made it possible to compensate for the lack of direct, in-person observation of the execution of movements.

It should be noted that the use of digital feedback tools in the educational process helps develop students' skills of reflection and analysis of their own motor activity. Watching videos of their own workouts and then discussing them with the instructor allows students to more consciously approach exercises, identify technical errors, and adjust their training actions. This contributes to increasing the effectiveness of mastering motor skills and the formation of professionally significant competencies of future specialists in the field of physical education and sports.

Analysis of video materials showed positive dynamics in the acquisition of basic athletic gymnastics techniques by students in the experimental group. The most significant improvements were recorded in the indicators of correct starting position, range of motion, breathing control and coordination of efforts during strength exercises. Systematic receipt of recommendations from the teacher contributed to students' conscious attitude towards the quality of assignment completion and the development of self-control skills for exercise technique.

Online consultations, conducted via video and text comments, allowed us to quickly answer students' questions, clarify exercise techniques, and adjust individual training programs. As a result, remote support has become not only a means of control but also a tool for pedagogical support aimed at increasing the effectiveness of independent study.

The data obtained indicate that the use of video recordings of training sessions in combination with remote consultations provides the opportunity for high-quality methodological guidance of the educational and training process even in the absence of face-to-face interaction. This confirms the potential of digital technologies as an effective tool for organizing hybrid learning in physical education and sports disciplines and allows us to consider distance learning as a full-fledged component of the educational model.

Overall assessment of the effectiveness of the hybrid model. A comparative analysis of the results of the control and experimental groups showed that the introduction of a hybrid format for teaching athletic gymnastics using mobile fitness applications has a comprehensive positive impact on the key indicators of the educational and training process. In the experimental group, a more pronounced improvement in the physical fitness of students was noted, which was manifested in a significant increase in strength, speed-strength and endurance indicators compared to the traditional education system. This demonstrates the high effectiveness of combining in-person classes with independent training activities supported by digital monitoring and load planning tools.

Along with the physical indicators, the hybrid model contributed to a significant increase in students' academic motivation. The use of mobile apps, online platforms, and remote training support increased students' interest in classes, fostered a positive attitude toward the learning process, and strengthened their sense of personal responsibility for their physical fitness results. Students in the experimental group demonstrated higher levels of engagement, willingness to complete independent assignments, and a desire to exercise regularly.

An important result was the strengthening of students' independent activity. The ability to record training metrics, track progress, and receive feedback from the instructor encouraged systematic study outside of class hours and contributed to the development of self-regulation skills. Furthermore, the hybrid format has expanded the possibilities for individualizing the training process, allowing us to take

into account students' level of physical fitness, their pace of mastering exercises, and personal training goals.

It is important to note that the use of hybrid educational models in physical education and sports training allows for the integration of the advantages of traditional and digital forms of education. In-person classes provide direct pedagogical interaction, exercise technique monitoring, and motor skill development, while digital technologies expand opportunities for individualized training, activity monitoring, and independent student work. As a result, a more flexible educational environment is created, promoting the development of sustainable self-regulation skills and responsibility for the results of one's own physical training.

The obtained results confirm the proposed research hypothesis regarding the higher effectiveness of the hybrid format of athletic gymnastics training using mobile fitness applications compared to traditional forms of organizing classes. The comprehensive impact of digital technologies on students' physical fitness, motivation, and independent activity allows us to consider the hybrid model as a promising direction for modernizing the educational process in the system of training specialists in physical education and sports.

Discussion. The obtained results of the study with quantitative indicators confirm the effectiveness of the implementation of a hybrid format for teaching athletic gymnastics using mobile fitness applications, which is consistent with modern research in the field of digitalization of physical education and the use of mobile technologies in sports training. The most convincing differences between groups were found in terms of physical fitness. Thus, the increase in results in the experimental group was 28.9% in pull-ups (from 7.6 ± 0.5 to 9.8 ± 0.4 times), 30.8% in push-ups (from 27.9 ± 1.3 to 36.5 ± 1.2 times) and 30.2% in the plank exercise (from 77.9 ± 2.8 to 101.4 ± 3.0 s), while in the control group the increase did not exceed 13.0-14.1%. Statistical analysis confirmed the reliability of differences between groups ($t = 2.31-2.87$; $p \leq 0.05$), which indicates a significant impact of the hybrid model on the development of strength and endurance of students.

The obtained results are consistent with the findings of a number of modern studies devoted to the use of hybrid and digital technologies in the physical education system. Thus, in a systematic review by Chen et al. (2023, p. 7), it is noted that the introduction of blended forms of learning in physical education contributes to an increase in student engagement and the effectiveness of the educational process. Similar conclusions are presented in the works of Souza et al. (2023, p. 17), where it is emphasized that the use of wearable devices and mobile applications allows for improved monitoring of physical activity and individualization of training loads. The studies of Tagimaucia et al. (2024, p. 134) also indicate that the integration of digital technologies into the educational process contributes to the formation of new pedagogical models of interaction between teachers and students. The results obtained in this study extend these findings by demonstrating that the use of mobile fitness applications in a hybrid learning structure has a positive impact not only on students' physical fitness but also on their level of academic motivation and independent activity.

Another important aspect is that the use of digital technologies in physical education helps students develop skills for independent management of training activities. In the current context of training specialists in physical education and sports, the development of such competencies is considered a necessary condition for professional mobility and readiness to use digital tools in future teaching practice.

Significant changes have also been recorded in the indicators of academic motivation, which also confirms the results of studies indicating the positive impact of digital technologies and mobile applications on the involvement of students in physical education and sports activities (Lupton, 2021, p. 4). According to the survey data, interest in athletic gymnastics classes in the experimental group increased from 46% to 78%, readiness for independent training - from 40% to 80%, regularity of completing tasks - from 38% to 72%. Particularly significant growth was noted in the indicators of attitudes towards mobile fitness applications (from 52% to 85%) and assessment of the role of digital technologies in education (from 49% to 88%), which indicates the formation of a stable internal motivation for physical education.

Analysis of students' independent activity also confirmed the benefits of hybrid learning, which is consistent with the results of studies on the use of digital physical activity monitoring systems and data analysis technologies in sports training (Reis et al., 2024; Ren et al., 2024; Van Eetvelde et al., 2021). The frequency of independent training in the experimental group increased from 1.7 ± 0.2 to 3.0 ± 0.2 times per week (an increase of 76.5%), the total volume of physical activity – from 148 ± 7 to 205 ± 8 min/week (38.5%), the regularity of completing tasks – from 63.1 ± 3.0 to $85.6 \pm 2.8\%$ (35.7%), the level of self-control – from 3.1 ± 0.2 to 4.3 ± 0.2 points (38.7%). In the control group, similar indicators increased by only 10.9-16.7%, which indicates the limited effectiveness of the traditional training format in developing independent training skills.

The obtained data allow us to conclude that digital support of the training process contributes not only to the improvement of physical performance, but also to the development of self-regulation, responsibility and a sustainable need for regular physical activity, which is confirmed by modern studies of the influence of digital technologies and artificial intelligence on the development of sports and physical education (Glebova et al., 2024, p. 5). Remote support via video recording of exercises and online consultations ensured the maintenance of methodological control and contributed to the improvement of exercise technique, confirming the possibility of effective pedagogical support even outside the classroom.

Empirical evidence demonstrates that the integration of mobile applications into physical education classes serves as an effective tool for enhancing students' physical and motivational activity. The results of the pedagogical experiment revealed a positive dynamic in the physical fitness levels of the experimental group, while students' engagement in classes nearly doubled according to a 10-point motivational scale (Batyashova et al., 2025).

Overall, the results of the study are consistent with modern ideas about the need to move towards personalized and technologically supported models of physical education. A hybrid learning format that combines in-person classes with mobile apps and remote feedback demonstrates significant potential for improving the quality of training for future physical education and sports professionals. The limitations of the study include a relatively small sample ($n = 48$) and the experiment being conducted over one semester, which suggests the need for further research with an expanded participant pool and longer observation period.

Conclusion. The results of the study confirmed the achievement of the stated goal - to experimentally validate the effectiveness of a hybrid athletic training format using mobile fitness apps in improving students' physical fitness, motivation, and academic performance. The findings indicate that combining in-person training with digital support for the training process results in higher results than the traditional training model.

The implementation of the first task, aimed at analyzing scientific research on the digitalization of physical education, made it possible to substantiate the need to introduce hybrid forms of education as a promising direction for modernizing the training of specialists in the field of physical education and sports. The second objective - developing and implementing a hybrid learning model - resulted in the creation of a pedagogical system that included the use of mobile training diary applications, remote consultations, and video monitoring of exercise technique. The third task - the experimental evaluation of the effectiveness of the proposed model - was solved through a comparative analysis of the indicators of the control and experimental groups.

Experimental data showed that in the experimental group the increase in strength and endurance indicators was about 29-31%, while in the control group it was about 13-14%. The level of educational motivation increased by an average of 32-40%, and the indicators of independent activity increased by up to 35-76% depending on the criterion (frequency of training, volume of physical activity, regularity of completing tasks). Statistical processing confirmed the reliability of differences between groups ($p \leq 0.05$), which indicates a significant impact of the hybrid learning model on student learning outcomes.

Thus, the use of mobile fitness apps, digital platforms, and remote training support not only improves physical fitness but also develops sustainable motivation, independence, and self-control skills in

students. The obtained results confirm that the hybrid format of sports training using mobile fitness applications is effective for students majoring in physical culture and sports, as it contributes to improving their physical fitness, learning motivation, and independent activity. The obtained results allow us to consider the hybrid learning format as an effective means of improving the quality of the educational process in physical education and sports disciplines and as a promising direction for the further development of the higher physical education system.

Prospects for further research include expanding the participant sample, increasing the duration of the pedagogical experiment, and exploring the possibilities of integrating a wider range of digital technologies, including intelligent training data analysis systems and automated physical activity monitoring platforms. This will allow for a more complete assessment of the pedagogical potential of digitalization of the educational process in the system of training specialists in physical education and sports.

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ФИЗИЧЕСКАЯ И ТЕХНИЧЕСКАЯ ПОДГОТОВЛЕННОСТЬ СТУДЕНТОК ВОЛЕЙБОЛИСТОК В КАЧЕСТВЕ ФАКТОРОВ СОВЕРШЕНСТВОВАНИЯ СТУДЕНЧЕСКОГО СПОРТА

Аннотация

В статье охарактеризованы результаты по исследованию готовности физической и технической направленности студенток-волейболисток. В проекте участвовало 20 студенток 18-20 летнего возраста, являющихся членами сборной команды университета. Они обладали стажем тренировки от трех до пяти лет, имели спортивный разряд от первого до кандидата в мастера спорта. Подготовленность специального характера оценивалась по следующим тестам. Прыжок вертикального типа вверх с места с отталкиванием двумя ногами; динамометрия станового характера; бег 92 м с изменением направления (Елочка); наклон вперед; выпрыгивание вдаль с места, выбрасывание мяча набивного типа. Для определения технико-тактической подготовленности волейболисток выявлялись показатели объема подачи; объема приема подачи; приема передач; нападающих ударов; объема блокирования.

Выявлена специфика корреляционной взаимосвязи между параметрами готовности специального и технического характера спортсменок. Взаимодействие с отрицательной направленностью определено среди динамометрии станового характера, наклоном вперед и оптимальностью подачи количественного характера. По другим компонентам готовности специального характера выявлено взаимодействие положительного типа. Разработана методология развития готовности специального и технического характера студенток, занимающихся волейболом, как причин совершенствования спорта студенток. Предложен путь, направленный на внедрение физического воспитания со спортивно ориентированным типом на уроках по предмету «физическое воспитание». Для развития готовности специального характера даны задания, ориентированные на исправление недочетов в передачах, подачах, приеме мяча, удара атакующего стиля. По окончании опыта выявлены изменения позитивного характера по всем параметрам готовности специального и технического характера студенток.

Ключевые слова: волейболистки, специальная подготовленность, техническая подготовленность, корреляционная взаимосвязь, студенческий спорт