PHYSICAL EDUCATION

https://doi.org/10.31489/3081-0531/2025-1-1/5-11
UDC 378- 004.9
Received: 03.06.2025 | Accepted: 19.06.2025

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Integrating music mobile applications into students' physical education classes

This article examines the integration of music mobile applications into the educational process within the discipline of Physical Education among university students. A comprehensive analysis of current research was conducted, focusing on the effects of musical accompaniment on students' cognitive, emotional, and physiological responses during physical activity. The experimental study involved 60 students, divided into control and experimental groups. During the trial phase, mobile applications were used to personalize music track selection based on genre, tempo, and rhythm according to individual student preferences. The results demonstrated a significant increase in student engagement and improvement in emotional state. Positive changes were observed in anxiety levels and negative attitudes toward physical education classes. The subjective perception of physical exertion in the experimental group shifted toward a favorable range, suitable for cardio and aerobic training. Integrating music mobile applications into physical education practice encourages a positive attitude toward physical activity, enhances student involvement, and helps develop a sustainable habit of maintaining a healthy lifestyle. The implementation of modern digital solutions, such as music-based mobile applications, contributes to the individualization of the educational process by making physical education more responsive to each student's needs. The findings of this pedagogical study confirm that the integration of mobile technologies supports the modernization of traditional approaches to teaching physical education, expands the range of educational tools, and increases students' motivation to engage in regular physical activity.

Keywords: digitalization, motivation, music mobile applications, Fit Radio, PANAS, positive affect, negative psychological affect, Borg Scale, subjective perception of physical exertion.

Introduction

Kazakhstan's national strategy for digitalization is a fundamental pillar of contemporary development, particularly in the context of economic growth and improvements in citizens' quality of life. President Kassym-Jomart Tokayev emphasizes that in order to enhance competitiveness and optimize service delivery, digitalization must be employed as a tool for ensuring the country's sustainable internal development.

Over the past decade, digitalization has been actively incorporated into the country's educational landscape, facilitating the modernization of teaching practices and enhancing both the accessibility and quality of educational services. For instance, electronic textbooks for school students are now widely used and available on specialized platforms — currently 11 publisher platforms are providing access to 704 educational resources. Additionally, the digital platform *Kundelik.kz* functions as an electronic documentation system for educational institutions and other participants in the learning process.

Digital transformation in higher education in Kazakhstan is progressing in three main directions:

- modernization of the educational process (e.g., the "smart university" concept);
- enhancement of teaching quality (e.g., high-tech studios for recording lectures and conducting online lessons);

- alignment with international standards (e.g., integration of the global Coursera platform, offering 853 online courses).

The relevance of this study is determined by the integration of digital technologies into the practice of physical education and sports (PES) for university students, which necessitates the development of innovative strategies aimed at increasing students' motivation and engagement in the educational process.

Digitalization in the field of PES involves the comprehensive implementation of information and communication technologies (ICT) for the following purposes:

- optimization of training processes;
- enhancement of student motivation for physical education and sports;
- analysis of performance indicators.

For consumers in the field of motor activity (MA), the digital services market offers a wide range of options:

− mobile applications (MAs) and wearable devices (e.g., Apple Watch, Xiaomi Mi Band, Garmin fitness trackers; MyFitnessPal, Strava, Nike Training Club) provide biofeedback functionality;

− online platforms for physical activity (PA) (e.g., Zoom, YouTube, "Fizkultura Online", LesMills+) or interactive trainers (e.g., Peloton, Zwift);

− digital diaries and monitoring systems (e.g., the platform "Fizkultura.kz");

− VR/AR technologies (virtual and augmented reality) for simulating game situations, spatial orientation, and reaction improvement;

− Big Data and analytics in elite sports. For example, HUDL, Catapult programs for optimizing athlete training and recovery.

Integration of ICT allows the implementation of new digital tools into the educational process of physical education (PE) for personalized learning and athletic training of students. Personal productivity in PE classes depends on individual motivation. Motivation is defined as a combination of internal and external human drives. Within the framework of pedagogical science, motivation is a dynamic component of learning that influences the acquisition of knowledge, skills, and the formation of value orientations in the field of PE.

The effectiveness of PE classes depends on intrinsic motivation: interest, enjoyment, and self-realization. From a psychological perspective, motivation drives individuals to perform specific actions. In the context of physical activity, motivation serves several functions:

− motor. Motivation stimulates physical activity among participants. Intrinsic motivation is represented by the pursuit of self-development, the need for self-improvement, and concern for health. Extrinsic motivation includes social approval, status enhancement, rewards, or the avoidance of punishment;

− regulatory. Motivation sets priorities and goals, regulates behavior, and helps to optimally allocate physical effort during training;

− cognitive. For example, it improves memory, sharpens attention, and contributes to clear perception of information, which enables more effective learning during PE classes;

− emotional. Interest and enjoyment from PA contribute to emotional regulation and enhance the overall quality of classes.

In the context of motivational functions, music mobile applications (MMAs) can stimulate student engagement in physical education (PE) classes. From a physiological perspective, listening to music activates various areas of the brain, including the cerebral cortex, the limbic system, and the cerebellum. According to studies by Petri Toiviainen (University of Jyväskylä, Finland), conducted in the laboratory of cognitive neuroscience using magnetic resonance imaging (MRI), it has been proven that listening to music activates different areas of the brain (pleasure centers, memory, motor areas, and the prefrontal cortex). Several publications from Harvard Medical School (USA) report that regular music training or playing musical instruments develops memory, speech, analytical and mathematical abilities, thereby influencing a person's cognitive capacities.

The influence of music on the emotional sphere has been demonstrated in studies conducted at the University of Southern California (USC, USA) in the laboratory of Antonio Damasio. Researchers confirmed that music can elicit persistent emotional responses by engaging the amygdala (emotion centers), reducing stress, anxiety, and even pain sensations.

Professor Susan Hallam (Research Center for Music & Science, University of Oxford, UK) studied the effect of background music on cognitive functions. According to her review, music can either improve or impair attention and memory, depending on the type of music and listener preferences. For example, the well-known Mozart Effect study (Gordon Shaw, University of California, Irvine) [1] showed that listening to

 ISSN 3081-0531 (Print) ISSN 3081-054X (Online)

Mozart's music temporarily improves spatial reasoning, but the effect was overestimated and is now considered minor and short-lived. Numerous publications by Robert J. Zatorre (McGill University, Canada) support the claim that music triggers dopamine release, which is responsible for the sensation of pleasure and joy [2].

Most researchers agree that music can elicit emotional responses, influence overall mood, and affect motivational levels. The selection of specific musical rhythms can contribute to increased productivity, reduced fatigue, or have a relaxing effect. In experiments conducted by faculty at Wilfrid Laurier University in Canada, it was demonstrated that lyrical and calm music has a relaxing impact on individuals by reducing cortisol levels. To achieve this effect, it is necessary to select music with a tempo of 60–80 beats per minute; this rhythm is most "harmonious" with the human heartbeat and promotes calmness, rest, or soft concentration. Classical music (e.g., Bach, Mozart, Vivaldi) is characterized by regular rhythm and harmonious melodies that help relieve tension and improve psycho-emotional well-being. Accordingly, music with a clear rhythm and energetic tempo (pop, rock, electronic music) increases alertness and motivation and makes it easier to perform repetitive tasks. The greatest effect is achieved when the listener enjoys the music — personal preferences amplify emotional and cognitive responses. Therefore, the integration of MMAs into the physical education process is one of the promising areas for the application of digital technologies in PE classes [3].

Musical accompaniment of PA can have a positive impact on the psychophysiological state of participants, improving mood, reducing the perception of fatigue, increasing performance, and enhancing resistance to stress factors. In 2016, Clark, I. N., Baker, F. A., and Peiris, C. L., in their meta-analysis "Music interventions and physical activity," noted that using MMAs during aerobic training led to increased heart rate, reduced perceived exertion, and greater enjoyment of the activity. In 2020, Silva-Batista C., in studies on the effect of music-movement synchronization through mobile applications during group workouts, demonstrated an increase in group performance efficiency and improvement in participants' psycho-emotional condition [4].

In the context of the educational environment, especially among the student audience with a high level of digital literacy and a tendency to use mobile devices, the integration of mobile applications (MAs) into PE classes appears both appropriate and scientifically justified. Despite the high level of technological infrastructure in educational institutions and the active development of mobile platforms, scientific research aimed at evaluating the effectiveness of such integration remains at an early stage. This highlights the need to analyze various aspects of using music-based MAs in students' physical education activities.

The purpose of the study is to identify and assess the impact of integrating music mobile applications on the psychophysiological parameters of students during physical education classes.

Research Objectives:

- to systematize and summarize data on the influence of music on a person's psychophysiological and emotional state;
- to develop an experimental methodology for the study: to form student groups, select suitable music mobile applications (MMAs), and determine the evidence base;
- to assess and analyze changes in the psychophysiological condition of the participants;
- to formulate conclusions and practical recommendations.

The expected outcome is the confirmation of the hypothesis regarding the positive impact of integrating MMAs into students' physical activity, leading to increased motivation for PE and improved psychophysiological well-being.

Methods and materials

The study on the integration of music mobile applications (MMAs) into the physical education (PE) process of university students employed a combination of methods that allowed for an objective assessment of the impact of digital technologies on the psychophysiological condition of the participants.

To examine and synthesize existing scholarly publications relevant to the research topic and to develop the methodological framework, the method of analysis of scientific and methodological sources was used. Methods of systematization, evaluation, and comparison were applied to define the functional capabilities and to select the most suitable MMAs among ten music applications: Spotify, Yandex Music, SoundCloud, Apple Music, Deezer, Fit Radio, RockMyRun, Music for Fitness, Jabra Sport Life, and Peloton.

Based on criteria, such as functional convenience and operational reliability, five applications were selected for the study:

1) Spotify — the largest music streaming platform, enabling the creation of themed playlists for various types of physical activity (e.g., cardio, strength training, yoga); features personalized recommendation algorithms and integration with fitness trackers;

2) Fit Radio — a specialized fitness music application that offers curated playlists with optimal BPM for different workouts, along with timers and voice coaching;

3) RockMyRun — an application that generates special music mixes for running, walking, and training; it automatically adjusts to the heart rate rhythm, helping to maintain motivation and proper pace;

4) Deezer — a platform with a wide range of sport-oriented playlists; allows offline playback and supports integration with fitness devices;

5) Peloton — a well-known fitness application with music support, offering playlists for strength and cardio workouts, audio coaching sessions with music, and real-time feedback.

For the integration of a music mobile application (MMA) into students' physical education activities, we selected **Fit Radio** due to its optimal user-friendliness and intuitive interface.

To actively influence the study subject, a **pedagogical experiment** was conducted with the aim of testing the hypothesis and evaluating the effectiveness of MMA implementation. To substantiate the findings, two groups were formed: an **experimental group** and a **control group**, each consisting of 30 first-year students from the Faculty of Humanities and Social Sciences at *Torayghyrov University* (Pavlodar, Kazakhstan). The experimental procedure involved the use of **sociological methods** (observation, interviews) and **psychological methods** (questionnaires). The final conclusions were based on objective data validated through surveys using the **PANAS questionnaire** (Positive and Negative Affect Schedule) and the **Borg Scale**, followed by mathematical processing of the results. To formulate conclusions and recommendations, methods of **synthesis, induction**, and **generalization** were applied. The materials included **personal mobile devices** were used to access the **Fit Radio** application. Individual playlists were created within the MMA based on the personal music preferences of the participants.

Additional tools included the **PANAS questionnaire,** the **Borg Rating of Perceived Exertion (RPE) Scale,** a **computer with data processing software,** and **software for statistical analysis**.

Results and Discussion

1) The PANAS questionnaire measures the balance of Positive Affect (PA) and Negative Affect (NA) — a spectrum of emotional states (effect). It was developed in 1988 by D. Watson, L. Clark, and A. Tellegen, and later adapted into Russian by E.N. Osin in 2012 [5].

Students were given a questionnaire containing a list of adjectives describing various feelings and emotions, which they were asked to evaluate using a 5-point Likert scale (short-term version), reflecting their emotional state at the moment of the class [6–8]. The results are presented in Figure 1.

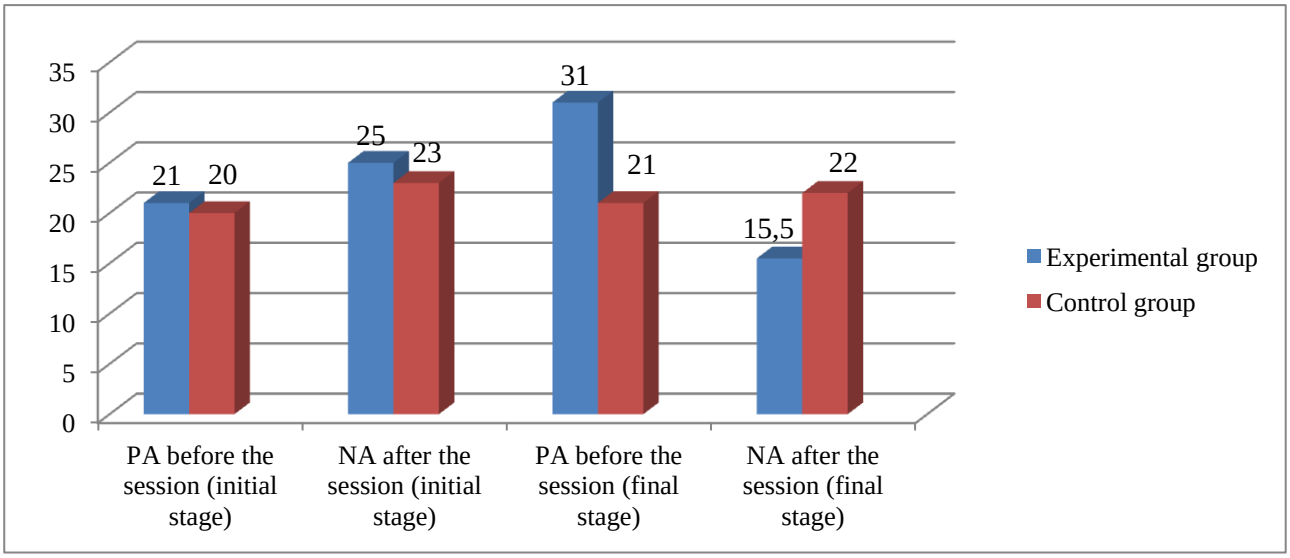

Figure 1. Dynamics of PA and NA at the stages of the experiment

ISSN 3081-0531 (Print) ISSN 3081-054X (Online)

According to the obtained data (Figure 1), at the beginning of the experiment, the PA levels in both groups were approximately equal and relatively low (21 in the experimental group and 22 in the control group), indicating a low level of emotional engagement and interest in physical education classes. The NA values — 25 in the experimental group (EG) and 23 in the control group (CG) — reflect a high level of negative emotions and anxiety. The PANAS measurement results at the final stage of the experiment (after 8 sessions) show an increase in the level of positive mood, emotional engagement, and energy in the experimental group — up to 31 points, which falls within the normal PA range (30–35 points) for a healthy student. Meanwhile, the control group showed stagnation, with the PA score remaining at 21. At the final stage, the experimental group demonstrated a low level of negative effect — 15 points, which corresponds to the lower boundary of the anxiety range (15–20). The control group showed a slight decrease in average NA from 23 to 22 points, which is not statistically significant for the purposes of this experiment.

2) The Borg Scale is a tool used for the subjective assessment of perceived physical exertion. It enables the evaluation of cumulative sensations related to changes in the cardiovascular, musculoskeletal, and respiratory systems experienced during physical activity. The Borg Scale is a vertical scale with numerical values from 6 (no exertion at all) to 20 (maximal exertion) and corresponding verbal descriptors of increasing intensity. The results obtained during the experiment using the Borg Scale are presented in Figure 2.

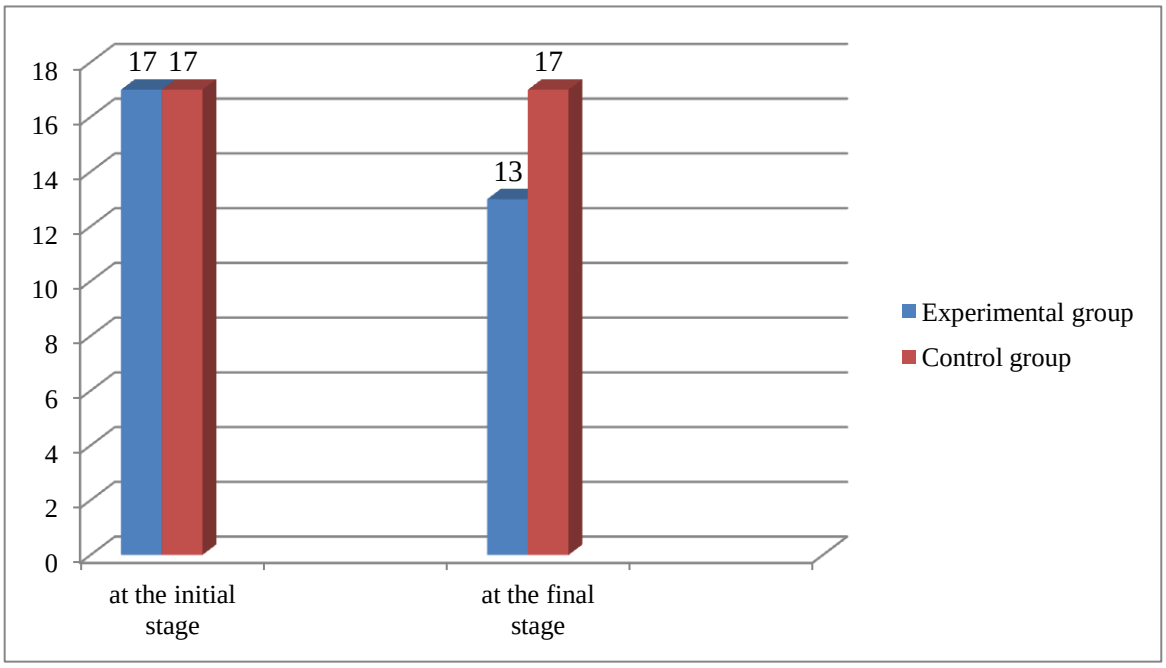

Figure 2. Dynamics of perceived physical exertion

Analyzing the diagram (Figure 2), it is important to note the identical initial level of the subjective assessment of physical exertion in both groups, characterized by the descriptor “very hard,” with a numerical equivalent of 17 points. At the control stage of the experiment, following the integration of the Fit Radio music application into the educational process, the experimental group (EG) demonstrated a reduction in perceived exertion from 17 to 13 points, corresponding to the “somewhat hard” level. The range of 12 (“slightly hard”) to 14 (“hard”) is considered aerobic and physiologically safe, particularly in the context of physical education. A score of 13 in the EG indicates that the individual experiences strain but is still able to continue exercising. In contrast, the control group (CG) showed no change in the level of perceived physical exertion.

Conclusions

1) Psychological and emotional state of students.

The study using the PANAS questionnaire revealed that the integration of the Fit Radio music mobile application into the physical education curriculum significantly increased the level of positive affect (PA) in the experimental group (EG). After eight sessions, PA scores increased from low baseline values (21–22 points) to the normative level (31 points), reflecting a rise in positive emotions, energy, and student engage-

ment in PE classes. At the same time, there was a substantial decrease in negative affect (NA) scores from 25 to 15 points, indicating reduced anxiety and emotional tension. In the control group (CG), no significant changes were recorded; PA and NA levels remained at the same level.

2) Subjective assessment of physical exertion.

According to the Borg Scale data, the initial level of perceived physical exertion in both groups corresponded to a high intensity ("very hard" — 17 points). By the end of the experiment, students in the EG reported a significant decrease in subjective fatigue (to 13 points), indicating a transition to the "somewhat hard" range, which is considered aerobic, physiologically safe, and conducive to optimal training adaptation. In the CG, the level of perceived physical exertion remained unchanged.

Recommendations:

- implementation of audio-musical technologies. The results of the study support the systematic use of music mobile applications (e.g., Fit Radio) in the organization of physical education classes. Audio-musical accompaniment contributes to the improvement of students' emotional state, a reduction in anxiety levels, and an increase in the perceived attractiveness of physical activity.

- integration of MMAs to optimize the training process. Musical accompaniment enhances tolerance to physical exertion by reducing subjective feelings of fatigue and discomfort. This allows for the optimization of training intensity and duration, making sessions more effective and comfortable for learners.

- individual playlists support a personalized learning approach. When planning PE sessions, it is recommended to take into account students' individual music preferences in order to maximize the positive effects on emotional well-being and physical exertion tolerance.

- monitoring and assessment of students' condition during PE classes. To objectively assess and monitor psychophysiological states and exertion tolerance, it is advisable to regularly apply validated psychometric tools (PANAS and the Borg Scale) in the format of repeated measurements.

The integration of innovative music-based mobile solutions into PE sessions contributes to the development of stable positive motivation, reduction of anxiety, and optimization of the training process, which overall has a beneficial effect on the psychophysiological condition of students. Digital tools enhance the scientific and methodological foundation of physical training, support learners' motivation and self-regulation, and make physical education more accessible and attractive to various social groups, including youth and university students.

Thus, this study, which explores the potential of music mobile applications as a means of increasing motivation, engagement, and the effectiveness of physical education, represents a relevant area of scientific inquiry aligned with the objectives of modernizing higher education and fostering a culture of healthy living among young people.

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