**UDC: 371.213**

# MOBILE APPLICATIONS AND ROBOTICS ELEMENTS AS A MEANS OF MASTERING PHYSICS IN HIGHER MILITARY EDUCATION

**Nasriddinov Dadaxon Komiljonovich**
*Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan*
*E-mail: dadahon20172019@mail.ru*

**ARTICLE INFORMATION**

**ARTICLE HISTORY:**
*Received:11.06.2026*
*Revised: 12.06.2026*
*Accepted:13.06.2026*

**KEYWORDS:**
*higher military education, teaching physics, mobile applications, robotics elements, digital educational technologies, interactive teaching, virtual laboratories, modeling, practical competencies, innovative pedagogy.*

**ANNOTATION:**

*This article examines issues related to the effective use of mobile applications and robotics elements in teaching physics at higher military educational institutions. The study analyzes the significance of an instructional process organized on the basis of modern digital technologies for helping cadets thoroughly master theoretical knowledge and develop practical skills and competencies.*

*It demonstrates the possibilities of using mobile applications to visualize physical phenomena and processes, organize interactive learning activities, and support independent study. The article also substantiates the formation of problem-solving skills through experimentation and modeling by integrating robotics elements into physics instruction. The study's findings contribute to improving the quality of physics teaching in higher military education.*

**Introduction.** A review of methodological works on educational robotics, together with an analysis and generalization of experience in applying robotics in the practice of higher military educational institutions, makes it possible to consider it as an independent educational technology. The structure of this technology can be divided into three components:

1. Robotics as an object of studying physics;
2. Robotics as a tool for studying physics;
3. Robotics as a means of teaching physics and developing cadets.

The components outlined above are defined by their core educational functions.

**The role of robotics in scientific inquiry and in teaching physics.** In the system of scientific study of physics, robotics is used to conduct experiments involving technical knowledge and technical objects [70].

A natural experiment carried out with the use of robotic technologies may be defined as a roboticized experiment. Such forms of observation and experimentation are increasingly applied in various fields of scientific knowledge. The need to robotize scientific experiments is determined by the fundamental functions of the robot as a technical object.

**Literature Review.** Extracurricular activities constitute an important component of the educational process. Their main purpose is the learner's personal development, moral upbringing, maximum self-realization, and the individualized development of the learner's educational trajectory. According to state educational standards, cadets of higher military educational institutions should be involved in extracurricular activities in the following areas: sports and health improvement, spiritual and moral development, social activity, general cultural development, and intellectual development. These are implemented through club work, socially useful practice, social design, and other forms in accordance with extracurricular activity programs.

According to Y.B.Yevladova, "extracurricular activities, above all, help cadets of higher military educational institutions understand their interests, try themselves in different types of activity, and discover the world beyond classroom instruction, rather than merely aiming to enter the 'world of mastery'" [5].

A relevant goal of the new-generation standard is "to prepare a graduate of a higher military educational institution as an individual and citizen interested in broadening his or her educational worldview." This means that the educational environment in which the individual is being formed should help reveal the learner's capabilities and develop knowledge, intellectual abilities, and creative potential. All of the above substantiates the legitimacy of introducing educational robotics into the modern education system.

The issues of implementing the fundamentals of robotics in teaching cadets at higher military educational institutions and in supplementary education have been addressed in the works of many contemporary scholars and teachers, including X. X. Abushkin, D. V. Andreyev, O. S. Vlasov, K. A. Vegner, R. A. Galustov, L. N. Gostev, A. V. Dadonov, A. N. Dakhin, M. G. Ershov, A. S. Zlakazov, O. S. Netesov, T. V. Nikitin, N. P. Petrov, S. A. Filippov, V. N. Khalamov, I. V. Shimov, and others [6].

Some researchers describe educational robotics as "a relevant pedagogical technology located at the intersection of promising fields of knowledge: mechanics, electronics, automation, design, programming, and technical engineering." Others define it as "an interdisciplinary educational field that integrates knowledge of technology, physics, cybernetics, mathematics, computer science, and other disciplines, and is aimed at developing students' technical creativity as well as increasing the importance and prestige of engineering education." Still others understand it as "a didactic model of the science of robotics." The elements of this model are not limited to scientific and engineering knowledge in robotics; they may also be used to organize propaedeutic instruction in the basics of engineering in order to strengthen cadets' interest in engineering and technical specialties.

**Research Methodology.** The process of conducting a roboticized experiment or observation is distinguished by higher quality implementation, broad coverage, and highly accurate data recording, as well as by automatic data collection and processing, complete and error-free logical analysis, visualization of the experimental process, and presentation of results. Cadets of higher military educational institutions should master the methodology of scientific inquiry and acquire key skills for conducting traditional, computerized, and roboticized experiments.

Below is a roboticized experimental setup for studying the laws governing oscillations of a spring pendulum.

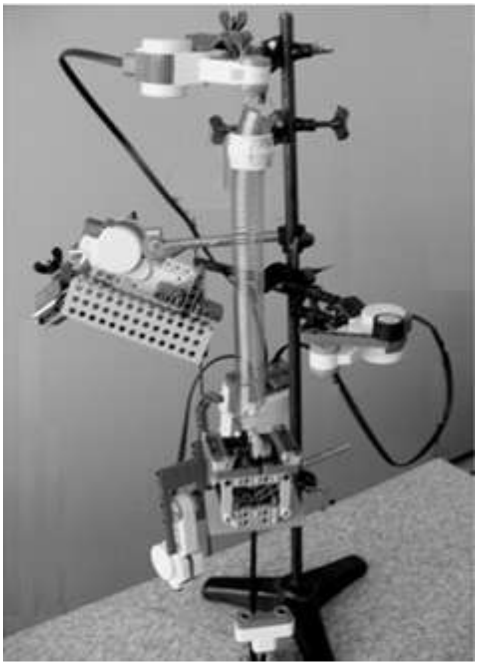

***Figure 2.1. Device for studying the laws of spring pendulum oscillations.***

At the automated stage of this experiment, the following actions are performed: physical manipulations with the elements of the device, data collection and processing, and the display of results on a microprocessor and computer screen. At the same time, the following mechanisms responsible for the sequence of operations are activated: displacement of the system from equilibrium and damping of free oscillations; variation of the pendulum mass by increasing the number of weights on the hook; and variation of the spring stiffness. During the experiment, two programs are launched in sequence: one for studying the dependence of the period of spring pendulum oscillations on its mass, and another for studying the dependence of the oscillation period on the spring stiffness. The control program includes the values of mass and stiffness, the number of experiments, and mathematical formulas for reprocessing the experimental results. The oscillation period is estimated from the graph of the distance from the sensor to the oscillating pendulum as a function of time. The graph is displayed on the computer screen. The roboticized experiment takes no more than one minute to complete.

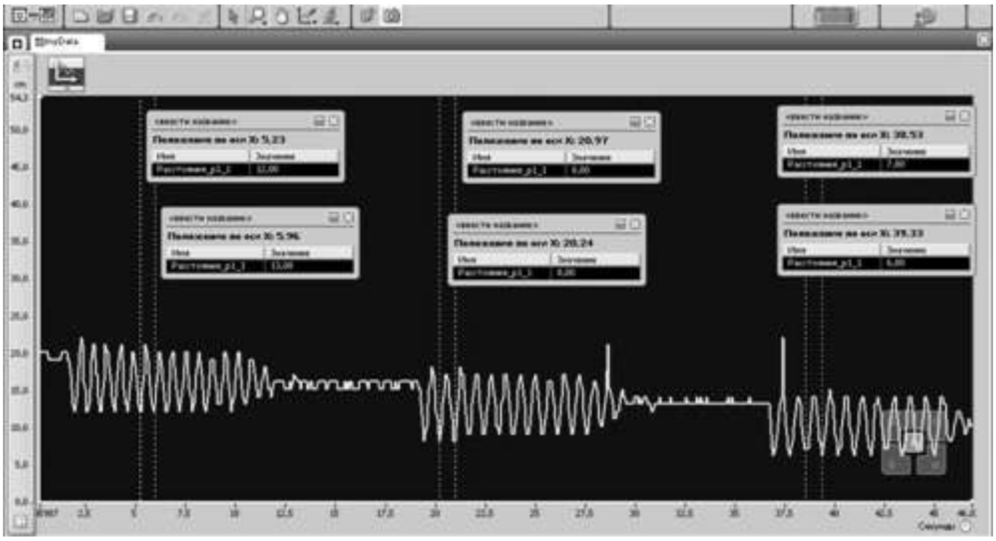

***Figure 2.2. Graph of the distance from the sensor to the oscillating pendulum as a function of time.***

Let us identify the advantages of a roboticized experiment as a tool for learning. When conducting such an experiment, the quality of measurements increases substantially due to the use of a sensor-based data acquisition system. It becomes possible to exert an automatic influence on the object under study. The accuracy of the applied parameters increases, and these parameters can be monitored automatically. The response time of the roboticized system to external influences can also be controlled. A robot-experimenter can automatically manage and monitor the state of its systems according to various parameters.

For example, the rotational accuracy of the shaft of an educational robot's electric motor is 1 degree. This makes it possible, with sufficient precision, to ensure the rotational plane of the object under study, the translational movement of a mechanical part of the system, the strict periodicity of oscillations, and so forth.

Under the conditions of a roboticized experiment, the system can adapt to the required operating mode. For example, it can bypass resonance frequencies, control the temperature of the objects under study, maintain gas pressure in a vessel, monitor the level of surface illumination or changes in its color, and correct the values of parameters in an electric circuit. The presence of electronics in the hardware component of a roboticized device, together with microprocessor speed, makes it possible for the system to achieve the response rate required for various external influences.

If not one but several robotics kits are used in the experimental setup, it becomes possible to conduct even more complex multi-stage physical experiments.

Cadets can work not only with a ready-made roboticized device. They may also participate in its construction and adjustment. As a rule, this work involves cadets who are interested in robotic design and programming.

**Analysis and Results. In the system of scientific and technical study of physics, robotics appears in various capacities [71].**

1. A robot can serve as an effective means of studying or diagnosing already existing technical objects. The use of robotics in such research eliminates the influence of subjective factors, reduces the time required to search for technical faults, increases diagnostic accuracy, and, when necessary, ensures the automatic elimination of defects in a number of cases during diagnostic testing and measurement.

2. The design of a robot can itself become the goal of scientific and technical inquiry in teaching physics. Creating new and more advanced robotic systems is one of the pressing problems of modern engineering. Engineering activity includes the following tasks: carrying out an analytical study of a technical problem; inventing or improving a technical object in order to solve that problem; preparing and studying a model of this object; creating a real technical object and introducing it into the relevant sphere of social practice; ensuring its operation; and diagnosing defects and eliminating shortcomings that arise in a timely manner.

The methods of scientific and technical inquiry include analytical research methods, natural experiments, mathematical and computer modeling, technical design, and the physical modeling of technologies. At the initial stage, any of these methods is suitable for cadets to study.

There are opportunities to involve cadets in creating new robot models or improving existing ones, and this can be implemented within elective physics courses, optional classes, and independent training sessions. It is advisable to organize such tasks within the framework of project-based learning. It is beneficial for each project to be carried out as an object of collaborative work by a cadet team.

Cadets should be guided toward the design and modeling of diverse robotic systems. The objects of modeling may include experimental devices for physical experiments, as well as technical devices for other purposes. During the course of project development, particular attention should be paid to ensuring that the robot possesses the properties and performs the functions required of it.

At the present stage of the development of scientific and technical research methods, computer modeling methods have particular importance. Alongside real devices, virtual models allow engineers to find more appropriate solutions when designing technical devices. With specialized software, it is possible to create a complete digital prototype of a robot. Such software environments must meet a number of requirements, including: the possibility of creating a virtual model similar to the robot's real physical prototype; the possibility of virtually modeling the robot's behavior in an environment similar to the real physical world; three-dimensional visualization of the robot model and the demonstration of its behavior in a virtual environment; and the possibility of using programs written for the virtual model with a real robot.

The structural components of educational robotics can be considered as a technology for teaching physics. Cadets' knowledge of the subject, as well as of the technical applications of physics, becomes broader and deeper, and their skills in learning and mastering the discipline improve.

**Conclusion and Recommendations.** The use of mobile applications and robotics elements in teaching physics within the higher military education system significantly increases the effectiveness of the educational process. These tools make it possible to explain complex physical processes in a visual and interactive way and to strengthen the connection between theoretical knowledge and practical training.

As a result, cadets' subject knowledge, independent thinking, decision-making in problem situations, and competencies in working with modern technologies are developed. Mobile and robotic solutions reinforce the practice-oriented character of military education and strengthen the professional training of future specialists.

## References

1. Extracurricular Work in Physics / ed. by O. F. Kabardin. Moscow: Prosveshchenie, 1983. 223 p.
2. Lebedeva, O. V., & Grebenev, I. V. Design and organization of students' research activity in the educational process. Pedagogika, 2013, No. 8, pp. 52-58.
3. Lebedeva, O. V., & Markov, K. A. Research-based teaching of physics as a factor of integration in the "school-university" system. Nizhegorodskoe obrazovanie, 2014, No. 2, pp. 43-49.
4. Lebedeva, O. V., & Veretennikova, O. N. Formation of research skills in the process of teaching physics and mathematics in the pre-university training system. Nauka i shkola, 2012, No. 6, pp. 106-108.
5. Malakhov, A. A. Main aspects of integrating classroom and extracurricular physics lessons when activating students' cognitive activity. Novaya nauka: Sovremennoe sostoyanie i puti razvitiya, 2017, No. 1-1, pp. 86-90.
6. Methodology of Elective Physics Classes: A Teacher's Guide / ed. by O. F. Kabardin and V. A. Orlov. 2nd ed., revised and expanded. Moscow: Prosveshchenie, 1988. 240 p.
7. Popova, M. N., Sitnova, E. V., & Popov, I. P. Some principles for constructing integrated physics lessons within extracurricular activity. Mir nauki, 2017, Vol. 5, No. 1, p. 59.
8. Nemirovich, E. M. The use of metasubject skills in extracurricular physics lessons for the development of research competence. Pedagogicheskoe obrazovanie i nauka, 2018, No. 6, pp. 119-121.
9. Purysheva, N. S., Sharonova, N. V., & Isaev, D. A. Fundamental Experiments in Physical Science: textbook. Moscow: BINOM. Laboratoriya znaniy, 2005. 159 p.

10. Physics: Observation, Experiment, Modeling. Elective Course / A. V. Sorokin, N. G. Torgashina, E. A. Khodos, A. S. Chiganov. Moscow: BINOM. Laboratoriya znaniy, 2006.