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Pedagogical Experimental Work on the Effectiveness of Teaching Physics based on Mobile Applications and Robotics Elements

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ABSTRACT: This article presents pedagogical experiments and their results in connection with increasing the efficiency of teaching physics in higher military education based on mobile applications and robotics elements. The main achievements and scientific innovations of the study are the increase in the efficiency of teaching physics in higher military education based on mobile applications and elements of robotics in the development of the implementation methodology, the increase in the efficiency of teaching physics in higher military educational institutions. education based on elements of mobile applications and robotics, the improvement of the content of physics based on integration, aimed at forming professional knowledge of specialists, as well as the increase in the efficiency of teaching physics in higher military education using mobile applications and robotics due to the improvement. Based on elements of higher military educational institutions, the mechanism for implementing the methodology based on practical issues and experimental developments, aimed at developing independent educational skills of cadets and students, is reflected in the improvement of information and optimization of didactic support.

INTRODUCTION

Checking and analyzing the results of observations and experiments with mathematical and statistical methods made it possible to draw reliable conclusions. Such methods are sufficiently developed for pedagogical research. It is important for pedagogical research that the effectiveness of the tools used in this is checked based on the comparison of the achievements or conclusions of a certain group, objects (group of listeners, group of teachers, etc.) or different groups, objects in a certain

time.

The aim of the pedagogical experimental work is to determine whether the proposed method of teaching physics is effectively mastered by students and cadets, to develop educational activities, to support the growth of their creative thinking, and to develop the skills of independent educational activities. is to check availability. The χ2-Pearson criterion method was used for statistical analysis of the results of pedagogical experiments.

On the fact that new content has been created on the basis of mobile applications and elements of robotics to improve the effectiveness of teaching physics in higher military education, on the basis of which the results of assessing the level of skill of cadets and students and ways of effectively using pedagogical opportunities are formed.

LITERATURE REVIEW

The famous psychologist R. Gottsdanker commented that "The goal of any experimental study is to make sure that the results based on a limited amount of data remain outside the experiment".

As noted by another scientist B.Ananev, based on the characteristics of the research, we used the following methods:

1. Organizational (comparison, generalization).

2. Empirical:

a) methods of observation (observation and self-observation);

b) teaching experiment method;

c) psychoanalysis methods (standardized and designed tests, questionnaires, interviews and interviews);

d) practical methods (description, work evaluation);

e) modeling method (mathematical, etc.);

f) biographical methods (pedagogical process and evidence analysis).

3. Quantitative (mathematical-statistical) and qualitative method of analysis.

4. The method of interpreting the obtained results.

In the implementation of the above, the knowledge obtained from all departments of physics will be of great importance. In addition, the use of robotics elements and mobile applications in learning physics shows high efficiency.

In addition, the study analyzes scientific, scientific-methodical works and literature related to the problem, theoretical analysis of pedagogical, methodological, scientific-research and scientific-technical data, questionnaires, observations, interviews, experimental-testing works, assessment, generalization. research results and methods of mathematical-statistical analysis. For example, cadets and listeners used the experimental work method to explain laboratory works related to physics, using mobile applications and new laboratory devices developed on the basis of robotics elements. The above methods can be used mainly for training cadets and interns studying in the field of technology.

Along with this, in the studies conducted by J.Bannet, S.Papadakis, S.Kantarci, S.Kaya, M.Cakir, M.Erdem, A.Carberra, A.Mckenna, M.Bers, J.Trobaugh, E.Silk, R.Tellez, C.Angulo, V.Stella, J.Ruiz, R.Salazar great successes have been achieved in the development of students' independent work skills through mobile applications, the effectiveness of studying the laws of physics and mechanics by students using robotics tools has been analyzed, and special attention has been paid to the development of students' scientific thinking skills, problem-solving, and practical skills using robotics.

Analysis of foreign literature shows that the effectiveness of teaching physics through mobile applications and robotics elements increases significantly. Students will be involved in more interactive experiments and will have the opportunity to test theoretical knowledge in practice. Pedagogical experimental work also confirms the effectiveness of the use of mobile technologies and robotics.

MATERIALS AND METHODS

During the pedagogical experimental work, the use of robotics elements in laboratory classes in physics, as well as achieving thorough mastery of all sections of physics using mobile applications in lectures and practical classes, the ability to apply theoretical knowledge in practice in the process of carrying out life and professional activities, requires special attention to the development of skills and abilities.

It is important for students and cadets of higher military educational institutions to thoroughly master knowledge in physics, to master knowledge at the level of state educational standards, and on their basis, to be able to meet the requirements for a modern rescuer based on state educational standards.

Indeed, the physical knowledge, laws, and regularities imparted in the educational process in higher military educational institutions allow for the correct formation in the minds of students of ideas about fire safety and the role of these knowledge in emergencies.

The main goal of the experimental work aimed at improving the effectiveness of teaching physics to students and cadets of higher military educational institutions is to fully convey knowledge to students and cadets of higher military educational institutions, to determine ways to achieve high indicators while spending less time on the full formation of their knowledge of physics. Experimental and control groups were selected from among students and cadets of the Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, the University of Public Security of the Republic of Uzbekistan, and the Academy of the Armed Forces of the Republic of Uzbekistan.

Ensuring a positive solution to the above-mentioned goal requires the establishment of a new approach to improving the educational process for training qualified officers based on the requirements of today.

The following tasks have been defined for conducting the experimental work:

identification of existing problems from physics teachers working in academies and universities;

development of educational and control tasks, test questions based on the analysis of the studied sections of physics;

development of existing laboratory work in physics based on robotics elements;

Formation of theoretical and practical information using mobile applications for the convenience of conducting lectures and practical classes.

Testing of the system of tasks developed to determine the level of formation of knowledge in the field of physics among students and cadets of the Academy and the University;

analysis of preliminary results;

clarification and supplementation of the system of assignments, development of the necessary methodological guidelines for their implementation in the educational process;

Analysis of the current level of achieved educational effectiveness;

preparation of proposals and recommendations based on the results of the analysis.

Increasing the effectiveness of teaching physics to students and cadets of the Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, the University of Public Security of the Republic of Uzbekistan, and the Academy of the Armed Forces of the Republic of Uzbekistan is ensured by:

1. Competence of physics teachers in higher military educational institutions in improving the quality of their professional activity and organizing scientific, methodological, and creative activities.
2. Thorough mastery of the fundamentals of specialized subjects and pedagogical knowledge by physics teachers working in higher military educational institutions.
3. Ability to apply acquired physical and pedagogical knowledge in practice.
4. The ability to determine the interest, need, and motivation of students and cadets in mastering physics.

5. Possession of initiative and organizational skills by students and cadets.
6. Their ability to understand the essence of new pedagogical technologies and their effective use in the educational process plays an important role in increasing the effectiveness of education in an educational institution.

RESULTS AND DISCUSSION

Below is a detailed description of the conduct of experimental work and their significance at the Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, the University of Public Security of the Republic of Uzbekistan and the Academy of the Armed Forces of the Republic of Uzbekistan.

In the process of experimental work, attention was paid to the formation of the following skills and qualifications in physics teachers, which help the effective progress of the educational process:

1) determine the purpose of training;
2) determination of tasks to be carried out within the scope of the goal;
3) development of training content;
4) to determine the forms, methods and tools that serve to fully cover the content of the training;
5) establishing a control that determines the level of mastery of the essence of the topic or educational material by the listeners.

As it was mentioned, the ability of physics teachers to use new pedagogical technologies and their competence in improving the effectiveness of teaching physics at the Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, the University of Public Security of the Republic of Uzbekistan and the Academy of the Armed Forces of the Republic of Uzbekistan it is important to increase gradually.

As well as how important the diagnosis of patients is, the correct diagnosis determines the effectiveness of further work. Therefore, special importance was attached to determining the initial state of formation level of knowledge, imagination and skills of the students about physics. A question-and-answer session was held with the listeners and cadets based on assignments. According to the analysis of the results of the answers, it was found that students and cadets have insufficient skills in using robotics elements and mobile applications in physics lessons.

According to the preliminary results of the experimental work, the following conclusions were drawn:

Insufficient knowledge and imagination of students and cadets of the Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, the University of Public Security of the Republic of Uzbekistan and the Academy of the Armed Forces of the Republic of Uzbekistan;

there are deficiencies in their understanding of the nature of physical laws;

they hardly engage in project-engineering activities.

The Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, the University of Public Security of the Republic of Uzbekistan and the Academy of the Armed Forces of the Republic of Uzbekistan have published instructional and training manuals, textbooks on the use of robotics elements and mobile applications in teaching physics. not done.

In the process of monitoring the lessons, the audience's knowledge of physics, mainly mechanics, molecular physics, electromagnetism, optics, atomic and general physics, and the role of the existing laws in these departments in the field, is the main basis for the level of formation. attention was drawn. In addition, the elements of robotics and mobile applications were actively offered during training sessions.

At the Academy of the Ministry of Emergencies of the Republic of Uzbekistan, the University of Public Security of the Republic of Uzbekistan and the Academy of the Armed Forces of the Republic of Uzbekistan, the teaching of physics is carried out by the traditional method in the control groups, and on the basis of experimental materials and methods in the experimental groups. went

Based on the analysis of the final results of the experimental work carried out at the Academy of the Ministry of Emergency

Situations of the Republic of Uzbekistan, the University of Public Security of the Republic of Uzbekistan and the Academy of the Armed Forces of the Republic of Uzbekistan using mathematical and statistical methods, the content of the research work and the ideas put forward in them Confirming that it is effective and reasonable is the main task of experiment-test work.

The stage of pilot-testing of the special methodology aimed at increasing the effectiveness of physical science training at the Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, the University of Public Security of the Republic of Uzbekistan and the Academy of the Armed Forces of the Republic of Uzbekistan consists of the following:

1) Stage of analysis of the obtained results. The final results are compared with each other according to the indicators obtained from the experimental and control groups, processed using the mathematical-statistical method.

2) Based on the final results obtained at the end of the experimental work process, scientific-methodical recommendations will be developed, which will allow to increase the efficiency of students' and trainees' learning using robotics elements and mobile applications in the teaching of physics.

Experimental work is in three stages, i.e. emphasis

(2021-2022), formative (2022-2023) and final

(2023-2024) consists of stages, the Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, the University of Public Security of the Republic of Uzbekistan and the Academy of the Armed Forces of the Republic of Uzbekistan

The 1st and 2 nd stages were held among the cadets and their listeners.

Table 1: General statistical analysis of experimental work conducted in academies and universities

Acade-mic years	**Groups**	**Number of listeners**	**"5"**	**"4"**	**"3"**	**"2"**	**The average value of the grade**	**Share (percent age)**	**Efficiency**
General	Experien ce	196	73 A 55,9	101 B 48	20 S 36	2 D 3	4,25	49,8	1,18
	Control	197	27 E 38,5	76 F 41,6	79 G 54,7	17 H 12,75	3,6	50,2	
	Total	393	100	177	99	17		100 %	1,18

We calculate the differences in cells:

$$f_A = |7,3 - 5,59| = 1,71 \qquad f_E = |2,7 - 3,85| = 1,15$$

$$f_B = |10,1 - 4,8| = 5,3 \qquad f_F = |7,6 - 4,15| = 3,45$$

$$f_C = |2 - 3,6| = 1,6 \qquad f_G = |7,9 - 5,47| = 2,43$$

$$f_D = |2 - 3| = 1 \qquad f_H = |1,7 - 12,75| = 4,25$$

χ^2 – criterion determination formula:

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$$\chi^2 = \sum \frac{(f_э - f_m)^2}{f_m} \qquad (3.1)$$

Here, $f_э$- observed (empirical) values; $f_т$- expected (theoretical) values. Empirical according to the determined values $\chi_э^2$ – We calculate Pearson's criterion [111]:

$$\chi_э^2 = \frac{1{,}71^2}{5{,}59} + \frac{5{,}3^2}{4{,}8} + \frac{1{,}6^2}{3{,}6} + \frac{1^2}{3} + \frac{1{,}15^2}{3{,}85} + \frac{3{,}45^2}{4{,}15} + \frac{2{,}43^2}{5{,}47} + \frac{4{,}25^2}{12{,}75} = 13{,}04$$

We define degrees of freedom:

$$\mu = (\kappa - 1)(c - 1) \qquad (3.2)$$

Here, κ- the number of columns of the analyzed data,
c- number of rows.

$$\mu = (4-1)(2-1) = 3$$

Degree of freedom from the table $\mu = 3$ was χ^2 we write the corresponding values of: $\chi_\kappa^2 = \begin{cases} 7{,}815 & p = 0{,}05 \\ 11{,}345 & p = 0{,}01 \end{cases}$

According to the results of the test conducted at the end of the experiment $\chi_э^2 = 13{,}04 \geq \chi_э^2 = 11{,}325$ for being H_0 hypothesis (H_0-this is the null hypothesis, meaning that the differences are insignificant. In this hypothesis, there is no difference between the results obtained when performing a certain task in two ways. H1-hypothesis is the hypothesis that there is a difference between the results obtained when performing a task in two ways) was rejected.

It was determined that the level of knowledge of students and trainees in the experimental group was 1.18 times higher than the level of knowledge of students and trainees in the control groups. The results of the experimental work are summarized and shown in the form of a diagram in Fig.1

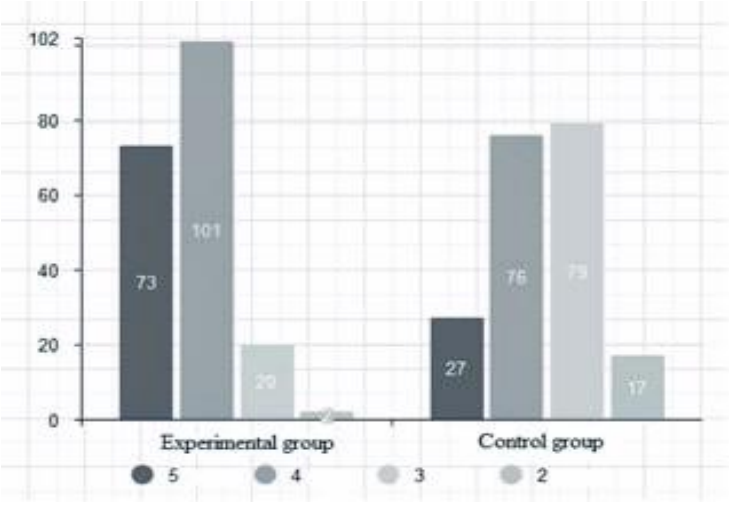

Figure 1. Diagram of mastering indicators of listeners and trainees at the end of the experiment

This confirms that the conclusions and recommendations developed on the basis of our research are reliable from a pedagogical point of view and have led to statistically significant positive results. It can be seen that the determined absorption efficiency is greater than one or increased by 18%. Therefore, the improved content of physics and the methodology of its teaching, which we recommended, have been proven to be more effective than the content and the traditional teaching methodology before its improvement.

Based on these statistics, it will be possible to find out to what extent the professional competence of students and interns has

developed. The results of the experiment will contribute to the further development of technical literacy in students and interns. Because during the experiment, they use various mobile applications and laboratory work on robotics. Similar studies were also launched by Russian scientists and educators L.G. Beliovskaya and N.A. Beliovsky, they mainly developed robotic laboratory devices for high school students. In the course of the research, mobile applications and robotic laboratory devices were developed for cadets and students of military universities in the field of technology.

In the course of pedagogical experiment-testing, the use of robotics elements in physics laboratory classes, as well as the use of mobile applications in lectures and practical classes, to achieve a thorough mastery of all sections of physics, to acquire theoretical knowledge in the course of life and professional activities. practical application requires special attention to the development of skills and competences.

It is important for students and cadets of higher military educational institutions to thoroughly acquire knowledge of physics, master knowledge at the level of state educational standards, and be able to meet the requirements of modern lifeguards based on state educational standards.

In fact, the physical knowledge, laws and regulations provided in the educational process in higher military educational institutions allow to correctly form the imagination of the listeners about the role of this knowledge in fire safety and emergency situations.

The main goal of experimental work aimed at improving the effectiveness of physical science training for students and cadets of higher military educational institutions is to fully deliver knowledge to students and cadets of higher military educational institutions, to provide them with full knowledge of physics. is to determine ways to achieve high performance by spending less time on its formation. Experimental and control groups were selected from among the students and cadets of the Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, the University of Public Security of the Republic of Uzbekistan and the Academy of the Armed Forces of the Republic of Uzbekistan.

Ensuring a positive solution to the above goal requires the decision of a new approach to the improvement of the educational process for training skilled officers based on today's requirements.

The following tasks have been set for conducting experimental work:

Clarification of existing problems from physics teachers working in academies and universities;

development of educational tasks and test questions based on the analysis of studied physics departments;

development of existing laboratory work in physics based on robotics elements;

formation of theoretical and practical information using mobile applications to facilitate lectures and practical training.

To test the system of tasks developed in order to determine the level of formation of knowledge of physics among students and cadets of academies and institutes;

analysis of preliminary results;

to clarify and complete the system of assignments, to develop the necessary methodical instructions for their implementation in the educational process;

analysis of the current level of achieved educational efficiency;

preparation of proposals and recommendations based on the results of the analysis.

Increasing the effectiveness of teaching physics to students and cadets of the Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, the University of Public Security of the Republic of Uzbekistan and the Academy of the Armed Forces of the Republic of Uzbekistan is ensured by the following:

1. ability of physics teachers in higher military educational institutions to improve the quality of their professional activity and to organize scientific-methodical and creative activities.
2. Physics teachers working in higher military educational institutions have thoroughly mastered the basics of specialized sciences and pedagogical knowledge.

3. The ability to apply acquired physical and pedagogical knowledge in practice.
4. To be able to determine the interest, need and motivation of students and cadets in learning physics.
5. Students and cadets have initiative and organizational skills.
6. Their ability to understand the essence of new pedagogical technologies and their effective use in the educational process is of great importance in increasing the effectiveness of education in an educational institution.

If we dwell on the scientific and practical significance of the conducted research, we can state the following. In the course of research work, new content was created to improve the efficiency of teaching physics in higher military education based on mobile applications and elements of robotics, on the basis of which methods for assessing the results of the level of proficiency of cadets and students and the effective use of pedagogical opportunities were developed and scientifically substantiated. The work performed shows the scientific significance of the study. In addition, the practical significance of the study is explained by the fact that the efficiency of teaching physics in higher military education has been increased based on mobile applications and elements of robotics, as well as the creation of educational and educational-methodical and electronic manuals based on this improved content. They improve the educational process, as well as increase the efficiency of the educational process of cadets and students, create the opportunity to study polytechnic education through the study of physics. Scientific and pedagogical foundations of design methods for mobile applications and robotic systems from the science of physics in scientific research on the use of robotics elements in the world system of higher education, issues of engineering design of mobile applications and robotic systems, mobile applications and robotics in higher military education, in which the elements are the object of study of physical sciences (National Institute for Training and Research of Technical Teachers (India)); the use of mobile applications and robotics elements in physical experiments in higher military education and issues of organizing scientific and technical research in physics through the widespread use of mobile applications and robotics elements in the process of higher military education (Shaanxi Normal University (China)); the content of issues of improving the professional skills of future soldiers through the use of mobile applications and robotics elements in teaching physics has been developed (Princeton University (USA)). The scientific and theoretical foundations for increasing the effectiveness of teaching physics in higher military educational institutions based on mobile applications and robotics elements have been developed by such foreign scientists as A. Carberry, T. Ford, N. Perova, C. Newton, M. Predko. However, no work has been carried out on controlling or obtaining results from robotic laboratory devices developed during their research through mobile applications.

CONCLUSION

In conclusion, the research work by increasing the efficiency of teaching physics in higher military education based on mobile applications and robotics elements disclosed the content of physics, the formulation of its topics, modern educational technologies based on the principles of professional training. focus, an integrated approach, developed a methodology for implementing information support. At the same time, by increasing the efficiency of teaching physics in higher military education based on mobile applications and robotics elements, the integrity of teaching physics was increased, and the teaching methodology aimed at developing the intellectual abilities of students and cadets was improved. These results can be recognized as the main novelty and scientific achievement of the research work.

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