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THE USE OF SIMULATORS AS A WAY TO INCREASE THE EFFICIENCY OF TRAINING SPECIALISTS TO OPERATE LOGISTICS EQUIPMENT

The methodical aspects of creating and using simulators for training military personnel to operate the technical means of the logistic services are analyzed (based on the example of food cooking means and transportation in field conditions).

Keywords: *training of military personnel, educational process, effectiveness of the educational process, technical means of the logistic services, simulator, practical skills.*

Statement of the problem. In a number of factors that determine the combat readiness of military units, an important role is played by the preparedness of personnel and the provision with material resources. The provision of military units with material means is mainly carried out by logistic services and units. At the same time, the main military units are also involved in the processes of materiel support for military personnel.

The quality of tasks execution of materiel support of units and the level of training of the personnel performing the tasks of materiel support have a correlation between them, which in an integral relationship reflects the influence of the level of training of the personnel on the completeness and timeliness of the provision of material resources. The level of training of the personnel is the result of a complex of measures and processes: combat, in particular, special training, acquisition of practical skills and experience during the performance of day-to-day and combat tasks. Together, these activities and processes can be considered as elements of a single (holistic) educational process.

The effectiveness of the educational process in terms of all its components depends on the quality of the organization, the level of preparation of educational classes (work) and the persons who do them, the degree of perception of the educational content by the personnel. The educational – material base used during classes has a significant impact on the results of the educational process.

This influence concerns both the effectiveness of the educational process and organizational

aspects, the motivation of personnel, the maintenance of serviceability and the technical resource of organic equipment.

Simulators play an increasingly important role in the system of military specialists training in various fields and specialties. The use of simulators for military specialists training has a long history. The more complex the weapons and military equipment became in evolution, the greater was the need to create educational and training devices for mastering them. During the development of simulators used in the training of military specialists, several generations of equipment have changed. The creation and use of dynamic platforms and computer equipment became the impetus for the significant expansion of the capabilities of simulators and their complexes [1].

Modern complex weapons samples, as a rule, provide for the creation of special separate or integrated in such equipment appropriate simulators (elements) for training combat personnel.

At the current stage, according to experts, simulators make it possible to solve up to 70–80 % of the tasks of the entire personnel training process [2]. They are used not only as separate (independent) means for training specialists in certain specializations, but also for systematic training of military branches personnel, being combined into complex systems.

At the same time, during the training of military personnel of the National Guard of Ukraine (NGU) for operation of field technical means of logistic services, in particular, means of cooking in the field, the simulators were not widely developed and used. Therefore, there were reasons.

This special equipment is relatively simple compared to the samples of combat equipment, its technical resource is quite large. Most of the field kitchens used in military units were developed in the last century. At that time, the development, manufacturing and operation of simulators were associated with significant capital and current expenditures, which determined the economic impracticability of such works.

For today the situation has changed. Firstly, the need to train personnel to use field equipment has increased. It became especially noticeable under the conditions of martial law, when the possibilities of using the educational-material base, which was created in training centers in peacetime, decreased, the need to train military personnel directly in the field with the use of standard technical means of the logistic services, and time constraints increased.

As the experience of combat operations shows, in order to provide food service for the personnel performing tasks in the areas of hostilities, not only the personnel of logistic support units, but also those of the combat units should have the skills and abilities to cook meals in the field. The commanders of the units, operating autonomously, are responsible for the organization of the logistic support of these units.

Cooking of hot meals for the military personnel performing tasks in the areas of hostilities is organized by full-time and freelance cooks from among the appointed military personnel of their units using technical means of food cooking in field conditions.

Secondly, the rapid development of computer technologies contributes to the creation of relatively cheap software and technical complexes for visualizing objects, working out the necessary actions (operations) simulating various environmental conditions, etc.

Taking into account the need to train specialists of the logistic services and freelance cooks from among the military personnel of the combat units to use field technical means of the food service, as well as modern technological possibilities for the development of simulators, the task of analyzing the feasibility of developing and using simulators in the educational process in order to increase the effectiveness of the training process arises.

Analysis of recent research and publications.

Great attention has always been paid to the issue of military training due to its importance for the combat readiness of military formations. In the publications, an important role is given to the effectiveness of the educational process and ways to improve it. The question of the influence

of the quality of the logistic support of military personnel on the final results of their actions during the performance of assigned tasks is being investigated [3]. In the theory of military science (military-economic analysis), formalized approaches to describing the process of combat training, its modeling, and optimization of training programs have been developed.

On the basis of these approaches and developed models, the influence of various factors on the level of training of military personnel (units) was considered in the works [4, 5], and proposals for improving the efficiency of the training process by managing the parameters of the training plan were substantiated.

Qualitative changes in armaments, military and special equipment, based on achievements in the applied fields of science, engineering and technology, the development of the IT sphere, the introduction of NATO standards in the management, supply and training of the troops caused the need for qualitative changes in approaches to the organization of combat training, in its materiel and technical support.

Possibilities of improving the educational and material base of combat training by integrating simulator technologies into the educational process and the impact of simulators on the level of combat training in relation to mechanized and armored units are disclosed in the article [2].

The paper [6] shows that the use of electronic educational platforms and interactive teaching methods change the paradigm of military education as a whole. It is noted that the use of interactive training methods plays an important role in improving the quality of training of military personnel to face modern challenges and threats. In a number of works, in particular [7], specific educational platforms and simulators are considered, the positive effects obtained as a result of their introduction into the training processes of military personnel of various specialties are noted.

Research as for the improvement of the educational and material base for troops (forces) training is actively conducted in various areas of the security and defense sector, as indicated in particular, by publications in specialized journals and materials of scientific and practical conferences [8–11]. For example, in the article [9], the advantages provided by the use of innovative computer tools and appropriate equipment with the use of real simulators of dangerous factors during the practical training of rescuers are revealed.

However, scientific publications do not pay due attention to the development of simulators for training

specialists of the logistic services, as well as to concerned categories of military personnel of other units to use the technical means of the logistic services.

The purpose of the article is to consider the methodological aspects of the expediency of creating and using simulators for training military personnel to operate the technical means of the logistic services (using the example of the technical means of cooking and transporting food in the field).

Summary of the main material. Based on the general theory, to describe the process of formation of the level of training of military personnel, we will consider the indicator P – "probability of completing tasks". To simplify the analysis, let's assume that this indicator depends only on the parameters of the educational process, and other factors that affect the performance of the tasks fully meet the requirements. The specified indicator depends on the number of lessons n , which means it changes over time. The dynamics of changes in this indicator over time is usually described by an indicator function in the form of

$$P(n) = P_{lm} - (P_{lm} - P_0)(1 - \xi)^n, \quad (1)$$

where P_{lm} is the value of the probability of completing the tasks that can potentially be achieved by $n \rightarrow \infty$ with the use of a certain type of learning means;

P_0 – the probability of completing tasks by military personnel at the time of the beginning of the training process (initial level of training);

ξ – the share of knowledge (skills) that is planned to be mastered in one (regular) class, from the total amount of knowledge (skills) to be mastered according to the training program;

n – number of classes.

The process of training personnel for using technical means of cooking in the field involves the assimilation of theoretical knowledge regarding the purpose, structure, specifications of such means, the rules of their operation, etc., and the formation of skills and abilities of deployment and concluding means, use them by their appointment, and maintenance.

Currently, two groups of tools are used as carriers of educational content (educational material base):

- textbooks, manuals, technical documentation, instructions, etc.;
- technical means for cooking and transporting food in field conditions.

The first group of tools will be called "educational literature", the second – "standard equipment".

The use of only educational literature for the training of specialists cannot a priori ensure a high probability of completing tasks. Theoretical knowledge is a necessary basis for understanding the processes, successful mastering the appropriate technique in practice. However, no matter how deep and systematic the knowledge is, it is necessary to form practical skills and abilities, which require practice of actions.

The parameter P_{lm} of formula (1) shows the level of preparation that objectively corresponds to a specific type of educational means. Then organic equipment as a type of training tool can provide the highest level of training, potentially $P_{lm}^{re} = 1$. The level of training that can be achieved using educational literature as a type of teaching aids will be lower, i.e. $P_{lm}^{el} < P_{lm}^{re} < 1$.

The dynamics of the training level of military personnel is shown graphically in Figure 1.

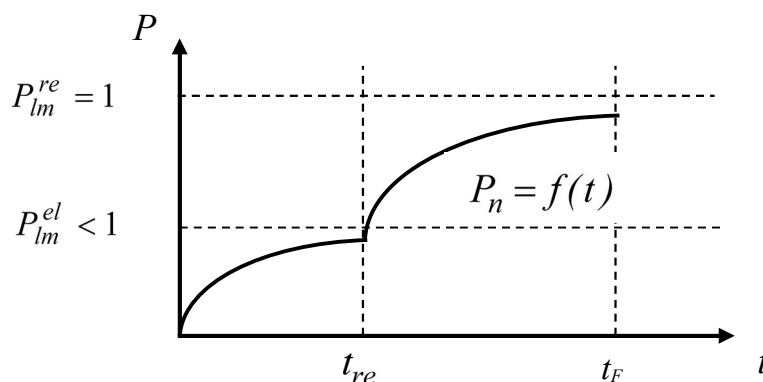


Figure 1 – Dynamics of the training level of military personnel (qualitative)

According to such a schedule, the level of training of a person, described by the indicator function (1), will change, provided that the educational literature and standard equipment are consistently used in the educational process. In a formalized form, it can be described as follows:

$$P^{el}(n) = P_{lm}^{el} - (P_{lm}^{el} - P_0) \cdot (1 - \xi)^{n_{el}}, \quad (2)$$

$$P^{re}(n) = 1 - (1 - P^{el}(n)) \cdot (1 - \xi)^{n_{re}}, \quad (3)$$

$$P^{re}(n) = P_{gl};$$

$$n_{re} - ?$$

The time t_{re} in Figure 1 corresponds to such a number of training sessions n_{el} , after which it is advisable to move from studying the training content based on the educational literature to the use of standard equipment. Since the cost of classes using educational literature and standard equipment is different, and the level of training of military personnel varies according to a non-linear exponential curve, the required number of classes using each type of training means is a value that must be determined.

Based on the relevant sections of the theory of military economic analysis, we have

$$n_{re} = \frac{\ln(1 - P_{gl}) - \ln(1 - P^{el}(n))}{\ln(1 - \xi)}, \quad (4)$$

where P_{gl} is the given level of training (the requirement for the probability of completing the tasks, which must be achieved, is set by directive).

The organization of the training process of military personnel according to this scheme can be considered a two-level model of training. The main drawback of this model is the low level of practical training of military personnel due to the limited amount of training (practical classes) that can be conducted on regular equipment. To increase the level of practical training of military personnel, it is advisable to introduce a three-level model, which along with the use of educational literature and regular equipment, involves the use of simulators.

In general, the three-level training model can be presented in the following form:

$$P^{el}(n) = P_{lm}^{el} - (P_{lm}^{el} - P_0) \cdot (1 - \xi)^{n_{el}}, \quad (5)$$

$$P^s(n) = P_{lm}^s - (P_{lm}^s - P^{el}(n)) \cdot (1 - \xi)^{n_s}, \quad (6)$$

$$P^{re}(n) = 1 - (1 - P^s(n)) \cdot (1 - \xi)^{n_{re}}, \quad (7)$$

$$P^{re}(n) = P_{gl};$$

$$n_s, n_{re} - ?$$

Accordingly, the number of classes that should be conducted using various educational tools is calculated according to the following formulas:

$$n_s = \frac{\ln(P_{lm}^s - P^{el}(n)) - \ln(P_{lm}^s - P_0)}{\ln(1 - \xi)}, \quad (8)$$

$$n_{re} = \frac{\ln(1 - P_{gl}) - \ln(1 - P^s(n))}{\ln(1 - \xi)}. \quad (9)$$

The graphic interpretation of the three-level model of military personnel training is shown in Figure 2.

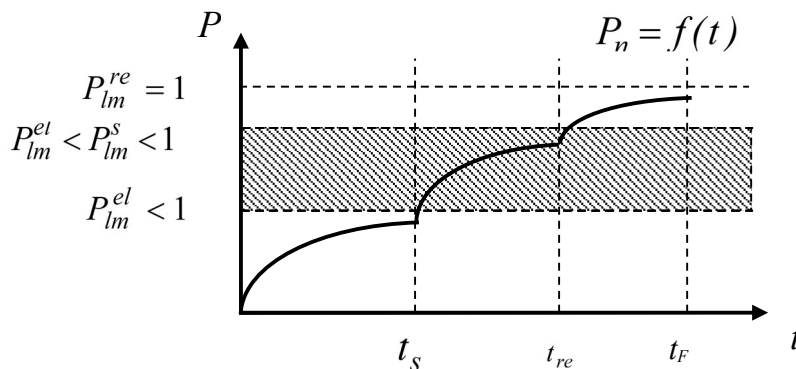


Figure 2 – Dynamics of the training level of military personnel during the application of the three-level model (qualitative)

During the application of the three-level training model, the number of classes on regular equipment is reduced. At the same time, there is an opportunity to practice certain actions (operations) on the simulator, which makes it possible to increase the amount of individual training (practice tasks) for each student. As a result, the level of acquiring practical skills enhances, and the effect of training, which will be carried out further on the standard equipment, increases [5].

An important result is also the saving of costs for military personnel training ΔC , which occurs due to the fact that during the time interval $\Delta t = t_F - t_{mp}$ the number of classes with the use of regular equipment decreases the consumption of its technical resources. In the general case, such savings can be calculated according to the formula

$$\Delta C = (C_{re} \cdot n_2^{re} - C_{re} \cdot n_3^{re}) + C_s \cdot n_3^s, \quad (10)$$

where C_{re} , C_s is the cost of one lesson using regular equipment and a simulator, respectively;

n_2^{re} , n_3^{re} – the number of classes using regular equipment according to the two-level and three-level training models, respectively;

n_3^s – the number of classes using simulators.

In general, the use of simulators is expected to have a number of positive effects. The main ones are as follows.

1. Increasing the level of practical training for the operation of food cooking equipment in field conditions.

2. Increasing the cognitive activity of military personnel doing training.

3. Economy of the technical resource of regular field equipment of the food service.

4. Reduction of costs for the cycle (program) of training.

The generalized requirement for simulators refers to the level of training that can potentially be achieved with their use in the educational process, that is, the parameter P_{lm}^s . This parameter characterizes the compliance (adequacy) of the simulator with the standard equipment, for the operation of which personnel are trained. This level should exceed the level that can potentially be achieved using only the educational literature, i.e. $P_{lm}^{el} < P_{lm}^s < P_{lm}^{re}$ (the area shaded by the slanted line in Figure 2). At the same time, the closer it will be to the level of training corresponding to standard equipment ($P_{lm}^{re} \rightarrow 1$), the higher will be the effectiveness of the use of the simulator during the training of military personnel.

Capital and current costs associated with their development (purchase) and operation are important economic indicators that must be taken into consideration when deciding on the feasibility of creating simulators. At the stage of qualitative analysis, it is obvious that these costs should be lower than the costs associated with the purchase and operation of standard equipment. Reducing the cost of educational materials is the main component of reducing the cost of classes and saving money.

Conclusions

The level of training specialists of the logistic services (logistic units) to perform tasks in the areas of hostilities is directly reflected in the quality of material, in particular, food supply of those units in which they perform tasks, and accordingly, in the final results of the actions of the troops (forces).

The use of food cooking equipment in the field is an important skill that logistic service specialists should master. These requirements also apply to the personnel of the main units, who may be appointed freelance cooks in units operating autonomously.

The use of a traditional approach to the training of such persons is not effective enough, as it is mainly focused on peacetime learning conditions, does not take into account modern approaches to the activation of cognitive activity, limitations on the possibilities of using standard technical means for learning.

The development and use of simulators is an important direction of increasing the effectiveness of the training process of military personnel of various specialties and military branches. The simulators significantly expand the possibilities for the formation of personnel practical skills in the field of training, make it possible to simulate a wide range of environmental conditions, quickly evaluate the results of training, etc.

The simulators have become widely used in training combat personnel using complex types of weapons and military equipment. However, they were not considered as a means of training specialists for the operation of technical means of the logistic services, which restrained work on their development. Such developments were considered impractical.

With the development of modern IT-technologies, the opportunities for developing simulators to master technical means of the logistic services and their use in the educational process have significantly expanded. The cost of such developments has

decreased. The conducted analysis indicates the expediency of creating simulators for mastering the technical means of the logistic services.

Further research provides for the formation of requirements for simulators to train specialists in using technical means of cooking in the field, the selection of a technological platform for the development of test samples, and the evaluation of the economic indicators of such developments.

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ЗАСТОСУВАННЯ ТРЕНАЖЕРІВ ЯК СПОСІБ ПІДВИЩЕННЯ ЕФЕКТИВНОСТІ ПІДГОТОВКИ ФАХІВЦІВ ДО ЕКСПЛУАТАЦІЇ ТЕХНІЧНИХ ЗАСОБІВ СЛУЖБ ТИЛУ

Проаналізовано методичні аспекти створення та використання тренажерів для навчання військовослужбовців експлуатації технічних засобів тилового забезпечення. Аналіз проводився на прикладі підготовки фахівців до роботи з харчовим і транспортним обладнанням у польових умовах. Підвищення ефективності навчального процесу військовослужбовців, зокрема в частині набуття практичних навичок експлуатації технічних засобів приготування їжі у польових умовах, є актуальним завданням, яке потребує вирішення. Відповідні знання, практичні навички та вміння необхідні не лише фахівцям підрозділів службового забезпечення, які за штатними посадами можуть бути кухарями та використовувати технічні засоби приготування їжі у польових умовах, а й військовослужбовцями основних частин, які можуть призначатися позаштатними кухарями командирами підрозділів, що діють самостійно. Як шлях підвищення ефективності навчального процесу пропонується перехід від дворівневої моделі навчання до трирівневої.

Перша модель передбачає організацію навчального процесу з послідовним використанням підручників і стандартного обладнання як засобів навчання. Друга модель передбачає використання тренажерів разом із підручниками та штатним обладнанням. У цьому комплексі засобів навчання тренажери займають проміжне місце. Їх застосування дасть низку позитивних ефектів. По-перше, поглибити практичні навички можна внаслідок збільшення кількості індивідуальних занять. По-друге, підвищиться пізнавальна активність тих, хто навчається, їх мотивація до навчання. По-третє, очікується зниження вартості циклу навчання. Для досягнення такого ефекту тренажери повинні відповідати певним вимогам, які можна підсумувати як адекватність тренажера штатному обладнанню, на якому навчають військових. На сьогодні бракує тренажерів для навчання фахівців роботі з кулінарним обладнанням у польових умовах. Водночас сучасний рівень науково-технічного і технічного прогресу відкриває нові можливості для розроблення відповідних тренажерів та їх використання у навчальному процесі.

Подано математичні інтерпретації дворівневої і трирівневої моделей організації навчального процесу та їх графічні інтерпретації.

Ключові слова: *військова підготовка, навчальний процес, ефективність навчального процесу, технічні засоби тилового забезпечення, тренажер, практичні навички.*

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