

Assessing the Effectiveness of Tactical Skills Level when Using a Laser Tag Type Two-Way Skirmish Simulator

Artem BRATKO¹, Viktor HASHCHUK², Taras SUSLOV³, Roman MISHENIUK⁴, Vitalii ZHURAVEL⁵, Vitalii HAVRYLIUK⁶

¹Ph. D. in Military Sciences, Associate Professor of the General Military Disciplines Department, Bohdan Khmelnytskyi National Academy of the State Border Guard Service of Ukraine, Khmelnytskyi, Ukraine. bratkoav84@gmail.com

²Ph. D. in Pedagogics, Associate Professor of the General Military Disciplines Department, Bohdan Khmelnytskyi National Academy of the State Border Guard Service of Ukraine, Khmelnytskyi, Ukraine. gas9669@ukr.net

³Ph. D. in Pedagogics, Lecturer of the General Military Disciplines Department, Bohdan Khmelnytskyi National Academy of the State Border Guard Service of Ukraine, Khmelnytskyi, Ukraine. zvdozdk@i.ua

⁴Ph. D. in Pedagogics, Associate Professor of the General Military Disciplines Department, Bohdan Khmelnytskyi National Academy of the State Border Guard Service of Ukraine, Khmelnytskyi, Ukraine. rmishenyuk@gmail.com

⁵Ph. D. in Military Sciences, Professor of the General Military Disciplines Department, Bohdan Khmelnytskyi National Academy of the State Border Guard Service of Ukraine, Khmelnytskyi, Ukraine. vg_zhuravel@i.ua

⁶Ph. D. in Pedagogics, Lecturer of the General Military Disciplines Department, Bohdan Khmelnytskyi National Academy of the State Border Guard Service of Ukraine, Khmelnytskyi, Ukraine. gavrilyuk.vitaliy85@gmail.com

Abstract: *The result of military personnel practical training lies in skilful and confident actions using available weapons and military equipment in all types of the combined arms operation. There is a need to use training and simulation equipment in order to increase the force proficiency, to save resources in weapons and military equipment use. Analysis of the ground forces personnel military training system in the militarily developed leading countries of the world indicates the tendency of further reduction of the weapons and military equipment use for the personnel professional training, the introduction of new forms and methods into training with the use of simulators, training and simulation equipment and training and simulation complexes. The armies of NATO countries have a tendency to use full-scale simulators designed to provide cadets with specific skills that allow the personnel training as part of crews (teams), platoons, company and other units, as well as to carry out the full range of their functional responsibilities. The authors of the article have developed a method for assessing the effectiveness of the military personnel competitive activity when solving tactical tasks using laser tag type two-way skirmish simulators, which allows to determine the level of separate components training (the skills level of separate tactical techniques accomplishment, tactical, physical, psychological readiness) and to carry out the personnel training level assessment as a whole. The assessment included the most important training level criteria which characterize a degree of a serviceman tactical training and have an influence upon the real end result when solving the tactical tasks by the unit as a whole.*

Keywords: *competitive activities; degree of tactical training; tactical task; tactical technique; effectiveness factor; two-way skirmish simulator.*

How to cite: Bratko, A., Hashchuk, V., Suslov, T., Misheniuk, R., Zhuravel, V., & Havryliuk, V. (2020). Assessing the Effectiveness of Tactical Skills Level when Using a Laser Tag Type Two-Way Skirmish Simulator. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 11(1), 189-203. <https://doi.org/10.18662/brain/11.1/23>

1. Introduction

At the present stage, the State Border Guard Service of Ukraine actively uses training and simulation equipment and training and simulation complexes for educational and training purposes, as evidenced by the number of command-and-staff training exercises and practical field exercises involving these technical means.

The use of simulators in the educational process in terms of the personnel training allows within the shortest possible training time to work out a solution of several training-combat tasks, choosing the most rational option, to expand the list of emergency situations (to increase the list of situations to occur), to learn new techniques and methods of conducting the combat.

MILES-2000 system is actively used by the Armed Forces of Ukraine. The experience of its use shows that such simulation of real combat can significantly improve the effectiveness of the military personnel individual combat training and therefore the overall level of the unit effectiveness.

The Multiple Integrated Laser Engagement System (MILES) is a training system that provides a realistic battlefield environment for soldiers engaged in training exercises. MILES provides tactical engagement simulation for direct fire-on-force training using eye-safe laser "bullets". Each individual and vehicle in the training exercise has a detection system to sense hits and perform casualty assessment. Laser transmitters are attached to each individual and vehicle weapon system and accurately replicate actual ranges and lethality of the specific weapon systems. MILES training has been proven to dramatically increase combat readiness and combat effectiveness of military forces.

Soldiers use MILES devices primarily during force-on-force exercises, from squad through brigade level, to simulate the firing and effects of actual weapons systems. These weapons systems include the M1 Abrams Tank, Bradley Infantry Fighting Vehicle, M113 Armoured Personnel Carrier, wheeled vehicles and other non-shooting targets. Additionally, Basic MILES simulations address anti-armour weapons, machine guns, rifles, and other ancillary items, such as a controller gun, within the program (Federation of American Scientists, 1999).

The National Academy of the State Border Guard Service of Ukraine (NASBGSU) uses a similar system, called the laser tag type two-way skirmish simulator.

In the process of using this simulator in training exercises on general tactics, military personnel perform competitive activities during which they receive a combat mission to solve a tactical task, and the instructors of the training exercise comprehensively evaluate each serviceman.

This system gives the opportunity during the execution of tactical techniques and tasks to record: the movement of soldiers across the battlefield, the total number of shots made by a serviceman, the number of hits, injuries and the effectiveness of fire activity.

In the process of the training exercises conduct involving the use of this system, we experienced a problem of qualitative assessment of the level of skills of performing certain tactical techniques and the degree of tactical training of the military personnel and units as a whole related to the use of weapons during combat operations.

2. Literature review

The significance of information and communication technologies usage by future border guard officers who study on specialty «State border security and protection» according to the first (bachelor) level of higher education for state examinations was revealed in the study of Bloshchynskiy (Bloshchynskiy, 2017a). The analysis of the scientific literature showed that the problems of modernization and creation of military simulation and modelling complexes were addressed by such scientists as Rusnak & Shevchenko (Rusnak & Shevchenko, 2002); methodical approach to substantiation of characteristics of simulation facilities and systems is described in the work of Matvievskiy (Matvievskiy, 2005); simulation support of ground forces as a mechanism for increasing the level of combat training of mechanized and tank troops is covered in the work of Rudkovskiy (Rudkovskiy, 2012); issues concerning training and simulation equipment state and prospects for its further development with respect to mechanized and tank units were addressed by Rusilo (Rusilo, 2010).

Since 2014, considering the complex situation in Ukraine and experience of the protection and defense of the southeastern border areas of the state, new models of cadets training based on practical execution of law enforcement and military objectives were developed; basic qualifications for graduates were corrected. In view of this, 2/3 of the teaching hours are allocated to the study of professionally oriented subjects, 70% of which are practical classes. Also, target reorientation on military specificity within the law-enforcement function of the border guard agency was performed. It was based on the experience of combat employment of border units in a rapid

change of the situation and localization of conflict, non-standard situations at the state border, combating sabotage-reconnaissance groups and illegal military formations. Cadets' military training at the NASBGSU now is performed in order to enrich and improve knowledge acquired during lectures, and to improve practical skills in performing duties in BG units under real conditions (Bloshchynskyi, 2017b).

The aforementioned works focus on the fact that military personnel training with the use of simulators becomes one of the main attributes in the professional development of almost all categories of servicemen. Also, the problem of assessing a serviceman training level and a unit as a whole specifically when using the simulators is not sufficiently covered. Therefore, the authors of the article have developed and tested a model to assess the military personnel competitive activity effectiveness when solving tactical tasks as exemplified by the use of laser tag type two-way skirmish simulator, which allows to determine the level of separate components training (the skills level of separate tactical techniques accomplishment and degree of tactical training) and to carry out the personnel training level assessment in general.

3. Materials and Methods

When conducting tactical exercises, there is a problem of qualitative assessment of the skills level concerning performance of separate tactical techniques and tactical training associated with the use of weapons and equipment in the conduct of combat operations by military personnel and units as a whole. Due to the fact that the laser tag type two-way skirmish simulator gives the opportunity during the execution of tactical techniques and tasks to record: the movement of soldiers across the battlefield, the total number of shots made by a serviceman, the number of hits, injuries and the effectiveness of fire activity, a demand arose in order to systematize the given data and include them in assessing the skills level concerning performance of separate tactical techniques and degree of tactical training of the military personnel using the laser tag type two-way skirmish simulator.

In the process of using the laser tag type two-way skirmish simulator in training exercises on general tactics, the military personnel perform competitive activities during which they receive a combat mission to solve a tactical task, and the instructors of the training exercise comprehensively evaluate each serviceman.

The competitive activities of the military personnel in solving tactical tasks with the help of the laser tag type two-way skirmish simulator should be understood as the military personnel splitting into 2 teams that will

perform tactical missions in real-time mode with the help of the laser tag type two-way skirmish simulators, whereupon one team carries out the tactical task in defence and the second team in the offense, taking into account the need for the advantages of the advancement unit as 1/3.

The complexity of assessing the effectiveness of the military personnel competitive activities in solving tactical tasks is due to the specificity and variety of tactical techniques used by the military personnel, the structure of which consists of a large number of diverse technical and tactical actions, which are accompanied by the manifestation of various mental, physical and individual-psychological characteristics of a serviceman and require the presence of stable skills in performing tactical techniques and tasks. When performing tactical tasks, the instructors taking into account the whole variety of criteria concerning the level of a servicemen training, as a rule, assess separate actions of the serviceman, which include specific mobile qualities and skills that reflect the physical, technical and degree of the serviceman tactical training in respect of tactical tasks performance, availability of stable skills in performing tactical techniques and tasks, as well as the manifestation of the servicemen individual-psychological characteristics such as endurance, resistance to stress, ability to assess the situation and make the right decision, etc.

At present, the problem of objective assessment of the military personnel competitive activities effectiveness in solving tactical tasks is not fully solved, by virtue whereof a method for assessing the effectiveness of the military personnel competitive activities in solving tactical tasks with the help of the laser tag type two-way skirmish simulator has been developed and tested. This method gives an opportunity to determine the level of separate components training (the skills level of separate tactical techniques accomplishment and degree of tactical training) and to carry out the unit training level assessment as a whole. It should be noted that the assessment included the most important criteria of the levels of training, which characterize the degree of the serviceman tactical training and have influence upon the real end result in solving the tactical tasks by the servicemen.

The proposed method has been tested in assessing the military personnel competitive activities when solving tactical tasks using laser tag type two-way skirmish simulators during practical classes at the General Military Disciplines Department of the State Border Protection and Security Faculty of Bohdan Khmelnytskyi National Academy of the State Border Guard Service of Ukraine during August-November of 2019 in the course of 53 training exercises on general tactics with different categories of the State Border Guard Service of Ukraine servicemen.

4. Results of Research

Assessment of the skills level of separate tactical techniques accomplishment.

Assessment of the level of skills in regard of performing separate tactical techniques is due to the assessment of the effectiveness of practical skills implementation concerning the performance of separate tactical techniques carried out in the course of tactical tasks solving. To do this, each serviceman must take part in the solution of at least three tactical tasks, two of which should be versatile (offense and defence).

The effectiveness factor of practical skills implementation (EFPSI) in the course of separate tactical techniques performance with the help of laser tag type two-way skirmish simulators was based on the following indicators: the total number of shots, the number of hits, the received injuries, the effectiveness of fire activity. The effectiveness of combat operations of an individual serviceman is calculated on the basis of these indicators by calculating the effectiveness factor of attacking actions (EFAA) and the effectiveness factor of defensive actions (EFDA).

The effectiveness factor of attacking actions (EFAA) determines the percentage of successful shots (SS) that were made by a serviceman to the number of all fired shots (FS) by a serviceman while performing competitive activities in the course of solving tactical tasks with the help of laser tag type two-way skirmish simulator in the group of the servicemen performing the tactical task in offensive operation. It is calculated for each tactical task separately, depending on the number of performed tactical tasks.

$$EFAA1 = \frac{SS1}{FS1} \times 100\%$$

$$EFAA2 = \frac{SS2}{FS2} \times 100\%$$

After obtaining the values of the effectiveness factor of the attacking actions (EFAA1), (EFAA2) for each of the tactical tasks performed, the average arithmetic value of the factor according to the formula is calculated, which will reflect the numerical value of the effectiveness factor of the attacking actions (EFAA).

$$EFAA = \frac{(EFAA1 + EFAA2)}{2}$$

The effectiveness factor of defensive actions (EFDA) determines the percentage of received injuries (RI) to the number of all fired shots (FS) by a serviceman while performing the serviceman competitive activities in the course of solving tactical tasks in defensive operation with the help of laser tag type two-way skirmish simulator. It is calculated for the performance of each tactical task separately, depending on the number of performed tactical tasks.

$$EFDA1 = \frac{RI}{FS} \times 100\%$$

$$EFDA2 = \frac{RI}{FS} \times 100\%$$

After obtaining the values of the effectiveness factor of the defensive actions (EFDA1), (EFDA2) for each of the tactical tasks performed in the defensive operation, the average arithmetic value of the factor according to the formula is calculated, which will reflect the numerical value of the effectiveness factor of the defensive actions (EFDA).

$$EFDA = \frac{(EFDA1 + EFDA2)}{2}$$

The arithmetic mean of the sum of the effectiveness factor of attacking actions (EFAA) and the effectiveness factor of defensive actions (EFDA) will be the effectiveness factor of practical skills implementation (EFPSI) when performing separate tactical techniques carried out in the course of tactical tasks solving with the help of laser tag type two-way skirmish simulators in offensive and defensive operations.

$$EFPSI1 = \frac{(EFAA1 + EFDA1)}{2}$$

The effectiveness factor of practical skills implementation when performing tactical techniques carried out in the course of tactical tasks solving for each serviceman is determined on the basis of the assessment of the aforementioned factors.

The arithmetic mean of the effectiveness factors of practical skills implementation (EFPSI) for each serviceman in the team has been determined in order to determine the effectiveness level of practical skills implementation (EFPSI) when performing tactical techniques carried out in

the course of tactical tasks solving with the help of laser tag type two-way skirmish simulators. An example for a team of six servicemen.

$$EFPSI = \frac{(EFPSI1 + EFPSI2 + EFPSI3 + EFPSI4 + EFPSI5 + EFPSI6)}{6}$$

The “reference” model of the effectiveness of practical skills implementation when performing separate tactical techniques carried out in the course of tactical tasks solving has been calculated in order to determine the effectiveness level of practical skills implementation (EFPSI) when performing separate tactical techniques carried out in the course of tactical tasks solving with the help of laser tag type two-way skirmish simulators. The “reference” model has been calculated with the condition that the effectiveness factor of attacking actions (EFAA) and the effectiveness factor of defensive actions (EFDA) makes 100% respectively, and the effectiveness factors of practical skills implementation (EFPSI) also equals to 100%.

Effectiveness models of practical skills implementation

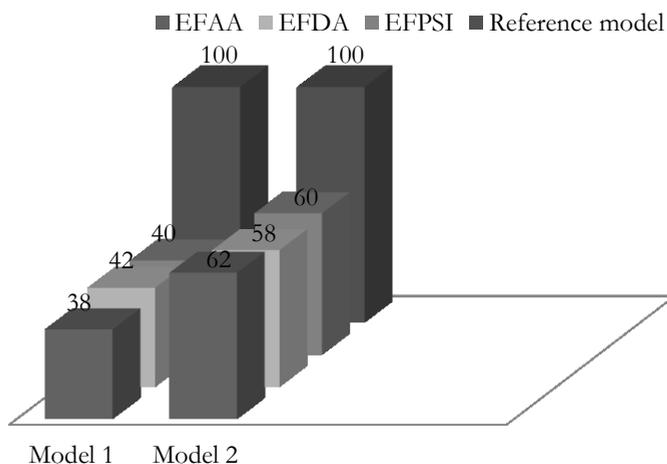


Figure 1. Effectiveness models of practical skills implementation when performing separate tactical techniques carried out in the course of tactical tasks solving

As a result of the analysis of the assessment of the effectiveness of practical skills implementation (EFPSI) when performing separate tactical techniques carried out in the course of tactical tasks solving with the help of

laser tag type two-way skirmish simulators of the defeated and winning teams in the course of the military personnel competitive activities in tactical tasks solving and comparison of their models of the effectiveness of practical skills implementation when performing separate tactical techniques carried out in the course of tactical tasks solving makes it possible to determine quantitative characteristics of practical skills implementation when performing separate tactical techniques carried out in the course of tactical tasks solving which are shown in figure 1.

The first model shows the quantitative characteristics of practical skills implementation when performing separate tactical techniques carried out in the course of tactical tasks solving with the help of laser tag type two-way skirmish simulators peculiar to the military personnel from the defeated team in respect to the “reference” model; as it can be seen the effectiveness factor of practical skills implementation (EFPSI) is below 50%, and makes only 40% concerning the team which was unable to accomplish the combat mission during the military personnel competitive activities in the course of tactical tasks solving.

The second model shows the quantitative characteristics of practical skills implementation when performing separate tactical techniques carried out in the course of tactical tasks solving with the help of laser tag type two-way skirmish simulators peculiar to the military personnel from the winning team (accomplished the “combat” mission) in respect to the “reference” model; as it can be seen the effectiveness of practical skills implementation (EFPSI) is above 50%, and makes 60% concerning the team which was able to accomplish the combat mission and won during the military personnel competitive activities in the course of tactical tasks solving.

A mathematical method, due to which the effectiveness factor of practical skills implementation (EFPSI) has been determined, was used to determine the level of practical skills implementation when performing separate tactical techniques by a serviceman in general; the results of the analysis indicated that if the effectiveness factor of practical skills implementation (EFPSI) when performing separate tactical techniques used in the course of tactical tasks solving is below 50% then the serviceman and the team cannot perform the combat mission, and accordingly, if the effectiveness factor of practical skills implementation (EFPSI) when performing separate tactical techniques used in the course of tactical tasks solving is above 50% then the combat mission is accomplished by the serviceman and the team.

Thus, it can be concluded that the servicemen and the military teams who won and accomplished the combat mission in the competitive activities

during practical exercises on general tactics using laser tag type two-way skirmish simulators showed the effectiveness level of practical skills implementation (EFPSI) above 50%.

Assessment and analysis of the level of tactical training

The level of tactical training is determined by the assessment of the following tactical actions: actions that ensure the implementation of the defined tactics of warfare; actions that provide a reorganisation of warfare tactics during combat; situational and preparatory actions to combat.

The actions that ensure the implementation of the defined tactics of warfare represent a particular variant of combat operations by a serviceman which is determined by a senior commander, but each serviceman still acts differently.

The actions that provide a reorganisation of warfare tactics during combat determine the readiness of a serviceman to suddenly change warfare tactics (counter a surprise attack, counterattack, etc.); the timeliness of decisions making to reorganise and to take appropriate actions should be evaluated in the course of this factor assessing.

The situational tactical action is an activity of a serviceman that aims at the advantageous use of individual elements during combat (relief, defensive structures, inattention of the enemy, etc.). During the competitive activities of the military personnel accomplishing tactical tasks, the reproduced situations can be divided into situations that will have positive consequences and the ones which are not favourable for the serviceman. The favourable situations include those situations in which the enemy is in a difficult position, the unfavourable situations include those where the serviceman finds himself in a difficult position. The favourable situations include: loss of alertness by the enemy, neglect of tactical standards by the enemy, withdrawal of one or more servicemen of the team from the competitive process, etc. The unfavourable situations include the opposite ones to the aforementioned.

The preparatory actions to combat within the military personnel competitive activities include: arrangements on cooperation and control within the team, false manoeuvres, throwing out advanced guard or servicemen, and other actions aimed at misleading the enemy, gaining an advantage in the tactical task solving. The aforementioned tactical actions were assessed in quantitative indicators, on the basis of expert assessments and were recorded in the protocol of assessment of the military personnel degree of tactical training in the course of competitive activities (Table 1).

Table 1. Protocol of assessment of the military personnel degree of tactical training in the course of competitive activities

| Components of tactical training degree | Tactical tasks | | | Total points |
|--|----------------|--------|--------|--------------|
| | Task 1 | Task 2 | Task 3 | |
| Ability to apply the chosen tactics of warfare | | | | |
| Ability to reorganise warfare tactics as appropriate | | | | |
| Use of situational actions during combat | | | | |
| Use of preparatory actions during combat | | | | |

Assessment of tactical actions is as follows: if a tactical action was used during the military personnel competitive activities, then it was evaluated as 1 credit point, if it was not used, then it counted 0 points. The points in the protocol of assessment of the military personnel degree of tactical training during the military personnel competitive activities are allotted for each of the tactical tasks, and as we have already mentioned herein above, there can be at least three what is more of bidirectional character. After that, the total points for each element of degree of tactical training is determined by adding all received points. The quantitative characteristics obtained during this assessment make it possible to evaluate the degree of an individual servicemen tactical training in the course of competitive activities using the following factors:

EFSTA stands for an effectiveness factor of the selected tactical actions, purposefulness and perseverance of the serviceman in accomplishing the tactical techniques inherent in the tactics of actions that are defined to the team;

EFRTA stands for an effectiveness factor of reorganising of tactical actions i. e. actions that provide reorganisation of tactics of conducting competitive activities in the course of the solution of a tactical task, to ensure a positive end result, or to mislead the enemy.

EFSTA stands for an effectiveness factor of situational tactical actions indicating how confident a serviceman is using an immediate situation at this or that moment of time when performing competitive activities in the course of a tactical task accomplishment (using terrain, protective structures, friendly casualties, changing the order of movement, etc.).

EFPTA stands for an effectiveness factor of preparatory tactical actions which is a quantitative indicator of the availability or absence of preparatory tactical actions when performing competitive activities in the course of a tactical task accomplishment.

The ideal model of tactical skills training has been calculated for the purpose of comparative analysis of the level of the military personnel degree of tactical training. It is a model in which the factor of tactical skills training of the servicemen is equal to the number of tasks completed by the serviceman, i. e. when performing three tasks, the factor makes 3, which will correspond to 100% of the qualitative tactical training of the serviceman.

Thus, having analysed the tasks execution by the teams defeated in the military personnel competitive activities in the course of accomplishing of the tactical tasks, it can be seen that the servicemen do not qualitatively implement the selected tactics of action at the level of no more than 33% and have a quantitative factor of 1, prematurely or without interaction with the group, reorganise the warfare tactics depending of the circumstances at the level of 33%, insufficiently use situational actions in the course of the combat at the level of 66% and do not always use preparatory actions in the course of the combat at the level of 33%.

The effectiveness factor of tactical training degree (EFTTD) equals the arithmetic mean of the factors of selected tactical actions, reorganising of tactical actions, situational and preparatory tactical actions.

$$EFTTD = \frac{EFSTA + EFRTA + EFSTA + EFPTA}{4}$$

Thus, the effectiveness factor of tactical training degree for each serviceman is taken into consideration. The arithmetic mean of the effectiveness factors of tactical training degree of all military personnel participating in the team is calculated in order to find out the quantitative value of the effectiveness factor of tactical training degree for a military team.

Analysis of the tasks execution by the winning teams in the military personnel competitive activities in the course of accomplishing of the tactical tasks indicated that the servicemen skilfully implement the selected tactics of action at the level of more than 66%, timely and in interaction with other servicemen of the group reorganise the warfare tactics depending of the circumstances at the level of 100%, sufficiently use situational actions in the course of the combat at the level of 100% and in the majority of cases

use preparatory actions in the course of the combat at the level of 33%. (Figure 2).

Analysis of the tactical tasks implementation by teams in the course of the military personnel competitive activities

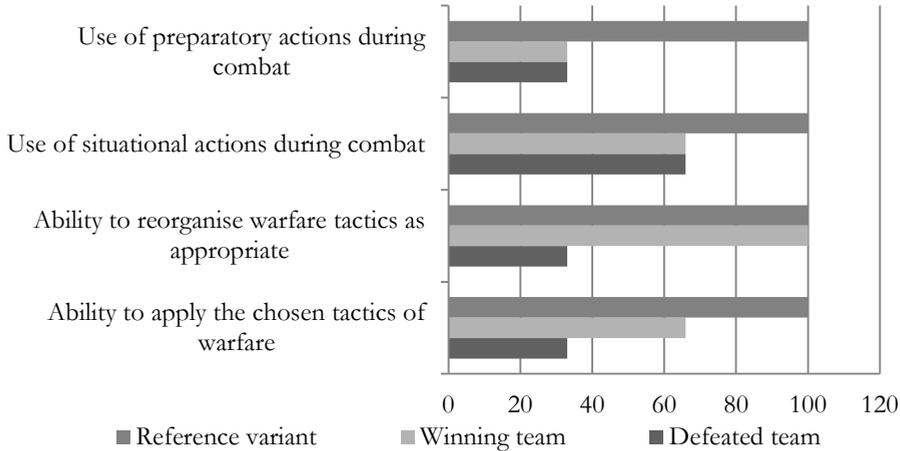


Figure 2. Analysis of the tactical tasks implementation by teams in the course of the military personnel competitive activities

A mathematical method due to which the effectiveness factor of tactical training degree (EFTTD) has been determined was used to define the level of tactical training in the course of competitive activities as a whole. Carrying out comparative analysis of the values of the effectiveness factors of tactical training degree (EFTTD) shown by the winning and defeated teams, we can conclude that, with relatively similar indicators, when using preparatory and situational actions, the teams that accomplished the task showed higher results in the ability to reorganise warfare tactics depending on the situation and applied the chosen tactics of action more skilfully.

5. Discussion

The use of modern simulators makes it possible to increase the level of trainees without significant cost when using weapons and military equipment in the course of practical exercises. The main unresolved issue is the procedure for assessing trainees when using simulators. The authors of the article have developed a method for assessing the effectiveness of the

military personnel competitive activity in the course of solving tactical tasks using laser tag type two-way skirmish simulators, which allows to determine the level of separate components training (the skills level of separate tactical techniques accomplishment and degree of tactical training) and to carry out the personnel training level assessment as a whole. The assessment included the most important training level criteria which characterize a degree of a serviceman tactical training and have an influence upon the real end result in the course of the tactical tasks solving by the unit as a whole.

6. Conclusions

Thus, the use of the laser tag type two-way skirmish simulator during practical exercises on general tactics gives a unique opportunity to assess the level of skills of separate tactical techniques accomplishment and degree of tactical training related to the use of weapons in the process of combat operations conduct by a serviceman. Taking into account the possibility of recording events that occurred in the course of competitive activities while carrying out tactical tasks during practical exercises, there is an opportunity to carefully analyse the actions of teams with appropriate further analysis of their activities and assessment of the team leader concerning the organization of competitive activities, and work in the course of its implementation, which may constitute a material for further research.

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