

A study on the psychological qualities of military personnel in technical support units based on the implementation of an automated control system program for the process of special physical training

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Published online: January 31, 2025

Accepted for publication: January 15, 2025

DOI:10.7752/jpes.2025.01004

Abstract:

The profession of a military specialist is aimed at applying a number of professionally important qualities. This is associated with many risks, both physical and psychological, which requires special specialized training. Therefore, the modern educational process in higher military educational institutions requires the correct definition of the forms and methods of training and urgently requires reformatting the practical professional and applied focus of all its components in relation to the new training regime, conditions of military service, physical and psychological stress. A correctly constructed process of special physical training of military personnel, taking into account all important aspects, contributes to the better formation of the psychological state for the implementation of assigned tasks. The psychological readiness of a serviceman allows not only to control his psyche, but also determines the readiness to act in extreme conditions and difficult situations when involved in combat operations, to successfully overcome the challenges they face in modern conditions. According to the results of our study, it has been proven that the psychological qualities that most influence the effectiveness of the work of specialists in the technical support units of troops include concentration of attention, stability of attention, switching attention, work efficiency, the degree of involvement in work, psychological stability and mental fatigue. The introduction of technology for optimizing special physical training using automated systems, the content of which is formed taking into account the level of training and professional focus, and based on the individual selection of special physical exercises to improve the qualities of a serviceman, contributes not only to improving the physical condition and fulfilling combat training standards, but also to improving the indicators of psychological preparedness of servicemen, which form high professional qualities in a future specialist, characterizing the moral and psychological portrait of a specialist, ensure the body's resistance to stress, materializing knowledge, skills and abilities in reliability parameters. *Purpose:* to study the dynamics of the formation of psychological qualities of military personnel of technical support units in the process of special physical training based on the use of automated control systems. *Material and methods.* The study involved 64 military personnel who are acquiring the educational level of "master" in a higher military educational institution. Participation in the study was carried out in accordance with the ethical principles of the «Helsinki Declaration» and was voluntary. The study participants were divided into control and experimental groups, between which differences were determined during the experiment. The study was conducted for 1,5 years.

Key Words: physical fitness, psychological state, concentration, attention stability, attention switching, work efficiency, degree of involvement in work, psychological stability, mental fatigue.

Introduction

In connection with the armed conflict on the territory of Ukraine, the issue of high-quality training of military personnel for professional activities and, in particular, for conducting military operations has acquired particular relevance. It should be noted that the profession of a military serviceman is a special and complex type of activity and requires a set of professionally important qualities. Their positive development is influenced by physical training classes. This is confirmed by leading specialists (Klymovych V., Oderov A., Romanchuk S., Olkhovyi O. et al., 2022; Oderov A., Romanchuk S., Yuriev S., Babych M. et al., 2024) and our previous research (Kamaev O., Hunchenko V., Hradusov V., Homanyuk S. et al., 2018; Yuriev S., Zonov O., Tseplyaev Yu., Bolshakov O., Hunchenko V. et al., 2022; Hunchenko V., Yuriev S., Romanchuk S., Tseplyaev U. et al., 2023).

As noted by Andres A., Slimakovsky O., Kryzhanovsky V., Krasovska I. (2022), regular physical activity contributes to the development of not only physical, but also moral and psychological qualities of the individual, without identifying which it is impossible to further improve the physical fitness of military personnel. According to Volkov M. (2023), in modern war conditions, the side that not only ensures the physical training of personnel, but is also able to form the psychological readiness of soldiers for activities in extreme combat conditions will have an advantage. Therefore, the problem of forming the psychological readiness of military personnel is of great importance, since both the effectiveness of service activities and personal safety depend on this readiness. Physical training of military personnel occupies a significant place in the formation of such readiness. In this regard, when constructing a process of special physical training based on the implementation of an automated control system program, there is a need to study the formation of psychological qualities of military personnel of technical support units.

Material & methods

In order to study the formation of psychological qualities of military personnel of technical support units in the process of special physical training based on the use of automated control systems, we conducted an experiment for a period of 1.5 years. The study involved 64 military personnel who are acquiring the educational level of «master» in a higher military educational institution. Participation in the study was carried out in accordance with the ethical principles of the Declaration of Helsinki, and took place on a voluntary basis, for which the military personnel signed a consent. The study participants were divided into control (n=33) and experimental (n=31) groups, between which differences were determined during the experiment.

Hypothesis assessment and testing methods were used to characterize the study groups and identify differences in indicators between the groups using the functions: arithmetic means in groups – $\bar{x}$; errors of arithmetic means – m . The reliability of differences in one characteristic in the group before and after the experiment and in two different groups was assessed using Student's t-test. Differences between arithmetic means were defined as significant at a reliability level of 95 to 99%.

A standard software package (MS Excel spreadsheets of the Windows operating system and Statistica – 6.0) was used to accumulate and analyze the data. Software methods of mathematical processing were used to characterize the data of military personnel of a certain sample and to study the difference between the indicators of representatives of the control and experimental groups.

Results

The indicators of concentration of attention of military personnel in the control group (CG) and the experimental group (EG) have equal reliable indicators at the beginning of the experiment, the difference in test results is 0,9 conventional units ($t=0,010$; $p>0,05$) (Table 1). At the end of the first semester of training, the results of the military personnel from the EG improved by 16,0 conventional units ($t=0,207$; $p>0,05$), and the results of the CG changed positively by 11,7 conventional units. ($t=0,156$; $p>0,05$). A comparison of the indicators of military personnel from the CG and the EG at the end of the first semester of training revealed a difference of 5,2 conventional units. ($t=0,088$; $p>0,05$).

The results of testing military personnel in the second semester of training revealed a more significant improvement in the indicators in the EG ($\Delta X=22,2$ conventional units; $t=0,363$; $p>0,05$) in contrast to the dynamics of the indicators in the CG ($\Delta X=1,8$ conventional units; $t=0,037$; $p>0,05$). We did not find any reliable difference between the indicators of concentration of attention of military personnel in the CG and EG at this stage of the study ($t=0,418$; $p>0,05$).

At the end of the experiment, the results of testing military personnel from the EG in assessing concentration were better, but reliably equal, than their results in the second semester ($\Delta X=16,1$ conventional units; $t=0,269$; $p>0,05$) and the results were obtained at the beginning of the experiment ($\Delta X=54,3$ conventional units; $t=0,715$; $p>0,05$). The dynamics of the results of assessing the concentration of attention of military personnel in the CG during the experiment is also positive ($\Delta X=17,7$ conventional units; $t=0,228$; $p>0,05$), but no significant changes were identified in relation to the initial data.

The introduction of the author's technology for optimizing special physical training using automated systems contributed to the improvement of indicators of concentration of attention of military personnel from the EG relative to the indicators of the CG ($\Delta X=37,5$ conventional units; $t=0,616$; $p>0,05$), but the results of the studied groups for this indicator were reliably equal.

Table 1. Dynamics of attention concentration indicators of military personnel from the CG and EG, conventional units

Researched groups	Admission		1 semester		2 semester		3 semester	
	X	$\pm m$	X	$\pm m$	X	$\pm m$	X	$\pm m$
CG	452,6	63,1	464,3	40,1	466,5	41,9	470,3	44,7
EG	453,5	63,7	469,5	43,2	491,7	43,2	507,8	41,2

No less important for technical support military personnel is such a psychological quality as stability of attention, which allows them to perform tasks with a certain quality for a long time. The dynamics of improving the stability of attention of military personnel from the EG throughout the study are positive. An improvement in the indicators in the first semester in relation to the initial data is observed ($\Delta X=0,18$ conventional units; $t=0,998$; $p>0,05$), and also in the second semester in relation to the results of the first semester ($\Delta X=0,16$ conventional units; $t=1,076$; $p>0,05$) and in the third semester relative to the second semester ($\Delta X=0,02$ conventional units; $t=0,140$; $p>0,05$), but no reliable difference was found between the above indicators (Fig. 1). Indicators of stability of attention of military personnel from the EG at the end of the experiment are significantly better than at the beginning of the research ($\Delta X=0,36$ conventional units; $t=2,057$; $p<0,05$).

The studies of the dynamics of the characteristics of the stability of attention of the servicemen of the CG allowed us to find reliable stability throughout the entire experiment. The changes in the test results amounted to 0,01-0,02 conventional units in the first and third semesters ($t=0,071$ -0,122; $p>0,05$).

A comparative analysis of the indicators of stability of attention of military personnel from the CG and the EG made it possible to determine that the results of the studied groups were reliably equal at the beginning of the experiment ($t=0,052$; $p>0,05$) and the end of the first semester of training ($t=1,009$; $p>0,05$). In the second semester of training, the indicators of attention stability of the EG are reliably better than in the CG by 0,33 conventional units ($t=2,027$; $p<0,05$), and at the end of the third semester the difference between the indicators is 0,34 conventional units ($t=2,981$; $p<0,01$). This allows us to assert that the introduction of a program for an automated system for controlling the process of special physical training made it possible to improve the indicators of stability of attention of military personnel.

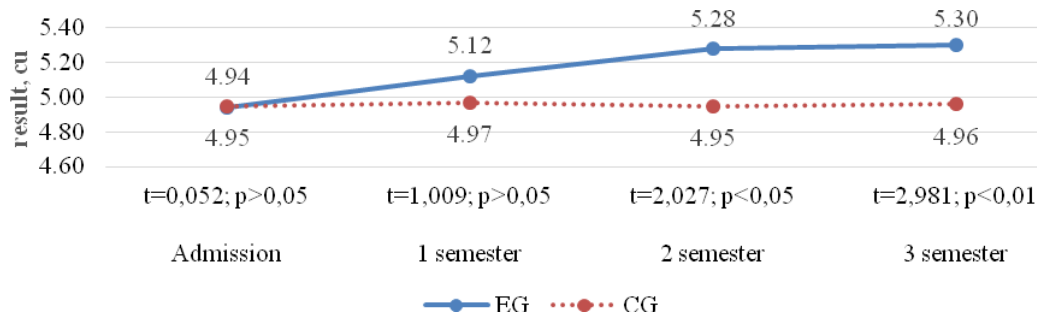


Figure 1. Dynamics of indicators of attention stability of military personnel of the CG and EG, conventional units

Studies of the indicators of attention switching among military personnel from the CG and EG during the experiment allowed us to determine positive dynamics in both groups (Fig.2). However, the dynamics of the attention switching indicators in the EG has a more rapid growth, starting from the first semester of study in the master's program ($14,16 \pm 1,11$ conventional units) relative to the initial data ($\Delta X=0,65$ conventional units; $t=0,395$; $p>0,05$). At the second stage of the study, the results of military personnel from the EG ($14,81 \pm 1,21$ conventional units) improved by 1,08 conventional units. relative to the indicators of the first semester ($t=0,674$; $p>0,05$). During the training at the final stage of the study, the results of the EG ($16,97 \pm 0,78$ conventional units) improved by 1,08 conventional units relative to the indicators of the previous stage ($t=0,825$; $p>0,05$). During the experiment, the indicators of attention switching of the EG improved by 2,81 conventional units and reliably exceeded the initial indicators of the military personnel of the study group ($t=2,071$; $p<0,05$).

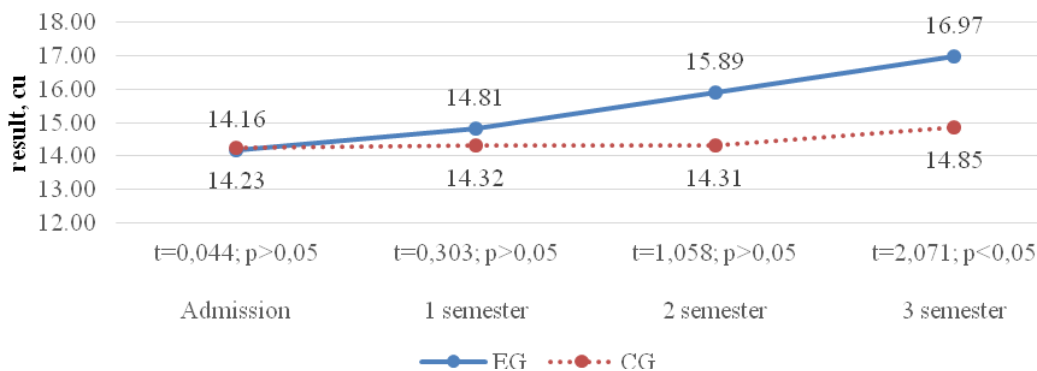


Figure 2. Dynamics of attention switching indicators of military personnel of the CG and EG, conventional units

The results of military personnel from the CG also showed positive changes during the experiment, but we did not identify any significant difference between the final ($14,85 \pm 0,64$ conventional units) and initial ($14,23 \pm 1,09$ conventional units) data ($\Delta X = 0,62$ conventional units; $t = 0,490$; $p > 0,05$). Comparison of the indicators of military personnel from the CG and EG during the study made it possible to find out that the initial data ($t = 0,044$; $p > 0,05$), results in the first ($t = 0,303$; $p > 0,05$) and second semesters ($t = 1,058$; $p > 0,05$) are reliably equal. The obtained indicators of attention switching in the CG and EG at the end of the experiment differ by 2,12 conventional units. The military personnel who were engaged in the implemented program of the automated system for managing the process of special physical training have reliably better ($t = 2,071$; $p < 0,05$). The performance indicators of military personnel from the CG and EG were reliably equal only at the beginning of the study ($t = 0,235$; $p > 0,05$). Subsequently, a reliable difference in the performance indicators in the CG and EG was determined in the first ($t = 2,121$; $p < 0,05$), second ($t = 2,257$; $p < 0,05$), third ($t = 2,906$; $p < 0,01$) semesters of study in the master's program (Table 2). The dynamics of performance indicators for military personnel from the EG has a gradual improvement throughout the experiment. Thus, after the first semester of training, relative to the initial data, performance indicators improved by 1,1 conventional units ($t = 1,525$; $p > 0,05$). At the end of the second semester of study, the EG indicators improved by 0,9 conventional units ($t = 1,116$; $p > 0,05$), and in the third semester – by 0,6 conventional units ($t = 0,526$; $p > 0,05$). In general, during the study, the EG results for work efficiency significantly improved by 2,6 conventional units ($t = 2,403$; $p < 0,05$).

The dynamics of performance indicators of military personnel in the CG during the study are more complex. During training in the first semester, performance indicators improved by 0,1 conventional units ($t = 0,138$; $p > 0,05$); Subsequently, during the second and third semesters of study in the CG, performance indicators deteriorate by 0,3 conventional units ($t = 0,335$; $p > 0,05$) and by 0,7 conventional units ($t = 0,581$; $p > 0,05$) relative to the preliminary stages of the study. Over the entire period of the experiment, the performance indicators of the CG military personnel decreased by 0,9 conventional units ($t = 0,832$; $p > 0,05$).

The degree of integration into work characterizes the speed of switching military personnel to a new activity, a new academic discipline and issuing the first results. A good result is considered to be an indicator below 1,0. A higher value of this indicator is indicated as low. The indicators of the degree of integration into work of military personnel of the CG and EG do not differ significantly at the beginning of the study ($t = 1,414$; $p > 0,05$) and in the first semester of study ($t = 0,707$; $p > 0,05$). Subsequently, their statistical analysis determined an increase in the difference between the results of the CG and EG (Table 2). Thus, in the second semester of study, the difference in indicators was 0,06 conventional units ($t = 2,121$; $p < 0,05$), and in the third semester, the results of the EG are better than in the CG by 0,08 conventional units ($t = 2,828$; $p < 0,01$).

The dynamics of the indicator of the degree of integration into work of the KG military personnel has a reliably stable result and is assessed as good. The improvement of the results of the degree of integration into work in the KG occurred in the first semester of training by 0,01 conventional units ($t = 0,277$; $p > 0,05$) and in the third semester by 0,02 conventional units ($t = 0,707$; $p > 0,05$). During the study, the indicators of the degree of entry into work of CG military personnel did not change significantly ($\Delta X = 0,03$ conventional units; $t = 1,060$; $p > 0,05$). The dynamics of the military personnel indicator of the EG has a stable increase in results, which indicates an improvement in the degree of entry into work. Thus, during the training in the first semester, the indicators in the EG did not change ($p > 0,05$), but the results of the degree of entry into work in the second semester improved in relation to the previous stage by 0,03 conventional units ($t = 0,832$; $p > 0,05$). During the training in the third semester, the results of the military personnel of the EG changed positively relative to the second semester by 0,04 conventional units ($t = 1,414$; $p > 0,05$). Changes in the indicator of the degree of entry into work in the EG, which were engaged in a special physical training program using automated control systems, have reliable positive dynamics relative to the initial data ($\Delta X = 0,07$ conventional units; $t = 2,474$; $p < 0,05$).

Table 2. Dynamics of changes in performance indicators and the degree of entry into work of military personnel from the CG and EG, conventional units

Researched groups	Admission		1 semester		2 semester		3 semester	
	X	$\pm m$	X	$\pm m$	X	$\pm m$	X	$\pm m$
Performance indicator								
CG	38,9	0,6	39,0	0,4	38,7	0,8	38,0	0,9
EG	39,1	0,6	40,2*	0,4	41,1*	0,7	41,7** [#]	0,9
Indicator of the degree of entry into work								
CG	0,90	0,02	0,89	0,03	0,89	0,02	0,87	0,02
EG	0,86	0,02	0,86	0,03	0,83*	0,02	0,79** [#]	0,02

Notes: * – the presence of a reliable difference between the results of the EG and CG at the 95% level;

** – the presence of a reliable difference between the results of the EG and CG at the 99% level;

[#] – the presence of a reliable difference between the results of the EG and CG relative to the initial data at the 95% level.

The indicators of psychological stability of military personnel characterize the ability to perform official duties in difficult combat conditions, under the pressure of unfavorable environmental factors, psychological stress, etc.

The result is considered good if the value is less than 1,0, more – is assessed as insufficient stability.

The initial indicators of the servicemen of the CG and EG do not differ significantly ($t=0,353$; $p>0,05$), but their value is assessed as an insufficient level of psychological stability (Fig. 3). This fact can be explained by the fact that combatants entered a higher military educational institution to study.

During the study, it was determined that the level of indicators of psychological stability of military personnel from the CG did not cross the 1,0 mark during the entire period of the experiment. This indicates insufficient development of psychological stability.

The EG indicators in the first semester are characterized as an insufficient level, and in the second and third semesters – already as a good one. This is confirmed by the results of our studies. There was no reliable difference between the initial indicators of psychological stability in the EG ($1,07\pm0,02$ conventional units) and the indicators of the first semester ($1,05\pm0,01$ conventional units) ($t=0,894$; $p>0,05$). A reliable improvement in the results was determined between the indicators of the first and second ($0,99\pm0,01$ conventional units) semesters ($t=4,242$; $p<0,001$). We also identified reliable changes in the indicators of military personnel of the EG relative to the initial data in the second semester of training ($t=3,577$; $p<0,01$) and at the end of the experiment. ($t=3,535$; $p<0,01$).

Statistical analysis of the results of the study of the CG and EG indicators proved the positive impact of the special physical training program using automated control systems on the development of psychological stability of military personnel. Thus, the indicators of the EG shown in the second semester of study reliably exaggerate the similar indicators in the CG by 0,05 conventional units ($t=2,236$; $p<0,05$), and the results shown in the third semester are by 0,07 conventional units ($t=2,474$; $p<0,05$).

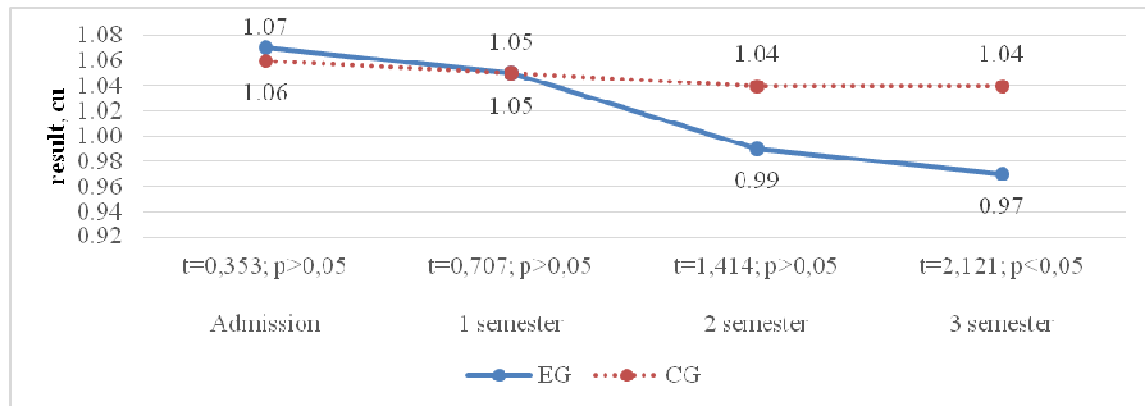


Figure 3. Dynamics of psychological stability indicators of military personnel of the CG and EG, conventional units

An important indicator of professional work capacity and training is mental fatigue. This indicator evaluates the duration of time during which a serviceman can perform a mental action at a high professional level.

Initial data on mental fatigue of military personnel from the CG and EG are defined as a mild degree of mental fatigue. They are not reliably different ($p>0,05$).

The dynamics of mental fatigue indicators in the CG has the following trends: improvement of indicators in the first semester of training ($t=1,316$; $p>0,05$), deterioration of indicators in the second semester by 1,01 conventional units ($t=1,097$; $p>0,05$) and deterioration of indicators at the end of training by 0,62 conventional units ($t=0,594$; $p>0,05$). At the same time, the studied indicators correspond to the level of moderate mental fatigue and do not differ significantly from the initial data, even worse by 0,14 conventional units ($t=0,149$; $p>0,05$) (Table 3).

Similar indicators in the EG during training improve by 3,0 conventional units ($t=3,046$; $p<0,01$). The indicators of the military personnel from the EG at the end of training characterize the level of mental fatigue as its absence.

Comparison of the results of the study of mental fatigue of military personnel in the CG and EG reveals that the indicators do not differ at the beginning of the experiment and in the first semester of study ($t=0,837$; $p>0,05$). In the course of further research, it was revealed that the indicators in the CG and EG differ significantly in the second ($t=2,398$; $p<0,05$) and third ($t=3,591$; $p<0,001$) semesters of study.

Table 3. Dynamics of changes in mental fatigue indicators of military personnel of the CG and EG, conventional units

Researched groups	Admission		1 semester		2 semester		3 semester	
	X	±m	X	±m	X	±m	X	±m
CG	15,1	0,91	13,65	0,62	14,66	0,68	15,28	0,79
EG	15,1	0,9	12,91	0,63	12,42*	0,64	12,10**##	0,41

Notes: * – presence of a reliable difference between the results of the EG and CG at the 95% level;
 ** – presence of a reliable difference between the results of the EG and CG at the 99,9% level;
 # – presence of a reliable difference between the results of the EG and CG relative to the initial data at the 99% level.

Discussion

Many studies that address the issue of military personnel preparedness are related to improving physical fitness (Krutsevych T., Pangelova N., Pidleteichuk R., 2021; Svystun V., Verbyn N., 2023; Romanchuk S., Hunchenko V., Ishchenko Ye., Iarovyi M. et al., 2024; Babaiev Yu., 2024).

Our preliminary research optimized the process of special physical training of military personnel based on the introduction of automated control systems, which ensured the optimal selection of means and methods of physical improvement, taking into account all the negative factors influencing this process (Gomanyuk S., Gradusov V., Gunchenko V. et al., 2014).

But, as noted by Kostetska L. & Lyseyuk A. (2021), the military profession is associated with many risks: both physical and psychological. This, in turn, requires physical and psychological fitness. That is why a number of such professionally important qualities are important for this profession: reaction speed; endurance; ability to mobilize; high development of will; developed thinking; ability to adequately analyze facts; high volitional self-regulation; ability to focus on an object for the required amount of time; high psychological and emotional resilience.

Scientific works reflect that the constant involvement of military personnel in the performance of duties in extreme conditions can contribute to maladaptation, decreased adaptability to various environmental conditions, neuropsychic overstrain, the development of persistent negative mental states and injuries. (Misyura V., Ruban L. & Mishyn M., 2022; Sorokolit N., Olkhovyi O., Ivakin T., Mitova E. et al., 2024). Therefore, the problem of forming the psychological readiness of military personnel of the Armed Forces of Ukraine to perform the tasks of military professional activity in today's conditions is relevant, since not only the effectiveness of the professional activities of military personnel, but also their personal safety depends on such readiness (Diachkova O., 2019; Romanchuk S., Kuznetsov M., Petruk A., Didenko O., 2021; Oderov A., Pervachuk O., Lesko O., Pylypchak V. et al., 2023).

In this regard, the modern educational process in higher military educational institutions urgently requires reformatting the practical professional and applied focus of all its components to the new training regime, conditions of military service, rest, physical and psychological stress (Klymovych V., Oderov A., Romanchuk S., Olkhovyi O. et al., 2022). We agree and believe that this will allow us to correctly determine the forms and methods of training and concentrate our efforts in the right direction.

According to the research of Penkova N. (2022), it was determined that the moral and psychological qualities of military personnel studying at a higher military educational institution are formed in connection with the content of the educational process and professional activity, life experience, family status, level of upbringing and development, education and other factors. Therefore, to organize professional and psychological training, it is necessary to identify the individual psychological characteristics of military personnel to facilitate the disclosure of their internal resources for mastering professionally significant qualities.

Our research has confirmed that the process of physical training solves the problems of not only ensuring the readiness of military personnel for combat activities and performing official tasks as assigned, but also facilitating the solution of other tasks of their training and education. Physical training classes develop moral and psychological qualities, which contributes to the formation of a professional worldview and professional self-awareness of the individual in military personnel, which presupposes deep reflexive knowledge of oneself in activity. Developed professional self-awareness helps to better understand and evaluate oneself, the specifics of one's official activities, and to determine the guidelines for professional and personal growth (Moskalenko N., Otkydach V., Korchagin M., Baldetskiy A., 2022; Oderov A., Leshchinskyi O., Pervachuk O., Babych M. et al., 2023). The influence of the physical development of a serviceman on personal qualities and the existence of a certain correlation between the level of psychomotor readiness and personality traits and the need to improve the psychological structure of psychomotor training for a qualitative impact on personality traits have been confirmed (Simko R., 2018).

The results of our study have determined that the use of technology for optimizing special physical training based on automated systems, the content of which is formed taking into account the professional focus, contributes to the improvement of indicators of psychological preparedness of military personnel and forms high

professional qualities in future specialists. It has been proven that the psychological qualities that most influence the effectiveness of the activities of specialists of technical support units of troops include concentration of attention, stability of attention, switching attention, work efficiency, the degree of entry into work, psychological stability and mental fatigue of military personnel, characterizing the ability to perform official duties in difficult conditions of combat activity, under the pressure of unfavorable environmental factors, psychological stress, etc.

Conclusions

The process of physical training of military personnel studying at higher military educational institutions in the context of forming psychological readiness will be effective only if all important aspects are taken into account during its organization. Proper organization of physical training will contribute to improving the psychological state of military personnel and help them successfully overcome the challenges they face in modern conditions.

The conducted research has proven that the introduction of technology for optimizing special physical training using automated systems, the content of which is formed taking into account the level of preparedness and professional orientation, contributes not only to improving the physical condition and fulfilling combat training standards, but also to improving the indicators of psychological preparedness of the forming military personnel; the future specialist has high professional qualities that characterize the moral and psychological portrait of the specialist, ensure the body's resistance to stress, materializing knowledge, skills and abilities in reliability parameters.

Individual selection of special physical exercises to improve the preparedness of a specialist is aimed at bringing the level of development of physical and psychological qualities closer to the ideal model of a technical support military personnel.

Conflicts of interest – All authors in this study declare that they have no conflict of interest with any party.

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