

Original article

Training of commanders, gunners and loaders of the Leopard 2 tank using training devices

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INFORMATION

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ABSTRACT

The article addresses using the Leopard 2 tank simulators and trainers based on training experience from the 1st battalion of 10th Armored Cavalry Brigade (10 BKPanc) and the Leopard Training Center from Świątoszów. The Leopard 2 tank simulators and trainers from the perspective of the instructor and trainees are characterized. The author has attempted to evaluate individual devices. The possibilities of using individual training devices in the process of training subunits are presented.

KEYWORDS

simulator, device, training, trainer



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Introduction

During their development, tanks have experienced revolutionary technological changes. Modern constructions are equipped with advanced systems: fire control, vehicle protection, defense against weapons of mass destruction, underwater driving, and systems supporting crews' situational awareness. Therefore, only a well-trained crew can use the potential of the current combat vehicles maximally. On the other hand, the instructor needs tools that will enable the transfer of specialist knowledge in a simple, realistic, and fast way and analyze numerous information resulting from the trainees' actions. That makes it necessary to use new devices in the training process, which will provide the instructor with data on an ongoing basis while conducting classes and at the same time allow them to conclude discussions with an indication of mistakes made by the trainees.

The use of vehicles and combat assets in field conditions is considered the most critical part of the training process. This form of training is very expensive and time-consuming due to the high costs of tank exploitation and various organizational measures. Not all the advantages of a tank and tactical procedures can be practiced during range training. It is related to the limitations resulting from the safety conditions in force in the range training centers (e.g., safety conditions related to shooting) and infrastructural limitations (e.g., the capacity of tactical belts). Moreover, training in field conditions is characterized by the repetition of the terrain and exercise scenario.

Rationalizing training requires supplementing traditional training with new devices and ways to use them.

Given the above, the article aims to present the way of using simulators and trainers in the process of training tank units. The current literature lacks information on the scope of the use of simulators in the training of armored vehicles (number of hours, methods of their use in individual periods of training, organization of classes). The available literature on the training and training devices of the Leopard 2 tank is limited mainly to the maintenance and technical description but does not show their possibilities from the training perspective.

1. Curriculum requirements

The basis for planning, organizing, and implementing the training process in general military battalions is the "Training Program for Armored, Mechanized and Motorized Forces" (PSP-WPZiZ) [1, p. 5]. Already in the first training period, in the first stage, the Program assumes "improvement of individual skills, team training and teamwork to the platoon level" and the use of simulators and trainers in the initial training process of crews and subunits. In the other part of the first training period, coordinating the platoon is carried out during field training using combat vehicles [1, p. 36-37]. According to the Program, it is recommended to use simulators to support the training in further stages.

The combat training basic subjects, which are particularly crucial for preparing a tank subunit for operations as intended, include tactics and fire training [1, p. 32]. This fact is reflected in the number of hours planned for conducting classes in the subjects mentioned above. During the implementation of combat training classes, which consists of thirteen subjects, 1000 hours are planned for the first 12-month period, including 512 hours for tactics and fire training [1, p. 38]. Due to the importance of these subjects (mainly realized during field training), it can be concluded that the most significant demand for simulators and trainers will be among the classes as mentioned earlier. When analyzing the list of simulators and training and training devices recommended for use in curricular training by the training program, it can be stated that their vast majority is dedicated to the implementation of classes in the subjects as mentioned above [1, p. 167-168]. The suggested teaching aids should meet the highest requirements to enable the instructor to conduct training under the principles of military education, and particularly the principle of realism, and to bring combat training as close to the real conditions of the intended battlefield as possible [2, p. 9]. According to the author, simulators can be used at all training stages, from basic training to training related to specific combat environments or in an international environment.

2. Capabilities of training devices and their use

The current training program (PSWPZiZ) distinguishes the following simulators and trainers to be used in the process of training the Leopard 2 crews: a tank crew shooting simulator LEOPARD 2A4 of ASPT type, a tank turret trainer LEOPARD 2A4 of AAT type, a laser shooting simulator of the LEOPARD 2A4 of AGDUS type, a combat simulator of a platoon of Leopard 2A4 of AGPT type, and a driver training of the Leopard 2A4 tank [1, p. 167-168]. As the author's experience shows, the VBS 3 simulator is used in the process of training cadets (whose first position in the service is the platoon/crew commander) [3]. In addition, tank subunits from brigades equipped with LEOPARD 2 tanks regularly use simulators at the Mechanized Training Center (MTC) in Switzerland [4].

2.1. ASPT simulator and AAT trainer

The “ASPT Ausbildungsgerät Schießsimulator für die Truppenausbildung der Panzertruppe” simulator (Fire training simulator for training armored units) is designed for training commanders and gunners. It consists of three compartments for instructors, trainees, and servicemen.

This device enables trainees to learn:

- servicing the gunner’s and the commander’s compartments,
- target detection, recognition, and identification,
- laser rules (correctly measuring distances to targets),
- preparation of the fire control system (SKO) for combat,
- coordinating the commander and the gunner (“combat conversation”),
- activities in the environment of limited visibility and in the event of the SKO failure [5, p. 3].

Additionally, ASPT allows the commander to select ammunition in relation to the target, communication between the gunner and the commander through a set of headphones (as in a real tank). Loudspeakers with adjustable sound intensity are installed to reflect the prevailing noise in the combat vehicle (sounds of working components, rifle and cannon shots) [5, p. 19-21].

The instrumentation of the instructor’s compartment (Fig. 1) provides essential information on the commander and gunner’s training level. The exercise leader can choose the scenario depending on the crew’s training level. The individual scenarios differ in weather conditions, cell types, and fire control system failures [5, p. 33-39]. As for fire training, the instructor can control the correctness of the tank SKO operational preparation and track errors in its use during the fight [7, p. 231-232]. A significant feature of this simulator is its capability



Fig. 1. Instructor compartment in the ASPT simulator
Source: [6].

to control the gunner's and the commander's work on the joysticks. By analyzing the target point location using optical instruments, the laser point, the target point at the time of the shot, and the point of impact, the instructor can assess the smoothness of the weapon guidance and elimination any failures to break the shot (Fig. 2) [5, p. 26].



Fig. 2. The sighting and indications of the crew SKO status as seen by the instructor
Source: Own study.

The instructor's stand allows for an after-action review (AOR) to be played based on a recording of all information regarding the use of the SKO and the results of the fight (the crew's "combat conversation" is also played back) [5, p. 40]. The system automatically marks the crew's basic mistakes (e.g., wrong ammunition selection) on the timeline. The instructor has the option of printing the final report with the essential information on the fire training [5, p. 28, 41].



Fig. 3. One of the three AAT trainers used in the Leopard Training Center at the 10BK Panc in Świętoszów
Source: [8].

Another device used in training the LEOPARD 2 tank crews is the AAT trainer (turret training system), shown in Figure 3. It is used to train the turret crew, commander, gunner, and loader. Contrary to the ASPT, the trainer reflects the trainee's action in a dynamic way like in the real tank. Its design includes original tank parts.

The mapped turret section allows the trainees to acquire and improve various skills necessary to master in the initial period of training:

- safe behavior of the crew in the combat compartment during the work of the military control unit (turret rotation, cannon operation, simulated shot) makes the soldiers aware of the effects of activating the SKO components on other crew members and equipment [9, p. 25-23],
- switching on and operation of the SKO, including loading activities,
- actions in emergency situations,
- coordination of the crew of the fighting compartment [9, p. 12, 44, 47].

The instructor, whose seat is on the top of the trainer, supervises the trainees' operation. From the position, he/she has the possibility, based on the card, to introduce errors in the turret components to check the participants' reactions to the SKO failures [9, p. 48-53, 97]. The instructor can use AAT to pre-learn the arrangement and operation of components. The trainer has a shot counter, which allows for the possible calculation of shots fired [9, p. 19, 29]. In addition to the group of trainees and the instructor, AAT may have a group of observers. Due to the lack of armor in the turret and the attachment of their seats to the trainer, these soldiers can observe the detailed operation of the training crew and feel the turret movements. Besides, on the turret roof, there is a display informing about the SKO state, which allows the observers to analyze the action taken by the training participants [9, p. 22].

The short description of AAT and ASPT possibilities allows for the following conclusions:

- these devices should be used for combat drill training (preparation of a soldier for efficient habitual operation) [6, p. 32],
- they allow learning the basic activities related to the preparation and use of the vehicle during combat,
- they should be used in fire training (SzO) in the first period of training to coordinate the crews, and in the later stages to maintain the tank crews' fire skills,
- the training should be conducted by an experienced instructor (crew commander with appropriate experience, fire specialist) who is authorized to use this simulator and can analyze a large amount of information resulting from the SKO indications,
- training on simulators equips the trainees with various skills that reduce the possibility of accidents or damage to equipment while working on a tank,
- these devices allow shortening the training time, i.e., by quick detection of mistakes made by trainees or simple transfer of knowledge,
- appropriate documentation should be used to record the operation of devices to assess the savings achieved and shooting performed by the trainees.

2.2. AGPT and VBS simulator

Another simulator used in armored units is the AGPT simulator (Leopard crew combat simulator). In addition to the possibility of further fire training, unlike AAT and ASPT, it enables tactical training. The device consists of five containers, four containers reflect four tanks

(platoon) inside, the fifth container is the instructor's service station (Fig. 4). The modular structure of this simulator enables the replacement of obsolete electronic components with newer ones (monitors, graphic computers, etc.). The AGPT can be easily modernized along with the tank development [10, p. 5].

When it comes to the fire training, the AGPT enables commanders and gunners to improve in using the SKO (in the scope like in ASPT and AAT). The driver drives the tank in virtual terrain according to the tactical rules. The loader has similar operation possibilities as in the AAT, except that the cannon and turret operation is not mechanical but computer-simulated. Additionally, it gives the possibility, together with the entire crew, to practice the ammunition reloading procedure in combat (reloading the ammunition from the hull to the turret). This simulator requires all trainees to behave tactically as part of a platoon formation. The platoon commander can learn, improve, and develop tactical and fire procedures in force in a given subunit [10, p. 7-8].

The instructor's container allows full control over the trainees' operation and the course of the scenario (Fig. 5). Within the simulated area (3D), the operator builds an exercise scenario. It can control the weather and time of day [10, p. 10]. The instructor plans and fully controls the enemy's operation, own troops, vehicles, and civilians [10, p. 14-17]. In the container, the monitors display information about the equipment condition, attached components in

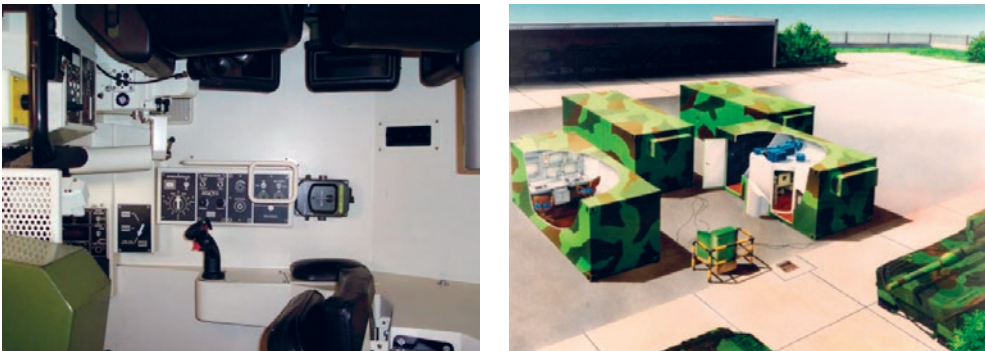


Fig. 4. A mapped commander's station and the general structure of the AGPT simulator
Source: [10, p. 1, 19].



Fig. 5. An example of a visualization seen in the trained periscopes and an example of an operator's container
Source: [11, p. 14, 21].

individual tanks, images from individual trained sights, and the tactical situation in the form of a map (2D) and real terrain (3D). The operator can eavesdrop on the conversations of individual crews and the entire platoon. At the end of the training, AAR can be performed with the possibility of playing back at a specific time and checking information discussed above, including the replay of the “training conversation” [11, p. 64].

The analysis of the AGPT simulator capabilities shows that:

- the currently used AGPT for the Leopard 2A4 version will be easily adaptable to the current Polish modernization of the Leopard tank,
- is a tool for learning, checking, and creating permanent operational procedures, both fire and tactical, at the crew and platoon level,
- it can be used in the first period to coordinate the crew, then the platoon, and maintain tactical skills in the later stages of training,
- before the implementation of the training field training, the subunits should practice the applicable procedures using this simulator,
- it gives the opportunity to conduct training in specific combat environments (urban, desert, etc.), difficult to implement on the available training grounds,
- it makes tactical training real (enemy influence, diverse battlefield),
- it forces commanders to use the command process and command documents (sketches, maps) throughout the entire period of operation.

In the context of training with the use of AGPT, it is worth paying attention to the VBS simulator (Virtual Battle Space, v. 3) used in military education. Also, it is intended for tactical training, mainly at the platoon level. Compared to AGPT, the construction of the simulator is not specialized. The crew member/team member function position consists of a desktop computer with a monitor, keyboard, and “mouse”. All stations are connected and controlled by the administrator (instructor). Its simple structure and operation enable assigning various functions within different combat vehicles (e.g., T-72, LEO2, ABRAMS) to the position depending on the needs (Fig. 6). Special knowledge of tank construction and operation is not required, unlike in the case of the AGPT. Learning how to use VBS is associated with a two-hour “tutorial” [12, p. 227-249]. The instructor develops an action scenario according to the training needs. The simulator enables the class manager to have real-time insight into the trainees’ operation from a 2D (map) and 3D (simulated operating site) perspective. After class, the entire activity can be played back for AAR. It is worth noting that the positions can be expanded according to the selected combat vehicle, e.g., replacing the keyboard with a gunner’s joystick. The Military University of Land Forces in Wrocław has such a version for the Leopard and PT-91 tanks.

In military units where there are no AGPT simulators (cost, no on the market), VBS, due to its universal design, is an excellent tool for learning and improving tactical rules and procedures.

2.3. AGDUS Simulator

Another simulator used in the training of tankers is the AGDUS simulator (Ausbildungsgerät Duellsimulator), in Polish terminology the name translates to “duel simulator”. The simulator consists of several components stored in transport crates (Fig. 7). This device is mounted on a tank in accordance with the instructions [13, p. 6, 7]. It should be noted that the tank is structurally adapted to the assembly of this type of simulator. Compared to the previous devices (stationary), the AGDUS preparation and installation on a Leopard requires a lot of



Fig. 6. VBS system used at the Military University of Land Forces in Wrocław
Source: [3].



Fig. 7. Installation of the AGDUS simulator on LEO2A5 by AWL cadets
Source: Own study.

work from the training crews. Its use, apart from the involvement of combat vehicles, also requires terrain in the form of tactical belts in training grounds.

AGDUS has two operation functions, “Ausbildung” (training) and “Duell” (duel). The main “Duell” mode is used for tactical duels at the platoon/company level (bilateral tactical classes). The second “Ausbildung” mode of operation is mainly used to conduct fire training without the use of ammunition [13, p. 3].

The general operation of the simulator is based on the emission of a laser beam when the gunner fires a shot, then the beam reflects off the target on which the prism is mounted and returns to the vehicle emitting the shot where it is analyzed by the AGDUS computer (rehner).

The results are displayed on the commander's dashboard (hit/no hit). In the "Duell" option, where the shot is sent to the vehicle with the AGDUS system installed, the information is additionally processed by the "rehner" of the impacted vehicle informing the commander about the effects of the received fire [13, p. 10].

Training with the use of the "Duell" option requires assigning the trainee roles of the enemy (OPFOR) and own troops (BLUE FORCES). This system does not limit the tank operation. Conducting tactical duels requires experience in using the tank and knowledge of tactics from the trained crews. As part of the duel mode, the "FEIN – small" option is available, it causes the tank to be recognized by other AGDUSes as a lower vehicle, which is to correspond to the T-72 silhouette (this option is used by tanks acting as an enemy). Depending on where the tank will be hit (laser beam), the destruction, e.g., damaged SKO system, damaged engine, or complete destruction, is simulated on the commander's display. Each information regarding the tank operation, its condition, hits and damages, along with the current time, is printed on an ongoing basis by the AGDUS printer. Failure to adapt to the effects of a hit (e.g., an order to switch off the engine) causes printing information about falsehood [13, p. 39-44].

During the exercise, the class leader can control compliance with the established rules through the shooting control device (UKS). It has the capability of activating and destroying tanks (e.g., that has entered the area designated as mined) [13, p. 48]. After completing the class/exercise, the manager can use the printouts from the AGDUS system to analyze the course of action (which tank hit which vehicle, together with the direction, distance, type of missile, and time).

This simulator reflects the battlefield in the best way out of all the devices discussed above. Duel training requires at least the participation of a tank company in the field, which generates costs in the form of equipment and fuel consumption. Without training at a good level in the use of a tank and the AGDUS system, training is not possible; therefore, it should be planned from the second training stage. In the initial period of training, this simulator should be used in the "training" mode to prepare crews to fire ammunition and carry out preparatory exercises. In addition, the author believes that a priority should be given to classes using the AGDUS simulator. The conclusions resulting from such classes, such as close-range combat between tanks, maneuverability (flanking), and quick change of the firing position, characterize the actions of tanks on the modern battlefield [14].

Under the training program (PSWPZiZ), the training level of the platoon/company is checked during the "Platoon/company in tactical operations with firing ammunition" classes. The author is convinced that given the capabilities of laser shooting systems, a platoon or company checking activities should be conducted with their use.

3. The use of simulators and trainers in the training process

In the Armed Forces of the Republic of Poland, two armored brigades are equipped with Leopard 2 tanks, the 10BKPanc in Świętoszów and the 1st BPanc in Wesoła, and the Leopard Training Center (OSL), which is part of the 10BKPanc, conducting training for their benefit (249 vehicles in total).

The possibility of using simulators by subunits is influenced by their location, quantity, and availability. All AAT simulators (3 pcs), ASPT (3 pcs), a driver's stent, AGPT (1 pcs) are only included in the OSL equipment. There are several dozen AGDUS simulators in the equipment of tank battalions in the 10BKPanc (50 pcs), in the 1BPanc, and the OSL [6]. The discussed

distribution of simulators indicates that their main users are the OSL and the 10BKPanc, hence, these units were considered the most representative for further consideration of using the devices in the training process.

The OSL is the only center in Poland that certifies drivers, loaders, gunners, and commanders of the Leopard 2A4/A5 tank. Currently, it is also preparing own staff to train specialists (commander, gunner, loader) of the Polish version of the Leopard tank. Before soldiers perform tasks as crew members in combat units in the afore-mentioned armored brigades, they must complete a course at the OSL.

About 310 hours (two months) are allocated to the certification training of the Leopard tank specialists. Excluding physical education, occupational hygiene, discipline, maintenance days, drill, chemical training and exams, basic training covers 230 hours. Almost half of these hours (120 hours) are spent on fire training (SzO). The remaining hours (110 hours) are related to learning how to build and operate a tank. The center does not conduct classes in tactics, they are carried out in subunits [15].

Most of the fire training (110 hours out of 120 hours) is in the form of practical classes, the remaining 10 hours are theoretical ones. Over 80% of the practical classes in fire training (88 hours) are performed only with the use of simulators or in combination with a tank. Mainly ASPT, AAT and AGDUS devices (in Ausbildung mode) are used for training to perform preparatory shooting [15].

To verify the legitimacy of involvement in the above-described dimension of training and training devices, the results of the subunit that carried out training in accordance with the Leopard 2 tank specialist course were used.

One of the specialist courses in 2020 achieved the following results (arithmetic mean of 13 firing crews) from tank-trained shooting using combat ammunition:

- number (no.) 1 – 4.84;
- 1N (night) – 4.61;
- no. 2 – 4.38;
- no. 2N – 5.0 – implemented while moving [16].

It should be emphasized that these results were achieved after 2 months of soldiers' training.

The high share of training devices (UST) used in the OSL in the CPR process brings excellent results from checking shooting (conducted at the end of the course with a tank with combat ammunition) after a short training. This Center also equips soldiers with specialized skills of using tank compartments, relieves them in the organization of such training, and allows them to function smoothly in the higher stages of training (maintaining capabilities by the company/battalion, participation in exercises).

To analyze the use of simulators by the 1bcz/10BKPanc subunits, their training documentation was verified. The analysis covered the "Plans of major undertakings" of the mentioned battalion for 5 selected months from 2016-2017 (the study used months in which there were no training restrictions, e.g., service, no possibility to use simulators). In the analyzed period, four tank companies spent 793 hours on fire training and tactics (T), of which at least 337 hours on simulators and trainers (43%). The above statistics do not consider the use of the AGDUS simulator during tactics and fire training. According to the author (resulting from the experience from the service in the 1bcz/10BKPanc), the number of hours spent on training devices may reach nearly 55%, including AGDUS devices [17].

The subunits spent 445 hours on tactics classes, including 247 hours (56%) on simulators (100 hours on the ELSA simulator – an advanced equivalent of AGPT in Switzerland, and 147 hours on AGPT). One of the companies for 3 months carried out 100% of the T classes (42 hours) using AGPT. On average, the companies spent 13 hours a month on simulators to conduct tactics classes, which gives 2 training days. The subject matter is also noteworthy. The subunits focused on the implementation of activities related to fighting in specific combat environments (built-up, forested) and with crossing water obstacles. Although AGPT was designed to carry out platoon-level activities, company-level activities were carried out [17]. Such an option of using this device is possible by tying the crews of “avatars” for each platoon commander (located in three containers) controlled by an instructor, based on following the platoon commanders’ orders.

The remaining hours (348), the 1bcz subunits were allocated to fire training, of which 90 hours (26%) with the use of training devices (UST). The conducted analysis shows that this ratio was 56% for one company. On average, each of the subunits spent 5 hours on UST per month. When planning training, the battalion subunits followed the principle of preceding classes at shooting ranges with training on simulators [17].

Below (Fig. 8), there is a pyramid of the sequence of using the available simulators in the training process.

Contrary to the OSL, combat units mainly use simulators to implement tactical training. That influences the possibility of developing and improving operational procedures. The 1bcz/10B-KPanc subunits, as few in the scale of the Armed Forces (if not the only one), use and require standard operating procedures at the crew, platoon [18], and company level [19]. It should be emphasized that the subunits also use AGPT for topics related to specific environments

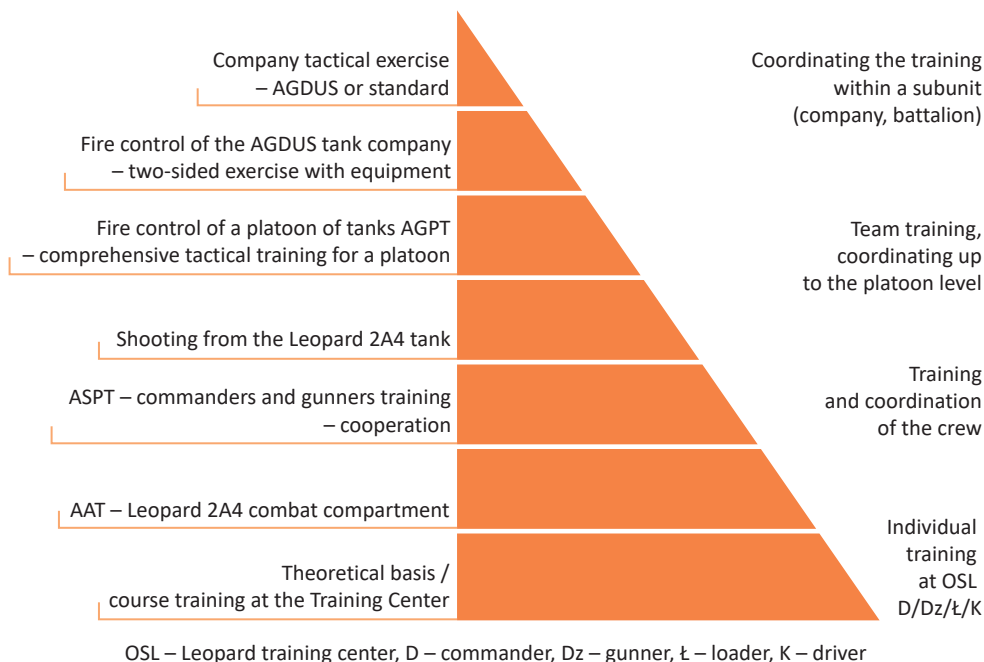


Fig. 8. The use of simulators in the process of training subunits equipped with LEO
 Source: [6].

that are difficult to conduct on the available training grounds. There is a visible lack of other devices of this type enabling the implementation of company-level activities.

Conclusions

Training using only the vehicle generates high costs, is time-consuming, increases the risk of damage to it, and exposes the crew to greater danger. Replacing traditional training, even to a large extent with UST training, shows that the results achieved are high.

The already functioning solutions regarding the use of simulators should be implemented and developed in other units of the Polish Armed Forces, where practical training is carried out only on the equipment, causing its inoperability and the use of significant amounts of simulating agents [20]. The author believes that the effect of training only in traditional ways is not commensurate with the costs incurred. Besides, the author noticed that the training level of subunits not using UST in the educational process is much lower than that of subunits applying this type of equipment¹. There is a visible lack of proper operating procedures, largely due to the previously discussed limitations of the training field. Given the above, the priority should be to obtain simulators by the Armed Forces that enable the implementation of tactics classes at the platoon and company level (laser shooting systems or AGPT simulators).

Concentrating all simulators in one organizational unit (OSL) which is operated by experienced instructors is an effective solution. Choosing the appropriate simulator/trainer to the training level (training pyramid) and the subject, supports the subunit's training process. In the author's opinion, it is justified to further expand the center to secure the training needs of the 1st Warsaw Armored Brigade. Moreover, such centers should function for the needs of mechanized and motorized units.

Simulators based on information systems use and are a response to the already acquired information culture of soldiers in the "civilian" environment.

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Conflict of interests

The author declared no conflict of interests.

Author contributions

The author contributed to the interpretation of results and writing of the paper. The author read and approved the final manuscript.

Ethical statement

The research complies with all national and international ethical requirements.

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¹ The author's experience from courses conducted with tank platoons, mechanized and motorized ones from various Armed Forces units, using the VBS 3 simulator.

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Biographical note

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Szkolenie dowódców, działonowych i ładowniczych czołgu Leopard 2 z wykorzystaniem urządzeń szkolno-treningowych

STRESZCZENIE

W artykule przedstawiono sposób wykorzystania symulatorów i trenażerów czołgu Leopard 2 na podstawie doświadczeń szkoleniowych z 1 batalionu czołgów 10BKPanc i Ośrodka Szkolenia Leopard ze Świątoszowa. Dokonano charakterystyki symulatorów i trenażerów czołgu Leopard 2 z perspektywy instruktora i szkolonych. Podjęto próbę oceny poszczególnych urządzeń. Przedstawiono możliwości wykorzystania poszczególnych urządzeń szkolno-treningowych w procesie szkolenia pododdziałów.

SŁOWA KLUCZOWE symulator, urządzenie, szkolenie, trenażer

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