Journal of Contemporary Educational Research, 2022, Volume 6, Issue 5
http://ojs.bbwpublisher.com/index.php/JCER
ISSN Online: 2208-8474
ISSN Print: 2208-8466

New Equipment Training Based on Virtual-Real Fusion Training Model

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Abstract: In view of the phased development in college education, military training, and new equipment combat training, this paper proposes the virtual-real fusion training model of "five-in-one and step-by-step." The five training modes, namely virtual panel training, immersive virtual training, physical (semi-physical) simulation training, training with equipped training equipment, and installation drill, are organically combined in the practical training of new equipment, which improves students' innovation consciousness and serviceability.

Keywords: Virtual-real fusion; New equipment; Training model

Online publication: May 30, 2022

1. Connotation of virtual-real fusion training model

The virtual-real fusion teaching model is a way to realizing the transformation of the teaching content of new equipment to students' skills, so that they can serve. This model is designed to meet the employment demands, to forge the key position ability as the main line, and to coordinate the whole teaching process, in accordance with the goal of laying a solid foundation of skills, strengthening the training of skills, and highlighting the use of skills, so that students will be encouraged to participate in teaching activities [1-3]. First of all, the use of virtual, simulation training equipment is to train the primary operator, so that students have a basic understanding of the equipment. Then, through collaboration with the army, it is possible to nurture initial operating experience, the use of actual troops training equipment, and the training of real operation skills under certain psychological pressure.

2. Features of virtual-real fusion training model

2.1. Optimize existing educational resources to overcome challenges in new equipment training

Computer simulation technology, virtual reality technology, and large-scale integrated circuit technology are all used to realize the simulation of operation, the use of new equipment, and the further optimization of educational resources [4]. In the practical teaching process of new equipment, the limited educational resources should be flexibly used to harmoniously integrate media and teaching resources so as to maximize the teaching efficiency.

Modern science and technology can be applied in the practical teaching of equipment operation to achieve multi-tiered composite training. Teachers should be equipped to teach students how to master different skills, select suitable training modes, guide students step-by-step and thoroughly, as well as solve equipment training fatigue problems and the single teaching method. It is beneficial to cultivate students' analytical skills to solve problems encountered in operations and the use of new equipment, improve their

comprehensive quality and practical capabilities, as well as promote the development of new equipment service education.

2.2. Improve the operation training level and train qualified operators

The basic operation of new equipment and some functions that can only be operated in actual combat can be taught by using three kinds of virtual simulation operation trainings: virtual panel training, immersive virtual training, and physical (semi-physical) simulation training [5]. Since they are only "virtual" technologies, there will still be a gap with the operation and training of the equipment in actual use. Therefore, on the basis of simulation training in a virtual environment, comprehensive operation trainings and actual combat drills are carried out using actual training equipment, so as to further improve the students' operation training level and cultivate qualified operators that meet the army's needs.

2.3. Advantages of the "virtual" and "real" training models are complementary to each other

The simulation of new equipment makes up for the shortage of actual equipment and site as well as provides favorable conditions for assessment. On the other hand, it is not limited by space and time; hence, it can be operated at any time. While the actual installation operation is limited by space, time, equipment quantity, and other factors, it can cultivate students' practical problem-solving skills and better reflect the teaching purpose of applying learning to post education [6]. On the one hand, the integration of "virtual and real" can improve the effect of new equipment service education and on the other hand, shorten the time in carrying out practical operation training in the army and save equipment maintenance costs as well as training funds.

3. Implementation of virtual-real fusion training model

Virtual panel training, immersive virtual training, and physical (semi-physical) simulation training involve the use of virtual reality technology, computer simulation technology, various functional board, and auxiliary equipment as the hardware platform to simulate the operation of weapons and equipment training. These three trainings have low training costs and are suitable for college training for the purpose of cultivating primary operators.

For new equipment, due to the high cost of actual installation and its supporting training equipment, it is only equipped to combat troops. In the initial stage, colleges and universities will not perform the actual installation. However, relying solely on virtual and simulation training equipment to prepare for battle is insufficient to assure that the new equipment is combat effective. To this end, colleges and universities need to collaborate with combat forces and integrate the educational system that is based on classroom knowledge with military practice, so that students will acquire experience and practical skills through post training [7]. Through close contact with the army, students will be able to familiarize themselves with post practice, integrate theory and practice, improve their skills in operating new equipment under certain psychological pressure, and become application-oriented talents who are sought by the army.

3.1. Virtual panel training

Virtual panel training refers to the use of computer modeling tools to build the operation panel of new equipment and its test equipment, and through the code editor, the instrument internal logic simulation can be completed, and real-time, three-dimensional, photo level interactive graphical interface can be created, so as to achieve the virtual operation training of new equipment.

GL Studio is a professional instrument simulation platform in the development of virtual panel training system [8]. As a prototyping tool of an independent platform, it greatly reduces the difficulty of modeling and the workload, improves the work efficiency, and reduces the requirements on computer hardware.

With virtual panel training, issues such as the complexity of the system, large operation panel, display of instruments, and the complexity of the logical relationship among various instruments can be solved. However, it also has several disadvantages: it only simulates the operation panel of the equipment, but not the geographical environment, climate, and external interference factors. Virtual panel training is only an equipment for functional training. In view of its high development efficiency and low cost, it can be used in training students to gain preliminary understanding and familiarize themselves with new equipment. At the initial stage of new equipment installation, colleges and universities can develop a virtual panel training system for students to use, so as to cultivate their perceptual understanding of the equipment.

3.2. Immersive virtual training

Compared with virtual panel training, immersive virtual training requires students to put themselves into the virtual scene generated by the computer, in which students will have a sense of "being on the scene" in virtual operation training [9]. The main features of immersive virtual training are interaction and conception [10,11].

Interaction refers to the ability of students to interact with various objects in a virtual scene. Interaction here does not refer to the interaction between two-dimensional input devices in traditional means, such as the mouse and keyboard, but in the virtual environment of operation training between human and virtual environment, which includes three-dimensional data gloves, data clothes, helmet display, raster glasses, and other accessories. This is the key factor of man-machine harmony. Interaction includes the degree of operation of the object, the degree of feedback from the environment, the degree of movement of an object in the virtual scene according to the laws of physics, and the virtual exchange with changing viewpoints. The most important factor in this process is real-time, which refers to the ability of the computer to change the state of the virtual scene immediately in response to user input.

The concept refers to that virtual reality is not only an interface between the student and the terminal, but also in enabling the student to immerse himself or herself in the environment to acquire new knowledge, improve perceptual and rational understanding, and thus generate new ideas. The result of these ideas is then input into the system, and the system will display the processed state in real time or feed back to the student by a sensing device. In a cyclic manner, this is a "learning-creation-learning" process. Hence it can be said that immersive virtual training helps inspire students to think creatively.

Modeling and simulation are at the heart of immersive virtual training. Through the establishment of a model to operate the trumpeter, new equipment, environment, and their relationship to the essence of description in the computer, it involves the display of 3D graphics, 3D sound positioning and synthetic technology, visual and tactile sensor technologies, remote sensing technology, identification technology (language, three-dimensional scene, facial expressions, and gestures), environmental modeling technology (geometric modeling, behavior modeling, and CAD), and other new and high technologies.

Under the premise of time and funding, colleges and universities should develop an immersive virtual training system to train students, whose training effect is much better than that of virtual panel training system in order to carry out the practical teaching of new equipment. Compared with the virtual panel training system, the requirement for hardware in the development of an immersive virtual training system is far higher than that of the virtual panel training system; moreover, it has a long development cycle, with high cost. However, its maintenance cost after its completion of development is low; it is suitable for use in training the skilled operation of new equipment in laboratory settings.

3.3. Physical (semi-physical) simulation training

Physical (semi-physical) simulation training refers to the design and manufacture of the shell frame and various connectors of the new equipment according to its actual appearance in a one-to-one ratio, and the

signal flow in the operation of the new equipment is simulated through the development of both, software and hardware, so as to ensure that the operation and use process are almost similar to that of the new equipment [12].

Compared with pure virtual training, physical (semi-physical) simulation training can provide students with more intuitive understanding since it is identical with the actual equipment used by troops in terms of appearance. In the process of operation and use, the connectors between the equipment can be connected and the results after each step of operation can be observed, which is better than pure virtual training in terms of training effect.

However, the physical (semi-physical) simulation training has its shortcomings.

(1) The vast majority of simulator applications are relatively isolated, and the interaction and reuse between simulators are poor.
(2) The development, maintenance, and use of equipment simulation are time-consuming and costly.
(3) The validation, validity, and confidence of the equipment simulation are low.
(4) The equipment is bulky, requiring a large space for storage, and it can only be operated by one person at a time; thus, the efficiency is low.
(5) The most important point is that the hardware-in-the-loop simulation is mainly for the simulation of specific models. In the simulation of similar equipment, there is no unified specification and standard, resulting in excessive repeated development.

In the practical teaching of new equipment service education in colleges and universities, physical (semi-physical) simulation training is a type of transitional training. In training, students are not exposed to live fire used by armed forces as a result of limitations from new equipment safety, economy, and other factors; thus, they rarely come into contact with new equipment. By using the material physical (semi-physical) simulation training system to operate the trumpeter, students can have a good grasp in the use of new equipment.

The three virtual simulation trainings have their own disadvantages. Most of the models established in virtual simulation training can only rely on existing experience to put forward empirical assumptions and judgments, which are impossible to accurately replicate reality, especially the battlefield. Data have shown that current training simulation systems can only provide about 80% to 85% simulation of the real world at most. Many important factors related to combat decision-making (leadership quality, political quality, psychological quality, morale, and troop training level) cannot be expressed through models. Therefore, virtual simulation training is a combination of science, experience, and judgment, which cannot completely guarantee the authenticity of training. The training will go astray if we rely on it blindly.

3.4. Training with equipped training equipment

Training with equipped training equipment refers to training with installed training equipment along with new equipment. The primary difference with actual training equipment is that training equipment does not have a warhead. Other systems are exactly the same as those in actual operation, so there is no difference between using training equipment and that in actual operation.

3.5. Installation drill

Actual drill refers to actual combat training with a tactical background. Under certain psychological pressure, students operate the new equipment according to actual combat standards, which is the most effective way to assess and evaluate the new equipment operation trumpeter trained by colleges and universities.

The physical and mental effects of actual drills are much more severe than normal daily drills. Physically, the full load, strong confrontation, fast pace, specific operation of weapons, direct training of

tactics, and other factors will affect the personnel's body. Psychologically, the operation personnel will feel nervous, anxious, uneasy, and other emotions in the actual installation drill, which will affect the play of tactics and technology.

If condition permits, colleges should collaborate with armed forces, allowing students to participate in live-fire drills under realistic circumstances. In view of certain psychological pressure in these settings, it is possible to assess the degree of students' mastery of new equipment and their educational level, so as to gain valuable experience for the applicational teaching of new equipment.

4. Conclusion

At present, the training model for new equipment is changing from mechanization to informatization. Virtual simulation training can simulate various training subjects and prevent training casualties, reproduce the combat situation, increase the control of training, save energy, ammunition, and training funds, as well as prevent pollution and damage to the environment. This kind of training is favored by all levels and has been widely used. However, it is worth noting that virtual simulation training is not perfect; it is extremely unscientific and even harmful to magnify or even "deify" it as a replacement of actual training. Therefore, after being trained by virtual training systems in colleges and universities, these students should enroll in armed forces to familiarize themselves with actual training equipment. Only in this way can we enhance the familiarity to new equipment use and cultivate maintenance talents who are needed by the army.

In short, colleges and universities should implement multi-tiered composite training with the virtual-real fusion training model. Not only do they need to promote virtual simulation training to improve training efficiency, but also avoid the absolute one-fits-all notion. At the same time, they should rely on live-fire training to increase the contact between man and weapon, so as to avoid the conundrum of concentrating on trivial matters but neglecting important ones.

Funding

The 2019 Ministry of Education Industry-University Cooperation Collaborative Education Project "Research on the Construction of Economics and Management Professional Data Analysis Laboratory" (Grant Number: 201902077020)

Disclosure statement

The authors declare no conflict of interest.

Author contributions

M.Z. conceived the idea of the study and wrote the paper; H.H., M.G., and Y.L. collected the data. All authors read and approved the final manuscript.

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