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Original Article

Educational technology for teaching survival skills to pilots using training routines

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Abstract:
The paper describes an educational technology for teaching pilots survival skills by using training routines. This technology is aimed at improving fitness and performance levels displayed by pilots in survival situations. It comprises six interrelated training routines encompassing pilot training for survival.
In the first routine, the emphasis is on enhancing the stamina of pilots; in the second routine, it is on strength and strength endurance; in the third routine, it is on developing pilots' skills for survival in extreme situations; in the fourth routine, it is on building up defense mechanisms employed by pilots for activities in specific climate zones and geographical locations; in the fifth routine, it is on solving survival-related problem tasks during practices on the range; and in the sixth routine, it is on arranging preparation activities and a survival test.
KeyWords: training routines, pilots, survival, educational technology, performance ability, methods of physical training.

Introduction

Current trends in the development of survival readiness among pilots indicate that a high level of professional competence can be achieved only in the course of professional activities. A possibly even better strategy is to «identify, then build on and develop» physical and other characteristics required for survival [2,4,6,8,9]. The point to be emphasised is that survival readiness development is an integral part of a pilot's professional military training at the start of which they feature various, distinctly individual nervous system properties, psychophysiological characteristics, physical fitness and performance levels [8,9,11]. This all means that pilot survival training must entail stagewise physical conditioning.

Survival training aimed at pilots mostly focuses on developing their psychological and physical readiness to survive on their own under extreme conditions and improving their ability to employ various survival and combat skills in different climate zones and geographical locations and to use personal safety equipment and sustenance kits in the most efficient way. Experience, however, shows that there are some major deficiencies in how the physical aspect of pilot survival training is organized and executed, which results in lower levels of stamina and strength endurance, strength, resolve, courage, perseverance, tenacity and other physical, moral and volitional traits necessary for survival. Recent research attests to a high efficiency of training routines for enhancing the levels of emergency readiness among military and law enforcement personnel [1,3,5,7,8,9,10].

A literature review discovered no scientifically valid technology for using training routines as part of the physical aspect of pilot survival conditioning. To date, almost no research has attempted to reveal the factors determining a high efficiency of employing training routines as part of the physical aspect of pilot survival conditioning. Also, the optimum pedagogical conditions necessary for using training routines as part of the physical aspect of pilot survival conditioning are yet to be established in a scientifically credible manner.

Thus, the current research is relevant due to:
- firstly, an increasing role of physical training in the development of survival skills among pilots;
- secondly, great importance of survival skills for pilots in active service;
- thirdly, an urgent need for substantial efficiency improvements in the process of pilot survival training.

Materials and methods

A thematic review of pedagogical literature on the organization of physical training made it possible to identify the most common forms and methods of developing an educational technology for teaching survival skills to pilots by using training routines [2,6,10]. Taken together, these forms and methods can help optimize the physical training process on the basis of the following techniques:

1) employing an integrated approach to designing and planning training tasks;

2) specifying the tasks of all the types of physical training with regard to the specific aspects of professional military activities engaged in by pilots in a survival situation;

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3) choosing the optimal training components;

4) choosing adequate training methods and corresponding organizational forms and means instrumental in tackling the issues related to improving the levels of fitness and performance displayed by pilots;

5) implementing personalized and differentiated approaches to training;

6) establishing psychological and learning environments that, with the help of training routines, will facilitate pilots in upgrading their performance levels.

It was also taken into account that the substantiation of an educational technology for teaching survival skills to pilots by using training routines requires a clear understanding of the action sequences.

Methodologies involving an integrated use of training resources for improving the fitness and performance levels of pilots usually rest on some educational technologies.

Educational technologies are basically complex, intricate systems, and as such, they cannot be classified linearly, i.e., by one classifier. As modern pedagogy still lacks a formal, uniformly accepted definition of the term «educational technology», their conclusive classification is yet to be developed [2,4,6,9]. However, there are classifications based on consideration of the following characteristics:

1) since physical development of each individual differs, their fitness levels vary as well, which should be factored into their physical training program;

2) methods of logic that presume that the development of an educational technology should employ expert knowledge of the phenomenon in question;

3) type of learning, using developmental learning strategies which facilitate pilots' physical improvement;

4) levels of cognitive independence manifested by pilots in the course of their physical development;

5) didactic goals and functions of the technology that involve methods for motivating, organizing and monitoring pilots to enhance their fitness levels and survival readiness;

6) type of physical activities pilots engage in.

Due to the current focus on meeting learner-centered objectives, integrated educational technologies have started to enjoy highest priority.

For the foregoing reasons, it was decided necessary to develop an educational technology of teaching pilots survival skills by using training routines (Fig.1).

The technology is aimed at improving fitness and performance levels displayed by pilots in survival situations. It comprises six interrelated training routines encompassing pilot training for survival.

In the first routine, the emphasis is on enhancing the stamina of pilots; in the second routine, it is on strength and strength endurance; in the third routine, it is on developing pilots' skills for survival in extreme situations; in the fourth routine, it is on building up defense mechanisms employed by pilots for activities in specific climate zones and geographical locations; in the fifth routine, it is on solving survival-related problem tasks during practices on the range; and in the sixth routine, it is on arranging preparation activities and a survival test.

Professional military readiness and performance levels among pilots were measured by applying special tests as well as through the use of monitoring, MTM, paired comparison and an ongoing evaluation of the performance against qualification standards.

Fitness testing was conducted to determine the development levels of physical and special abilities and to analyze the effect of training means and methods on the motor activities of pilots. The physical fitness of test subjects was verified and gauged against the successful completion of tasks and meeting the qualification standards set forth in the physical fitness program.

Rapid health assessments and criteria for evaluating the functional state of an organism were used to appraise the functional state of the pilots. Besides, the Stange and Hench breath-holding tests were carried out, a fatigue index was calculated, tapping and tremometry tests were conducted.

Breath-holding test results were evaluated in accordance with currently accepted criteria.

The Fatigue Index (FI) was calculated by using the formula below:

$$FI = \frac{SBP}{\sum P}$$

where

SPB – summarized systolic blood pressure data obtained at the beginning of the first, second and third minute of a rest period preceded by 15 squats;

$\sum P$- summarized pulse data.

The difference between performance index values before and after a full recovery constitutes a fatigue level (FL). The scoring protocol was expressed as three basic fatigue levels (in conventional units): a medium level of fatigue – 1.1-2.0; a high level of fatigue – 2.1-3.0; defatigation – 3.1 and over.

Using tapping and tremometry tests allowed, firstly, estimating the tempo, rhythm and steadiness of a motor action; and, secondly, assessing a fine sensory-motor coordination by registering shaking wrist movements (tremors).

The obtained data underwent mathematical treatment. The following statistical parameters were calculated:

$\overline{x}$ - average calculation;

δ - calculation of the root mean square deviation;

m – calculation of the standard error of the mean;

t – calculation of the Student's t-Statistic.

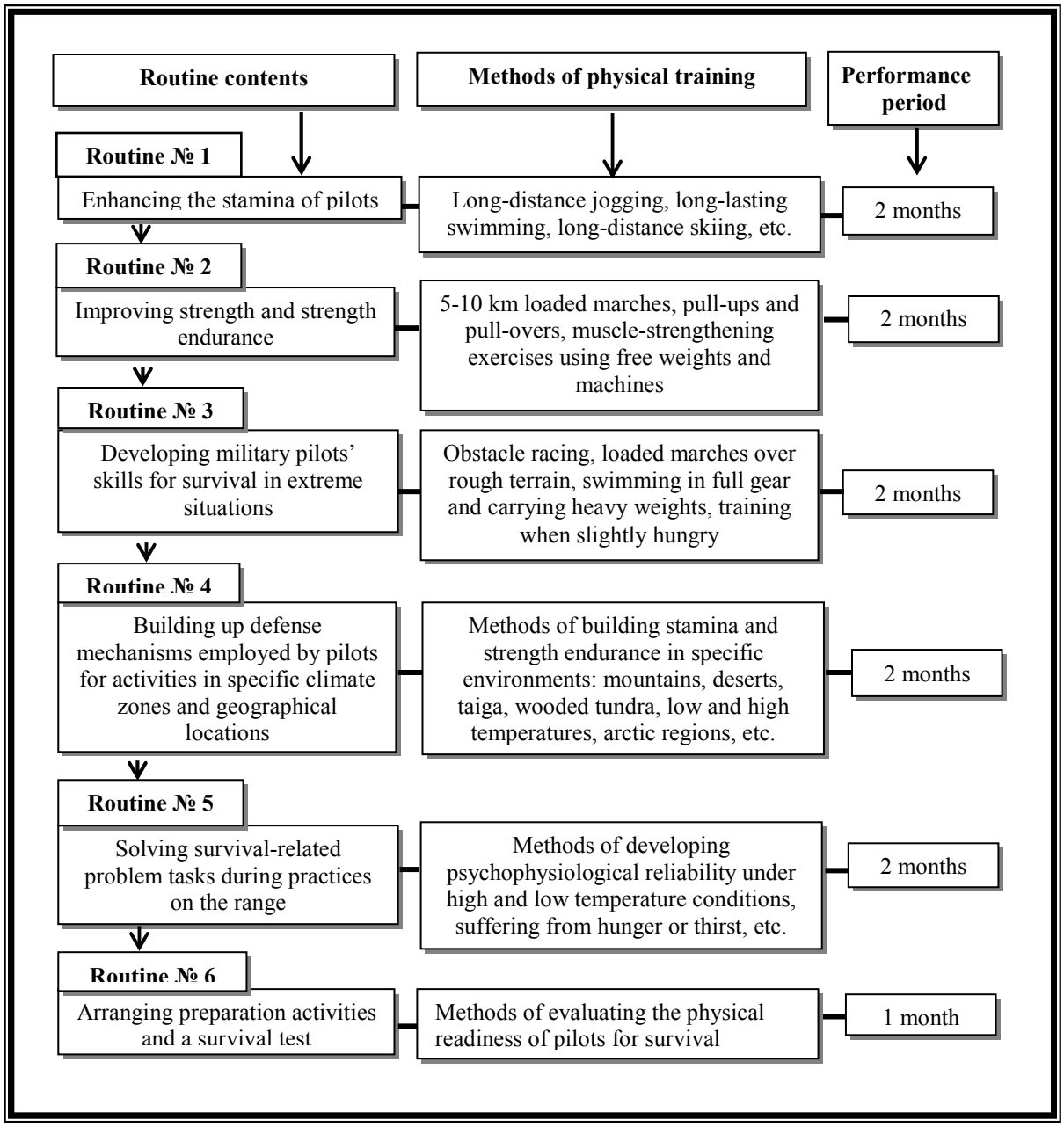

Fig. 1. Educational technology for teaching pilots survival skills by using training routines

Mathematical analysis was conducted under the assumption that a 5% p-value was statistically significant.

Results and their discussion

The research has shown that the most effective approach to solving educational objectives in the field of the physical aspect of pilot survival training is to use instructional systems build on integrated technologies.

Pilot survival training encompasses well thought-out preparation activities that include the elements of successful survival behavior. In order to evaluate the effectiveness of the developed educational technology of pilot physical training for survival, the following have been studied: the training motivation, performance dynamics and physical fitness of the pilots.

It should be pointed out that the pilots' functional systems manifested different degrees of activity on flight days and on days filled with routine military duties. It is apparent that the initial redundancy of systemic shifts decreases as pilots adapt to the negative inflight factors of their professional military activities.

Indeed, 98% of the officers who had been performing special training routines for three months reported an improvement in their general well-being, which did not always correlate with the subjective inflight results of

the WAM and Spielberg tests. State anxiety (SA) scores had very stable mean values across the whole group before flights (48.6±1.1 points) and after flights (50.8±2.3 points, $p<0.05$) as well as before and after a solo workout before flights (44.2±2.2 points) and after flights (48.0±2.1 points, $p<0.05$). The WAM test results were consistent (Table 1).

Table 1. Differentiated self-evaluation based on the WAM test (point scores) at the beginning and at the end of flight sessions engaging the EG pilots, before and after correction through physical training

Scale	Before correction		After correction	
	At the start	At the end	At the start	At the end
Well-being	4.4±0.3	4.8±0.3	4.7±0.3	4.7±0.3
Activity	4.0±0.3	4.8±0.2	4.2±0.1	4.9±0.2
Mood	4.4±0.3	4.0±0.3	4.5±0.3	4.9±0.3

Note: $p\leq0.05$ for all the values in the table.

According to the obtained results, the health of pilots is highly correlated not only with their aerobic performance, but also with the development levels of the other functional systems of their organism.

Physical qualities developed above normal exert no significant impact on general health. Moreover, when the values of the identified parameters far exceed the normal reference range, both certain indicators and overall health status start to display signs of degradation as a result of long-term excessive stress of overworking functional systems and failures of adaptation mechanisms. It has been established that the largest increase in health indicators in combination with a positive health dynamics are found when class time is distributed in the following way: 50-60% - enhancing stamina; 20% - building strength and strength endurance; 5% - developing the speed of movement and speed-strength; 5-10% - improving flexibility; 15-20% - increasing agility.

There has been a considerable positive impact of the experimental technology on the parameters related to the functional state, physical fitness, psychophysiological state and professional performance of pilots in survival situations (Tables 2 and 3). Table 2. Functional state dynamics displayed by the pilots throughout the course of the experiment EG (p=15); CG (p=15)

Indicators	Study groups	Baseline data	Subsequent experimental data	p
Stange test (s)	EG	70.2±2.3	75.3±2.0	-
	CG	72.4±2.4	67.1±1.1	0.05
Hench test (s)	EG	37.2±1.8	40.2±1.7	-
	CG	37.6±1.8	29.7±1.3	0.05
V02 max (mL/kg/min)	EG	44.1±1.4	44.7±1.3	-
	CG	44.2±1.0	41.2±0.6	0.05
Heart rate (b/min)	EG	66.7±1.8	68.7±1.8	-
	CG	71.2±1.8	74.2±0.8	-
Physical Fitness Index (unit)	EG	99.2±2.5	102.1±1.8	0.05
	CG	93.3±3.5	92.8±1.9	-
Endurance ratio (unit)	EG	17.1±0.5	15.2±0.3	-
	CG	17.8±0.5	18.3±0.3	-

Theoretical and empirical analysis of the technology for using training routines involved a comparison of the experimental (EG) and the control group (CG) data. In fact, professional performance dynamics was observed for a year in the perspective of implementing the technology in question.

The new technology making use of training routines was introduced with a special regard to the specific aspects of the professional activities of pilots who find themselves in a survival situation. The results of the pedagogical experiment demonstrate that the EG subjects having been engaged in performing training routines for six months noted improvements in their well-being in 98% of cases as well as some relief from muscle pain and spasms. Table 3. Psychophysiological state dynamics displayed by the pilots throughout the course of the experiment EG (p=15); CG (p=15)

Indicators		Study groups	Baseline data	Subsequent experimental data	p
Thinking speed (the number of successfully solved tasks)		EG	35.5±2.9	43.0±2.2	0.05
		CG	43.2±2.3	48.1±1.5	-
Attention switch and allocation (s)		EG	312.6±18.8	266.9±14.3	0.05
		CG	279.4±18.4	308.1±12.0	0.05
Spatial relationships and mental agility (the number of correct answers per minute)		EG	4.4±0.2	4.6±0.2	-
		CG	4.4±0.2	4.3±0.1	-
					-
Time of a complex motor reaction to light (s)		EG	3.81±0.14	3.34±0.71	0.05
		CG	3.72±0.51	3.53±0.48	-
Time of a simple motor reaction (s)	to noise	EG	0.251±0.06	0.210±0.04	0.05
		CG	0.238±0.05	0.226±0.05	-
	to light	EG	0.267±0.08	0.227±0.05	0.05
		CG	0.248±0.07	0.237±0.05	-

A growing fatigue resulted in more significant developments manifested by the CG subjects by the end of the year: apart from changes in every single indicator, there were widening gaps between them as the 'Well-being' and 'Activity' values were declining in relation to the more stable 'Mood' values. That said, the EG subjects that had performed training routines showed a tendency toward somewhat higher values of all the WAM indicators ($p>0.05$). The obtained results suggest that above-average physical abilities have a great impact on the effectiveness of pilot activities in survival situations. In addition, if the identified parameters far surpass the determined levels, emergency activities prove to be much more effective. The analysis of diagnostic data obtained from the EG subjects who were engaged in systematic training for a long time indicates that their survival skills are far better developed. The following dependency has been established: the longer pilots follow their training routines, the greater their survival readiness is, the less they suffer from fatigue, and, as a result, the better professional results they show in survival situations. A comparative analysis of the levels of survival readiness among the EG and CG subjects has been conducted in order to determine the effectiveness of the developed educational technology for pilot training by using training routines. Its results are presented in Table 4.

Table 4. Comparative analysis of pilot survival readiness among the EG and CG subjects throughout the course of the pedagogical experiment, in points ($\overline{X}$ ±m)

Subjects	Experiment phases		
	1	2	3
CG (n = 15)	3.69±0.18	3.81±0.21	4.05±0.27
EG (n = 15)	3.67±0.17	4.12±0.16	4.29±0.18

Using training routines with regard to the specifics of the professional activities of pilots in survival situations allows compensating for their professional shortcomings as well as ensuring a tendency toward their professional development.

Conclusion

The given research has made it possible to establish the following dependency: the longer pilots follow their training routines, the greater their survival readiness is, the less they suffer from fatigue, and, as a result, the better professional results they show in survival situations.

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