DEVELOPMENT OF SPEED ENDURANCE METHODS IN MIDDLE SCHOOL AGE SWIMMERS

Alexander B. Smirnov
Nizhny Novgorod State Pedagogical University named after Kozma Minin, Nizhny Novgorod, Russia. E-mail: smirnovab2010@mail.ru
Artem A. Fomenkov
Nizhny Novgorod State National Research University named after N.I. Lobachevsky, Nizhny Novgorod, Russia. E-mail: artjom2310@inbox.ru
Natalia E. Zhitnikova
Nizhny Novgorod State Pedagogical University named after Kozma Minin, Nizhny Novgorod, Russia. E-mail: g-nat73@mail.ru
Olga V. Reutova
Nizhny Novgorod State Pedagogical University named after Kozma Minin, Nizhny Novgorod, Russia. E-mail: olya.reutova2013@yandex.ru
Olga V. Sesorova
Nizhny Novgorod State Pedagogical University named after Kozma Minin, Nizhny Novgorod, Russia. E-mail: sesorova1974@mail.ru
Anna A. Zelenova
Nizhny Novgorod State Pedagogical University named after Kozma Minin, Nizhny Novgorod, Russia. E-mail: anyatka777@mail.ru
**corresponding author email: smirnovab2010@mail.ru*

Abstract: The issues identified with preparing of youthful swimmers are among the most intense issues of advancement of preparing program. Continuance is a standout amongst the most vital capacity of a swimmer. Improvement of continuance through amusement and extraordinary activities makes it conceivable to swim at a high pace for quite a while. Advancement of high sportsmanship capacities amid preparing is related with the dimension of engine capacities (quality, speed, perseverance) and with the effectiveness of their cooperation. The high proficiency and sportsmanship of a swimmer can be accomplished through progress of speed perseverance. Abnormal state of general and concentrated preparing of youthful swimmers is incomprehensible without adequate improvement of continuance. The motivation behind this article is to investigate the effectiveness of exceptional activities went for improvement of speed perseverance of youthful swimmers by leading an academic analysis. The best strategies for investigating the issue are educational perception, examination of logical and methodological writing, instructive test and control tests. The principle consequence of this exploration is the explained technique for improvement of speed perseverance of youthful swimmers amid preparing process. The materials of this article might be discovered helpful by understudies of professional and higher instructive organizations of physical training, authorities of broadened instructive framework, and understudies or instructors at schools.

Keywords:middle school age, swimming, speed endurance, training process.

1.Introduction

The issues related to training of young swimmers are among the most acute problems of development of training program. The growth of sport and technical results largely depend on the rationality of training of young athletes, the process of initial generation of technique, and the level of development of special physical abilities (Kuznetsov, 2014).

Swimming is critically important for a child's upbringing. During swimming, physical development of the child is diverse, the nervous, cardiovascular and respiratory systems become stronger, and the capabilities of the musculoskeletal system expand greatly. Swimming is an excellent mean of acclimation and contributes to the formation of the correct posture of the child (Platonov, 2014).

Endurance is a physical ability required in every sport to the various degrees. In some sports and exercises, endurance directly affects the result of performance of motor actions (walking, running for medium and long distances, cycling, speed skating for long distances, cross-country skiing, etc.). In others, it allows to perform certain tactical actions (boxing, wrestling, sport games, etc.) in the best way. And finally, during short-term exercises, endurance helps to sustain high training loads and provides a quick recovery of body's strength between training (throwing, jumping, sprinting, weightlifting, etc.) (Matveyev, 2013).

Age dynamic of speed development of young athletes is very peculiar. Speed and rate of movements, as well as the ability to maintain the maximum rate of movements are on the verge of their limit values by the age of 14 to 15 years. Children's and teenagers' bodies are well adaptable to speed loads. Therefore, the age between 8 and 15 years is the most advantageous for development of speed and increase of speed of movements (Petrova, 2014).

Development of speed and strength abilities increases with age of athletes. The level of their development is peaking at 13 to 16 years of age. For example, the annual growth of results during this period in standing jumps is 3.7 and 6.2 cm. During the period from 11 to 19 years the height of a jump grows by 24 cm (Mogileva, 2013).

2.Materials And Methods

2.1. Terms and Definitions

Middle school age – the age of transition from childhood to adolescence. During that age children are studying in middle school (grades 5 through 9). This period can be characterized by general lift of daily living activities and global rearrangement of the body.

Speed endurance – is an ability to maintain high speed for the longest possible time. It is customary to talk about speed endurance in relation to cyclic exercises (running, walking, swimming, rowing, cross-country skiing, bicycle riding, and basketball).

Specialized sports club – a department of an institution, enterprise, conference, or convention.

Training process – is a pedagogical process aimed at training and improving specific abilities that ensure fitness of athletes to achieve the highest results

Swimming – is a sport activity that requires an athlete to move through water for varied distances in the shortest time possible.

2.2. Review of Literature Related to the Elaboration of Method to Develop Speed Endurance of Young Swimmers during Training

Such modern authors as D.P. Adeyemi and O.N. Suleimanova (2018), V. Gomelskiy (2015), Yu.D. Zheleznyak, I.V. Kulishenko and E.V. Karyakina(2013), A.B. Muller (2013), Zh.K. Kholodov (1997) distinguish two types of endurance: general and special. Notably, all of specific types of endurance are combined into special endurance, but there is no mention about versatile endurance.

Such authors as Zh.V. Smirnova and O.G. Krasikova (2018), G.S. Abramova (2014), A.L. Venger (2015), B.S. Volkov (2014), N.Kh. Gafiatulina (2013) reviewed physiological basis of middle school age.

V.M. Zatsiorskiy (2014), Yu.F. Kuramshin (2015), M.A. Gribacheva and V.A. Kruglykhin (2013), and A.B. Muller (2013) study the mechanisms of energy production during muscle work, and loads for development of endurance in their works.

Such authors as Yu.I. Evseev (2014), D. Kaunsilmen (2013), N.ZH. Bulgakova (2001), G.I. Gapon (1971), B.D. Zenov, I.M. Koshkin and S.M. Vaitsekhovskiy (1976) contributed to major distribution and use of five-component classification of loads during training of swimmers.

2.3. Issues Arising From Elaboration of Method to Develop Speed Endurance of Young Swimmers During Training

The following challenges were established to solve the issues arising from elaboration of method to develop speed endurance of young swimmers during training:

1. Study scientific literature related to the subject of the research;
2. Elaborate a method to develop speed endurance based on special exercises;
3. Verify the efficiency of the elaborated method aimed at development of speed endurance during the pedagogical experiment.

Problem of the research: elaboration of a method to develop speed endurance and apply the method during training of young swimmers.

The goal of the research is to test by experiment the application of special exercises aimed at development of speed endurance of young swimmers.

The hypothesis of the research is the assumption that implementation of the elaborated method with special exercises into training will allow to improve speed endurance of young swimmers.

3.Results

The experiment took place at Sports School of Olympic reserve "Moscow's Youth" from April 2018 to May 2018. The experimental group included 20 swimmers of 11 to 15 years of age.

The experiment included 4 types of tests. Each test was divided into 3 levels in accordance with age-related qualifying standard: high, medium and low (Table 1).

Table 1. Assessment of speed endurance (sec)

Exercise description	Low level (seconds)	Medium level (seconds)	High level (seconds)
Shuttle run 3 x10 m	9.8	9.1	8.6
30 m run	4.7	4.4	4.1
60 m run	9.3	8.7	8.2
100 m run	15.2	14.2	13.4

The results of assessment of speed endurance of the experimental group at the ascertaining stage are given in Table 2 below.

Table 2. The results of assessment at the ascertaining stage

No	Initials	Results			
		Shuttle run 3 x 10 m (seconds)	30 m run (seconds)	60 m run (seconds)	100 m run (seconds)
1	B.A.	9.1	4.3	8.7	14.1
2	B.K.	8.9	4.3	8.6	13.8

3	V.A.	9.0	4.8	8.7	14.2
4	V.M.	9.1	4.3	8.7	13.9
5	G.G.	9.5	4.7	8.9	14.8
6	G.P.	8.7	4.2	8.1	13.2
7	G.F.	8.9	4.2	8.6	13.5
8	E.A.	8.8	4.3	8.4	14.0
9	E.M.	8.7	4.2	8.7	13.1
10	K.F.	9.7	4.9	9.1	15.6
11	L.A.	9.0	4.2	8.5	13.9
12	L.S.	9.1	4.5	8.4	13.8
13	M.D.	8.8	4.2	8.3	13.3
14	M.M.	9.4	4.6	9.5	15.4
15	M.P.	8.7	4.2	8.4	13.9
16	P.A.	8.5	4.1	8.1	13.0
17	P.G.	9.0	4.3	8.5	14.0
18	C.M.	9.3	4.5	9.4	14.2
19	T.A.	8.9	4.3	8.6	13.8
20	T.D.	8.8	4.4	8.5	13.7

The percentage of test results of the ascertaining stage is shown in Figure 1 below.

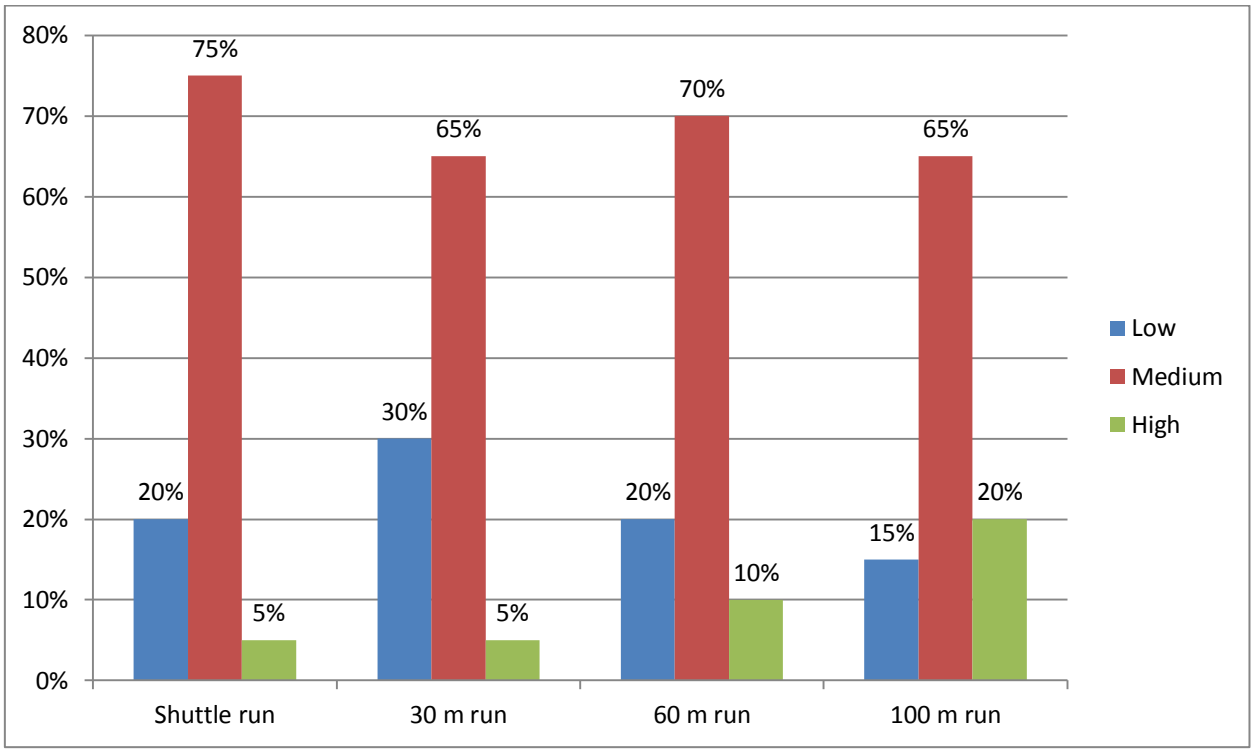

Figure 1. The results of the ascertaining stage

From Figure 1 it is apparent that at the ascertaining stage of the experiment most of the athletes demonstrated medium level of speed endurance. However, a large number of athletes demonstrated low level of speed endurance: shuttle run – 20% (4 people), 30 m run – 30 % (6 people), 60 m run – 20 % (4 people), 100 m run – 15% (5 people).

The results of analysis of the ascertaining stage of the experiment indicate insufficient maturity of swimmers' speed endurance abilities.

In such a manner we were faced with a task to develop a program aimed at development of speed endurance of swimmers by means of training exercises at the forming stage of the experiment.

4.Discussions

A. Young's recommendations below were used to elaborate a method for speed development of swimmers of middle school age.

To balance between different types of physical training, it is recommended to use a very simple formula that helps to plan training sessions and ensures optimal distribution of workload between warm-ups, strengthening exercises for the cardiovascular system, basic and compensatory tasks.

To our opinion, the following example of three-kilometer training run demonstrates the most optimal distribution of load. This example can be used as a guideline, even if the individual training distance is rather small, i.e. suitable for training at the middle school age and in the future.

1. Warmup – 400 to 1000 meters. The set includes most of the required exercises and improvement. Gradually increasing the intensity by building up the amount of effort expended up to the level that providing an average swimming speed.
2. Strengthening set – 200 to 500 meters. Three shorter sets aimed at increase of heart rate and prepare the body for the main part of the training.
3. Main set – 1200 to 2000 meters. During this set the attention shall be paid to different aspects: swimming technique, endurance exercises, speed swimming, improvement of threshold performance or swimming skills in the open water. In this section of the research this set shall be reviewed in more details.
4. Compensatory set – 100 to 400 meters. This set is the most important out of all training. It is aimed at decrease of heart rate, remove lactic acid from muscles and restore ease of movements.

Using such plan, training sessions can be very versatile. To make it easier, the author gives six variations for each set of the training session. Each variation is suitable for all six types of swimmers.

With this example training and the variations it is possible to make up individual training plans with perfect balancing of strength development, technique work, and training of swimming skills in the open water. Among other things it is possible to swap sessions using even those that are not directly related to the required type, as they will also be useful for overall development.

Considering the possibility of choosing from five main plans, six plans for open water and plans for technique work, it is possible to make up to 5100 unique training plans using these recommendations.

Main plans may be divided into three groups:

– Speed or sprinting;

– Endurance and long-distance swimming plans;

– Plans aimed at improvement of threshold performance capabilities or maintenance of swimming speed.

Below is detailed description of each plan in the order given above. As a matter of actual practice, a lot of swimmers prioritize speed and endurance training, and pay less attention to speed maintenance abilities.

First training plan is aimed solely at speed and sprinting.

The swimmers of masters category during training pay a lot of attention to development of sprinting abilities, meaning development of maximum speed on short distances – 10 to 200 meters – with long rests in between swimming rounds. A lot of swimmers consider such type of training the best way to learn to swim faster.

Of course, for competing on short sprinting distances (25 to 200 meters) such plan should take the most part of training session, as it is aimed at conditioning of an athlete to such starts. Nevertheless, triathlon and open water require preparation for 400 meter or longer courses, meaning that too much of sprint training may cause decrease in overall endurance. In the next paragraphs this issue is reviewed in more details.

For competitions on 200 m or shorter courses it is required to hold sprint training sessions. As a useful alternative, it is possible to do training sessions aimed at improvement of threshold performance and aerobic endurance.

Sprint training sessions imply long rest pauses between set for the athlete to be able to maintain high level of intensity during swimming. Ratio of work to rest during such sets may vary from 3:1 to 1”1 (or more). Below is an example training session:

8 x 50 meters in 40 seconds with 20 to 30 seconds of rest every 50 meters.

For competitions on 400 m or longer courses, and the training sessions take place 5 or more time a week, it is possible to include such training plan into weekly program until they are replaced with more important sessions to improve threshold performance.

Second training plan is aimed at improvement of endurance.

The simplest endurance training series may include long swimming with constant speed. It helps develop abilities to swim nonstop for a long period of time. Quite often the training time of swimmers is limited. During such sessions they tend to swim without stops. This can be advantageous, however, if every training session turns out to be nonstop swimming from one edge to the other, missing an opportunity to work on technique, there is a risk of hitting a plateau, as the athlete always swims with constant speed.

For swimmers participating in long-distance swims, extended swims help build self-confidence.

Swimmers, who give priority to long swims in their training, make a classic mistake: they accelerate too much at the initial stage and run themselves out by the end of the course.

By breaking endurance training into a series of long courses with short pauses for rest, it is possible to preserve the interest, motivation and get an opportunity to create micro energy reserves during 45-minute swim.

Here is an example of training set: 6 x 400 meters at 75 % of effort with 30-second resting pauses. For convenience, it is recommended to work not at 75 % of effort, but to swim at a maximum speed allowing to gain about 8 seconds each 100 meters.

Endurance training sessions with courses varying from 2.5 to 6 kilometers allow to go without warmup and callisthenic routine, as warmup is already included into the structure of such series. It is allowed to start swimming with steady speed, similar to routine during competitions. However, before engaging into such training sessions, it is required to pay 10 to 15 minutes to stretching (on land).

Third training plan is aimed at improvement of threshold performance and critical speed of swimming.

Conscious effort to improve threshold speed is a base of any training plan. Very often if the course is over 1500 meters long, threshold speed is also called competitive speed. Threshold speed is the rate at which the aerobic energy supply system of the body is developing, but it does not take a long time to recover between the courses. In matter terms, through such series, recovery is faster compared to series performed with greater intensity. By managing to develop the ability to swim well with an intensity corresponding to the threshold speed, it is possible to get the key to excellent results at courses of 400 meters or more.

Swimmers with low speed performance often say that the first several hundred meters are easy for them, but then they get the feeling that the technique is "falling apart". It is quite common for them to explain this phenomenon by insufficient fitness, and lack of endurance. Of course, to a certain degree these suggestions may be correct, but nine times of ten the issue lies within incorrect training rate. Constant training in such a mode do not give the required improvement of efficiency, but most certainly slow down long-term growth of swimmers. As a matter of fact, poor judgement of one's rate of development is one of the main reasons for swimmers and triathlon athletes not being able to unlock their potential in water.

It is very important to learn to accurately determine one's critical speed performance indicator (CSPI) and, set oneself up at the start for the optimum pace, maintain it at the middle of the course and at the end of the training session – this will help to better assess the efforts made. This is the most important skill which is called "internal speed rating". If an athlete manages to develop it, it will pay off at competitions, when everyone starts too fast and gets exhausted by the end of the run.

When doing a training session aimed at improvement of threshold performance it is important to try to swim longer courses at increased but balanced speed, decreasing rest pauses after each course. By doing so will bring much better results than individual maximal accelerations.

Work to rest ratio shall vary from 4:1 to 15:1, sometimes less, for example: 8 x 200 meters with accelerating up to 3:15 with 15-20 seconds for rest after each 200-meter course. With such short pauses it is very important to correctly assess the speed during swimming and rate the strength to be able to finish within the required time.

Training with such intensity gives better results in fitness and technique rather than during acceleration training. Lots of swimmers avoid high intensity training due to concerns with the technique, but not being able to control one's speed and exhausting by the end of the course is doing more harm.

Critical speed training is a great opportunity to maintain the high level of technique that is why it is important not to avoid steady speed training, as good technique is impossible without it.

To be able to see improvements, it is required to have trainings 3 or more times a week. The frequency of training is much more important than the duration of each training session. For example, three 30-minute training per week will give much better results than one 90-minute training.

Training program recommended by P. Newsome is given in the table below. It is based on the number of pool visits during a week, and combines three main focal areas: work on technique, training itself, and improvement of skills in open water. It is possible to train by this program the whole year round to develop swimming skills in open water and in pool, when the open water gets too cold.

Table 3. Training program recommended by P. Newsome

Day	Training exercises
Monday	2-3 km gentle swim; rest or general exercises to avoid traumas
Tuesday	6-7 km pool swim with medium speed, including exercises; 4-6 km continuous swim: 10-15 section 400 m each at a 1:24 speed for 100 m, 21 s rest after each 400 m (control the performance with metronome)
Wednesday	Heavy 9 km pool swim at a speed 0:43-0:45 for 50 m, i.e. 20 x 50 m,10 x 100 m, 5 x 200 m, 2 x 500 m, 1 x 1000 m, 2 x 500 m, 5 x 200 m, 10 x 100 m, 20 x 50 m. Cycle time includes rest, i.e. the faster an athlete swims, the longer the rest. Usually, P. Newsome was able to finish this swim at 1:18 in 100 m.
Thursday	10 km swim in cold (15° C / 59 F) open water, approximate speed 1:24, including stops for 15-20 seconds each 2 km to drink.
Friday	4-5 km smooth pool swim; exercises and technique is a priority.
Saturday	Heavy 8-12 km swim in cold (15° C / 59 F) open water, main goal is to maintain speed at 1:20 for 100 m.
Sunday	Goal of the series of exercises: assisted swim 14 to 25 km in cold (15° C / 59 F) open water, snack every 2 km, goal: maintain speed at 1:24 for 100 m.

Based on the recommendations above, we have developed a method to develop speed endurance of children of middle school age.

60-minute training sessions according to the elaborated program took place three times a week. On Mondays, Wednesdays, and Fridays the training was held according to individual training plans.

Table 4. Training program for 1 week

Day	**Standard training session**	**Training session for experimental group**
Mon	1. 10 min warmup. 2. 5 min callisthenic routine. 3. Circuit training (pull-ups, squads, band, rope jumping). 2 circuits of 2 sets (rest between sets is 1 minute, rest between circuits is 2 minutes). 45 minutes swimming: 1. 1000 m front crawl 2. 10 x 50 front crawl with stops 3. 200 gentle swim 4. 4 x 50 crawl kick 5. 600 gentle front crawl	60 minute swimming. 1. 500 warmup 2. 3 x 800 m front crawl (30 sec rest) 3. 400 gentle back swim 4. 4 x 100 crawl kick (30 sec rest) 5. 400m front crawl
Tue	Rest	Rest
Wed	1. 10 min warmup. 2. 5 min callisthenic routine. 3. Medicine ball (5 kg) routine: 50 repetitions from behind the neck – 50 repetitions left and right arm – 50 chest pushes. 4. 3 min stretch. 45 minutes swimming. 1. 600 m freestyle swim 2. 4 x 75 front crawl (rest between sets is 2 minutes. 100 m cool-down between circuits. 3. 400 m front crawl 4. 2 x 200 back crawl (10 seconds rest) 5. 200 breast stroke 6. 1000 front crawl with fins	60 minute swimming 1. 500 warmup. 5 x 200 freestyle swimming 2. 2 x 400 front crawl (rest between circuits 100 gentle 3. 200 gentle 4. 2 x 200 back crawl (30 seconds rest) 5. 100 gentle
Thu	Rest	Rest
Fri	1. 10 min warmup. 2. 5 min callisthenic routine. 3. Dodge ball game. 60-minute swimming. 1. 10 x 100 medley swimming (20 sec rest) 2. 4 circuits of front crawl 30 seconds each with belt on shoulder blades (20 seconds rest) 3. 800 m (75 m fast + 25 m gentle on the back) 4. 8 x 25 started front crawl	60 minute swimming. 1. One-hour swim 2. Turnings, starts

5.Conclusion

The empirical study of swimmers' speed endurance development took place at Sports School of Olympic reserve "Moscow's Youth" from April 2018 to May 2018.

It was established that there are significant differences between the results of speed endurance tests before and after training. Meaning that having conducted calculations under Mann – Whitney U-test, it is possible to conclude that our work contributed to improvement of speed endurance of athletes.

The results of calculations show that after holding training with the experimental group, the participant of the group improved their speed endurance performance.

It was found that 50% of athletes with low level of results of shuttle run were able to improve their results up to medium level (2 people out of 4). Moreover, 20% of the athletes (3 people out of 15) with medium performance of speed endurance improved their performance up to high level.

It was found that 67% of athletes with low level of results of 30-meter run were able to improve their results up to medium level (4 people out of 6). Moreover, 69% of the athletes (9 people out of 13) with medium performance of speed endurance improved their performance up to high level.

At the control stage we noted that 50% of athletes (2 people out of 4) improved their results in 60-m run, and 43% of athletes (6 people out of 13) improved their performance up to high level.

During the experiment it was found that 67% of athletes (2 people out of 3) improved their results of 100-meter run from low to medium level, and 38% of athletes (5 people out of 13) were able to improve their results up to high level.

Based on the obtained data it can be concluded that the work that was done during training benefited the swimmers by improving their speed endurance performance results. The results obtained after calculations are a proof of conclusions of empirical analysis.

Thereafter, in the course of this research we were able to establish that the work during training can improve the level of speed endurance of swimmers.

The hypothesis of the research that implementation of the elaborated method with special exercises into training will allow to improve speed endurance of young swimmers, is confirmed.

In connection with the foregoing, it can be stated that the goal of the research is achieved, the objectives of the research are solved, and the research hypothesis is confirmed.

6.Recommendations

The materials of this article may be found useful by students of vocational and higher educational institutions of physical education, specialists of extended educational system, physical education teachers, and specialists of elite sport system.

References

1. Abramova, G.S. (2014). Developmental psychology: text book for higher educational institutions. Moscow: Yurait.
2. Adeyemi, D.P., Suleimanova, O.N. (2018). Basketball: the basics of learning attack techniques: research and methodological manual. Moscow: Finta.
3. Bulgakova, N.Zh. (2001). Swimming: text book for higher educational institutions. Moscow: Physical culture and sport.
4. Evseev, Yu.I. (2014). Physical education. Roston-on-Don: Phoenix.
5. Gafiatulina, N.Kh. (2013). Handbook of school counselor, primary school teacher. Roston-on-Don: Phoenix.
6. Gapon, G.I. (1971). Research of the efficiency of means and methods to build physical abilities of children. *Theory and practice of physical education, 3,* 8-10.
7. Gomelskiy, V. (2015). How to play basketball. Moscow: Eksmo.
8. Gribacheva, M.A., Kruglykhin, V.A. (2013). Program of integrative physical education based on football for elementary school. Saint Petersburg: Chlovek.
9. Kaunsilmen, D. (2013). Control of training loads in sport. Moscow: FiS.
10. Kholodov, Zh.K. (1997) Theory and methods of sports. Moscow: Academia.
11. Kuramshin, Yu.F. (2015). Theory and methods of physical education (series of lectures): textbook. Saint Petersburg: Piter.
12. Kuznetsov, V.V. (2014). Strength training for athletes. Moscow: FiS.
13. Matveyev, L.P. (2013). General theory of sport and its applied aspects. Moscow: FiS.
14. Mogileva, V.N. (2013). Psycho and physiological features of school-age children during work with computers. Moscow: Akademiya.
15. Muller, A.B. (2013). Physical education. Moscow: Yurait, 432 p.
16. Petrova, O.V. (2014). Developmental psychology. Rostov-on-Don: Phoenix.
17. Platonov, V.N. (2014). Theory of sports. Moscow: FiS.
18. Smirnova, Zh.V., Krasikova, O.G. (2018). Modern means and methods of assessment of learning results. *Vestnik of Minin University,3(24),* 9 -21.
19. Venger, A.L. (2015). Psychological research of schoolchildren. Moscow: Vlados-Press.
20. Volkov, B.S.(2014). Psychology of a teenager. Saint Petersburg: Piter.
21. Zatsiorskiy, V.M. (2014). Physical abilities of an athlete. Theories and principles of education. Moscow: FiS.
22. Zenov, B.D., Koshkin, I.M., Vaitsekhovskiy, S.M. (1986). Special training for swimmers on land and in water. Moscow: Physical Culture and Sport.
23. Zheleznyak, Yu.D., Kulishenko, I.V., Karyakina, E.V. (2013). Methods of physical education. Moscow: Akademiya.