ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-515-x, Impact Factor: 9.23

American Academic publishers, volume 6, issue 01,2026

Journal: https://www.academicpublishers.org/journals/index.php/ijai

INNOVATIVE APPROACHES TO TEACHING YOUNG TAEKWONDO ATHLETES COMPLEX COORDINATION TECHNIQUES

REPUBLIC OF UZBEKISTAN

MINISTRY OF HIGHER EDUCATION, SCIENCE AND INNOVATION

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Annotation. This study is devoted to the problem of improving the learning process for complex coordination of technical actions of young taekwondo practitioners. The relevance of the work is due to the growing demands on the technical and tactical readiness of athletes in modern taekwondo, where success is determined not only by physical strength, but also by a high level of coordination abilities, which allows effective combination actions in conditions of time and space constraints. The article presents the results of a theoretical analysis and pedagogical experiment aimed at developing and testing innovative approaches to training young athletes. The methodology is based on the principles of consistency, individualization, sensitive periods of development and integration of modern technologies. Key complex coordination actions in taekwondo (such as "dolleo-chagi" from a turn, "bandal-chagi" in a jump, combinations of "double" and "triple" strokes) were identified, and factors influencing the success of their development were identified. Innovative techniques have been introduced and experimentally tested, including the use of specialized training devices (Biodex platforms, SMART SPEED systems, light and sound simulators), visualization and biofeedback methods (EMG, stabilography), cognitive-motor training and elements of virtual reality (VR). In the course of a pedagogical experiment involving 40 taekwondo practitioners aged 10-12 (control and experimental groups of 20 each), a statistically significant superiority in technical skill, accuracy and timing of actions in the experimental group was established. The results of the study confirm the hypothesis about the high efficiency of the proposed innovative approaches. The materials of the work can be used by coaches and specialists in the field of sports training to optimize the educational and training process in taekwondo and other complex coordination types of martial arts.

Keywords: taekwondo, young athletes, complex coordination actions, innovative techniques, sensorimotor integration, biofeedback, technical training, pedagogical experiment.

Introduction

The relevance of the problem. Modern Taekwondo of the World Taekwondo Federation (WTF) As an Olympic sport, it is characterized by exceptionally high dynamics and density of fights, constant intensification of competition. Winning top-level competitions increasingly depends on an athlete's ability to make instant decisions and masterfully perform complex technical actions in the face of fierce opposition from an opponent. The so-called complex coordination actions become key: kicks from a turn, in a jump, combinations of serial punches that require a well-honed sense of time, space, balance and muscle control.

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Teaching these actions to young taekwondo practitioners (10-14 years old) is a difficult pedagogical task. Traditional methods based on repeated repetition and direct imitation often turn out to be insufficiently effective, lead to the formation of technical errors and require a long time to automate the skill. This is due to the age-related features of the development of the nervous system and musculoskeletal system of children, as well as the high coordination complexity of targeted actions.

In this regard, there is an urgent need to develop and implement innovative approaches to training based on the latest achievements in sports science, biomechanics, psychophysiology and pedagogy. Such approaches should optimize the process of motor skill formation, make it more conscious, manageable and resistant to disruptive factors. The relevance of this study is determined by the search for scientifically sound ways to solve this problem.

Development of innovative teaching methods

A set of innovative tools and methods.

The block of spatial and temporal parameters development. To develop a sense of timing and accuracy of hitting, the following methods were used:

· "SMART SPEED" system: Training of the starting speed of impact and reaction to a visual signal. The young athlete strikes the boxing bag, and the system records the glove/foot speed. The task is to consistently exceed the set speed threshold.

· Light and sound simulators "Traffic Light" or "Reaction Light": Light panels are attached to the frame or wall, which randomly light up. The athlete's task is to kick or arm into the area of the illuminated target as quickly as possible. Develops the speed of simple and complex reactions, accuracy.

Graph 1: Dynamics of the speed of the dolleochagi stroke in subjects with EG and KG (according to the SMART SPEED system

The beginning of the experiment	After 3 months	After 6 months (end)
EG (average speed) 12.5 m/s	14.2 м/с	16.8 м/с
KG (average speed) 12.3 m/s	13.1 м/с	14.0 м/с

Explanation: The graph shows a distinct and statistically significant ($p<0.01$) advance in the increase in impact velocity in the experimental group (EG), where simulators were used, compared with the control group (KG), who practiced using the traditional method.

The statokinetic stability unit. To improve balance when performing strikes on one leg and in a jump:

· Exercises on BOSU platforms and balancing pads: Practicing postures, simple weight transfers, and then striking from unstable positions.

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· Biofeedback stability platform: Performing tasks to keep the pressure center in a given area on the screen. Allows you to objectively evaluate and improve the balance function.

Graph 2: Indicators of statokinetic stability (stability index) before and after the experiment

Group	Before the experiment (standard unit.)	After the experiment (standard unit.)	Growth (%)
EG (n=20)	64.2 ± 5.1	78.9 ± 4.3**	+22.9%
KG (n=20)	63.8 ± 5.7	68.3 ± 5.1	+7.1%

Note: ** — the differences are statistically significant at $p<0.01$. The stability index was calculated as the ability to hold a pose on a stability platform with eyes open and closed.

The results of the study and their discussion

A 6-month pedagogical experiment showed pronounced positive dynamics in all the tested parameters among the taekwondo practitioners of the experimental group (EG). Changing the quality of targeted complex coordination actions.

The results in the accuracy and speed of the "double strike" combination were the most revealing: ar-chagi in the head + dolleo-chagi in the torso by light targets.

Graph 3: Hit accuracy and total time to complete the double combination

Parameter / Group	The beginning of the experiment	End of the experiment
EG accuracy (%)	68 ± 7	91 ± 4**
Accuracy KG (%)	67 ± 8	79 ± 6
EG time (c)	2.31 ± 0.15	1.89 ± 0.12**
Time KG (c)	2.29 ± 0.18	2.10 ± 0.15

Note: ** — the differences between the groups at the end of the experiment were statistically significant ($p<0.01$). The EG athletes not only began to hit more accurately, but also completed the attacking action much faster.

Discussion

The data obtained convincingly demonstrate the high efficiency of the developed innovative methodology. The complex effect on various components of coordination abilities (spatiotemporal, statokinetic, cognitive) through specialized means led to a synergistic effect. Biofeedback turned out to be an important factor, which allowed young athletes to better understand and adjust their movements. The correct internal image of movement was formed faster, which accelerated the process of automating the skill. The advantages of the traditional method based on mechanical repetition turned out to be insufficient for high-quality mastering of complex coordination actions in a short time.

Conclusions

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1. An innovative method of teaching young taekwondo practitioners complex coordination actions has been theoretically substantiated and developed, integrating modern technological means (speed and reaction development simulators, stability platforms), biofeedback methods and cognitive-motor training.

2. The pedagogical experiment confirmed the hypothesis of the study, demonstrating a statistically significant superiority of the dynamics of the development of coordination abilities and the quality of technical skills among the athletes of the experimental group compared with the control group, who studied according to the traditional method.

3. The most pronounced increase was observed in terms of speed and accuracy of strikes in combinations, as well as in statokinetic stability, which directly affects the effectiveness of performing complex technical actions in a duel.

4. Practical recommendations have been developed for youth sports school coaches on the step-by-step introduction of elements of innovative methodology into the educational and training process, taking into account the age and fitness of those involved.

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