

## Developing cognitive independence in high school students through physical education lessons

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### Abstract

The article aims to present the results of experimental work on the implementation of a model for the development of cognitive independence of high school students in physical education lessons. Experimental work involved the development of the substantive foundations of the process of developing cognitive independence of high school students in physical education lessons, for this purpose, a phased implementation of this process was organized. The total participants of the research were 210 students between grades 10-and 11. The effectiveness of the implementation of the constructed model and technology is confirmed by the significant differences in the dynamics of the development of cognitive independence among high school students in control and experimental groups. The revealed differences allow us to state the effectiveness of the conducted experiment on the development of cognitive independence in physical education lessons among high school students in terms of motivational-value, cognitive-reflexive, and creative-activity components of cognitive independence.

**Keywords:** Cognitive independence; high school students; independence; physical education.

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## **1. Introduction**

Modern scientists have established that cognitive independence is a means of increasing awareness and effectiveness of the studied subject, an indicator of a high level of mental development, creativity, and subjectivity in schoolchildren (Zozuliak-Sluchyk et al., 2021). The problem of the development of cognitive independence in various subject areas has been developed in various studies. However, this issue was not specifically considered about high school students in physical education classes. Meanwhile, today, physical education lessons have a significant potential for the development of cognitive independence: they are designed to form discipline, responsibility, perseverance, purposefulness, functional capabilities of the body; movement culture, independence in the classroom, etc (Beasley, 2020).

The theoretical analysis of the problem under consideration allows us to determine that in the practice of general education institutions, contradictions are found between: - the need for pedagogical practice to improve the process of forming cognitive independence of high school students and insufficient development at the level of technological and substantive aspects of activities for the development of independence of high school students in the context of the subject "Physical Culture"; - the growing need of society for the formation of an active, independent personality and the insufficient possibility of its effective satisfaction in the conditions of a comprehensive school.

### **1.1. Purpose of study**

The study aims to determine the effectiveness of the developed program for the development of cognitive independence of high school children in physical education lessons. The developed and tested pedagogical technology for the development of cognitive independence of high school students includes the following components: goal setting; technological support; development of an individual trajectory for the development of cognitive independence; content of cognitive activity and diagnostics of effectiveness. Within the framework of this article, we will highlight the main results of experimental work obtained at the stage of the ascertaining and control section in two research groups.

## **2. Materials and Methods**

Diagnostics of the level of development of cognitive independence were checked using the methodology for determining the development of the structural components of cognitive independence, which, according to their content indicators, were grouped into components: motivational-target, cognitive-reflexive, and creative-activity.

### **2.1. Data collection instrument**

Tests, a questionnaire, and an expert assessment were used as tools for determining the levels of components, which made it possible to summarize and systematize the data obtained.

As part of the study, the following research methods were selected. To determine the motivational-value component of the development of cognitive independence, the test "Diagnostics of the structure of the student's educational motivation" by Matyukhina(2017) was used. This technique is designed to diagnose learning motivation, and identify additional learning motives (cognitive, communicative, emotional, student's position, achievements, external motivation).

Another diagnostic tool for studying motivation was a questionnaire to assess the level of motivation of schoolchildren for physical education (Luskanova, n.d) .

To determine the cognitive-reflexive component of the development of cognitive independence, an expert assessment of teachers was used, who evaluated high school students in the process of preparing and performing project work that could take place in various subjects during the year. The goals of the project activity are the development of the independent activity, the development of research and communication activities, instilling skills of teamwork.

The level of formation of the cognitive-reflexive component of cognitive independence was diagnosed by evaluating the results of project work according to the criteria of the modified score-rating evaluation map of project work proposed by I.D. Chechel. The methods of independent activity of students, manifested in the skills, are evaluated:

- 1) use various sources of information,
- 2) process information,
- 3) set goals, objectives,
- 4) draw up an activity plan,
- 5) compose tasks on the topic,
- 6) solve problems and find new solutions,
- 7) formulate questions about the topic,
- 8) prepare a message on the topic,
- 9) conduct self-monitoring,
- 10) work in a team,
- 11) to carry out the reflection of independent activity (Chechel, 2021).

To determine the creative-activity component of the development of cognitive independence, a questionnaire was used to study the cognitive activity of students (Pashnev, 2018). Interpretation of the results made it possible to determine the levels of cognitive activity and independence. Another method of evaluating the creative-activity component of cognitive independence was the developed expert scale, which includes the following parameters:

- internal motivation to perform activities
- readiness and striving for new knowledge on their own
- the desire and ability to act according to one's views and beliefs
- active in his initiative
- readiness to search for different ways
- decisions without outside participation
- awareness of actions is expressed
- manifestation of cognitive activity
- ability to navigate in a new situation
- there is the independence of volitional efforts
- there is a creative approach
- the ability to organize your
- cognitive activity
- the ability to purposeful activity

## **2.2. Data analysis**

Secondary statistical data processing was performed using the student's parametric statistical t-test to check the equality of the mean values in the two samples.

### 2.3. Participants

Experimental work was carried out in the schools of Atyrau: "Secondary school No. 10, "Secondary school No. 19" - covering 210 students in grades 10-11: in the experimental group – 104 people, in the control group - 106 people. The involvement of students in an independent cognitive process in the conditions of the development of cognitive independence of high school students in physical education classes met the requirements for the apparatus of pedagogical research on representativeness (210 people participated) and on the qualitative reproducibility of its results for different groups of students. The study also involved 30 teachers as experts.

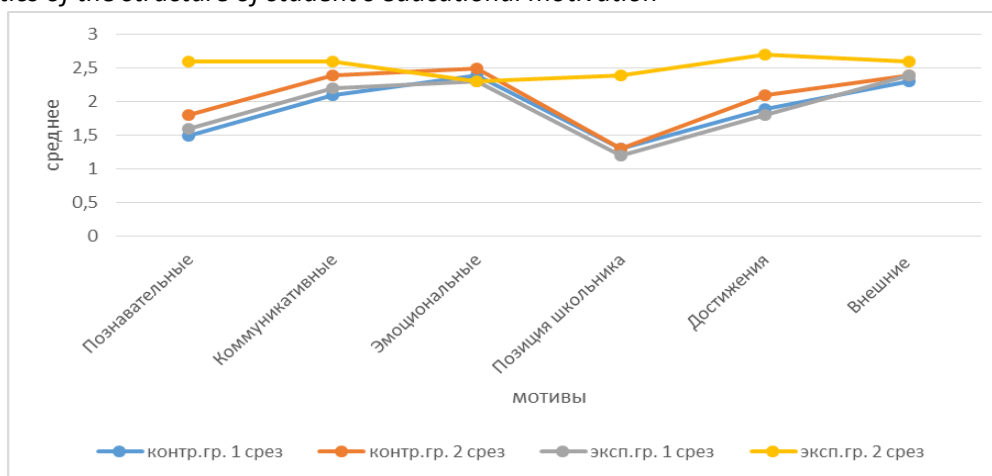
### 3. Results

Here are the results of diagnostics of the level of development of cognitive independence in dynamics - before and after the experiment.

The motivational and value component of cognitive independence is characterized by the presence of interest in cognitive activity, high motivation to achieve goals, initiative, and curiosity.

**Figure 1**

*Diagnostics of the structure of student's educational motivation -*



*Note:* Average group indicators of the dynamics of the development of educational motivation of high school students of the experimental and control groups according to the test "Diagnostics of the structure of student's educational motivation" by Matyukhina (2017) at various stages of the experiment

Diagnostics of the structure of the student's educational motivation allows us to draw the following conclusions (Figure 1). At the ascertaining stage of the study, no obvious differences in the motivational profile were found in the two groups under consideration. The schoolchildren included in both the control and experimental groups as a whole were characterized by the predominance of the importance of emotional and communicative motivation. Externally directed motives are also significant. To a lesser extent, at the level of partial significance, all schoolchildren have cognitive motives and motives related to the position of the student.

Thus, we can say that schoolchildren were mainly focused on the beginning of the experiment to get emotional satisfaction from the learning process, they were more aware of the social need for this than the personal one. It was important to take a certain position in relations with others, get approval from them and establish stable communicative ties. The training was mainly directed by virtue of duty, duty.

In the control group at the stage of the second diagnostic slice, we found no significant differences in the indicators of motivation structure. The motivational profile of schoolchildren in this group remained at the same level of severity of grades.

In the experimental group, significant differences were found in the dynamics of the two sections for three groups of motifs. High school students have become more focused on the content of educational activities and the process of its implementation (from 1.6 to 2.6 points). They strive to master new knowledge and new educational skills, can identify interesting facts, and phenomena, show interest in the essential properties of phenomena, patterns in the educational material, principles, and key ideas ( $t_{em} = 2.35$ , with their  $\leq 1.98$ ;  $p < 0.05$ ). For these high school students, it became important to achieve success, actively engage in the implementation of the goal, and independently choose the means aimed at achieving it (from 1.8 to 2.7 points). The calculation of the Student's criterion also showed changes in this motif ( $t_{em} = 2.17$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ). The level of orientation towards the assimilation of ways of acquiring knowledge has increased, the students of the experimental group have become more interested in the methods of independent acquisition of knowledge, methods of cognition, methods of self-regulation of academic work, and rational organization of their academic work (from 1.2 to 2.4), at the same time. The differences are also significant ( $t_{em} = 2.14$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ).

The communicative motivation in the experimental group increased slightly after the experiment (from 2.2 to 2.6 points), but no statistically significant differences were found. At the same time, this may indicate that communicative relations continue to occupy one of the leading motives among older schoolchildren, they need to get approval from others and have a certain authority. Emotional and externally oriented motivation decreased slightly in their dynamics.

Significant differences were revealed between the control and experimental groups at the stage of the control slice in cognitive motivation ( $t_{em} = 2.7$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ) and motivation associated with the student's position ( $t_{em} = 2.1$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ). As well as differences in the indicators of the control group at the stage of the first slice and the experimental group of the second slice on the scales of cognitive motivation ( $t_{em} = 2.14$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ), the position of the student ( $t_{em} = 2.14$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ) and achievement motivation ( $t_{em} = 2.14$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ). The revealed statistical differences allow us to state the effectiveness of the conducted experiment on the development of cognitive independence of high school students in physical education lessons.

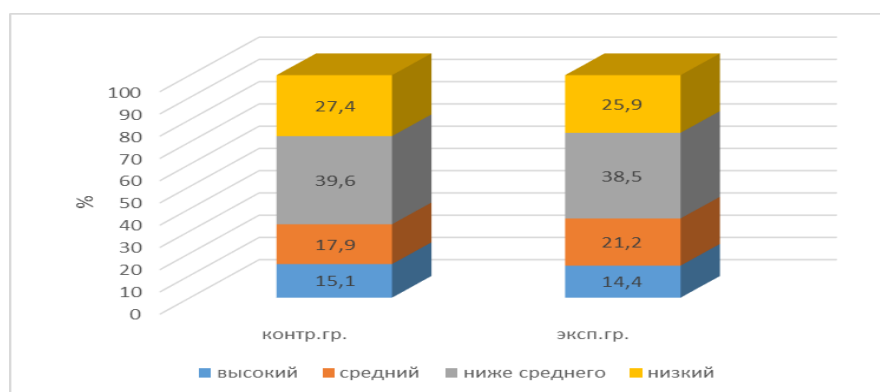
Another method of studying motivation was a questionnaire to assess the level of motivation of schoolchildren for physical education (Luskanova, n.d.). According to Figure 2, it can be determined that at the stage of the ascertaining slice, there were no significant differences in the two samples of subjects under consideration. This may indicate that the samples are homogeneous. The majority of high school students (39.6% in the control group and 38.5% in the experimental group) have a predominant motivation to engage in physical education at a below-average level. In general, the school attracts such high school students with extracurricular activities. Such children feel quite well at school, but more often go to school to communicate with friends, with a teacher.

The cognitive motives of such children are formed to a lesser extent, and the educational process attracts them little. There is no expressed interest in physical education lessons.

47.1% of students in the experimental group began to demonstrate a high level of motivation, while this level was expressed only in 16% of high school students in the control group ( $t_{em} = 2.8$ , with  $t_{teor} \leq 2.62$ ;  $p < 0.01$ ). Such children have a cognitive motive, the desire to most successfully fulfill all the requirements imposed by the school. Students follow all the instructions of the teacher, are conscientious and responsible, they worry a lot if they receive unsatisfactory grades. There is a pronounced interest in physical education, there is no negative attitude to the teacher of physical education, nor to the lesson itself.

**Figure 2**

*Results of indicators of motivation of schoolchildren to physical education according to the questionnaire of Luskanova in the control and experimental groups at the ascertaining stage*



The average level of motivation to engage in physical culture only slightly increased in the experimental group of subjects (29.8%), in the control group it is represented by 22.6% of high school students. Such students can be characterized as successfully coping with educational activities. Such a level of motivation is the average norm.

Significant differences were found in motivation at a level below average, wherein in the experimental group it was only in 14.4% of respondents, and in the control group, it remained predominant in 39.6% of students ( $t_{em} = 2.72$ , with  $t_{teor} \leq 2.62$ ;  $p < 0.01$ ). Such children have a positive attitude to school, but they are attracted to the school by extracurricular activities. Such children feel quite well at school, but more often go to school to communicate with friends, with a teacher. The cognitive motives of such high school students are formed to a lesser extent, and the educational process attracts them little.

A low level of school motivation prevails in 21.7% of high school students in the control group, while in the experimental group it remained leading only in 8.7% of students. These differences were statistically confirmed at the 1% significance level ( $t_{em} = 2.1$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ). Such students may have both a negative attitude towards school and school maladaptation in general and to physical education lessons in particular. Such children have serious learning difficulties: they do not cope with educational activities and have problems communicating with classmates, and in relationships with the teacher. School is often perceived by them as a hostile environment, the stay in which is unbearable for them. In other cases, students may show aggression, refuse to perform tasks, and follow certain norms and rules.

Significant differences were also found in the experimental group in indicators before and after the implementation of the experiment on the development of cognitive independence in physical education lessons. Thus, significant differences were found in indicators of a high level of motivation ( $t_{em} = 2.81$ , with  $t_{teor} \leq 2.62$ ;  $p < 0.01$ ), in indicators below the average level ( $t_{em} = 2.33$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ) and in indicators of a low level ( $t_{em} = 2.11$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ). Changes were also statistically significantly determined at these levels of motivation of schoolchildren for physical education, when comparing the control group at the stage of the first cut and the experimental group at the stage of the second cut - in indicators of a high level of motivation ( $t_{em} = 2.71$ , with  $t_{teor} \leq 2.62$ ;  $p < 0.01$ ), in indicators below the average level ( $t_{em} = 2.2$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ) and in indicators of a low level ( $t_{em} = 2.31$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ).

Cognitive-reflexive component of cognitive independence. This component is implemented in the ability to generalize, compare, analyze the results of the data obtained, draw appropriate conclusions, critically evaluate the results of their work, and generally reflect on their cognitive activity.

At the stage of the ascertaining section, it turned out to be quite difficult for senior schoolchildren to set tasks, then solve them and find new ways to perform them, conduct self-control, and further reflection on independent activity. These techniques of project activity were evaluated by experts at a very low level of implementation by students. At the average level, such indicators as making tasks on the topic, using various sources of information search, processing information, and preparing messages on the topic were evaluated. More highly appreciated by experts were such techniques of project activity as the ability to formulate questions on the topic and the ability to work in a team.

After the implementation of the experiment on the development of cognitive independence in physical education lessons, the experts evaluated the high school students who entered the experimental group at an average and high level in almost all indicators of project performance. Thus, the ability of high school students to process information (2.0) and formulate questions on the topic (2.0) were evaluated as highly as possible. High school students began to use various sources of information better (1.90), compose tasks on the topic (1.8), and prepare messages and presentations (1.8). The students of the experimental group learned to set goals and objectives more consciously (1.6), solve problems and find new ways to accomplish them (1.5), and make an activity plan (1.4). The reflexive component has also changed – high school students began to competently reflect on independent activity (1.5) and conduct self-control in the process of its implementation (1.4).

Analyzing the final indicators using the Student's t-test calculation, it is possible to determine the presence of statistically significant indicators in comparison to the experimental group in two diagnostic sections – before and after the experiment ( $t_{em} = 2.62$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ), in the indicators of the control and experimental groups according to the results of the experiment ( $t_{em} = 2.51$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ). And in the indicators of the control group at the beginning of the experiment and the experimental group at the end of the experiment ( $t_{em} = 2.62$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ).

It should be noted that high school students not participating in the experiment (control group) in the second diagnostic section showed only minor changes in the estimated parameters.

Creative-activity component of cognitive independence. The development of cognitive independence is closely related to independent activity, which manifests itself in the need, desire, and activity of performing any actions to achieve the goal, the ability to plan, organize their activities,

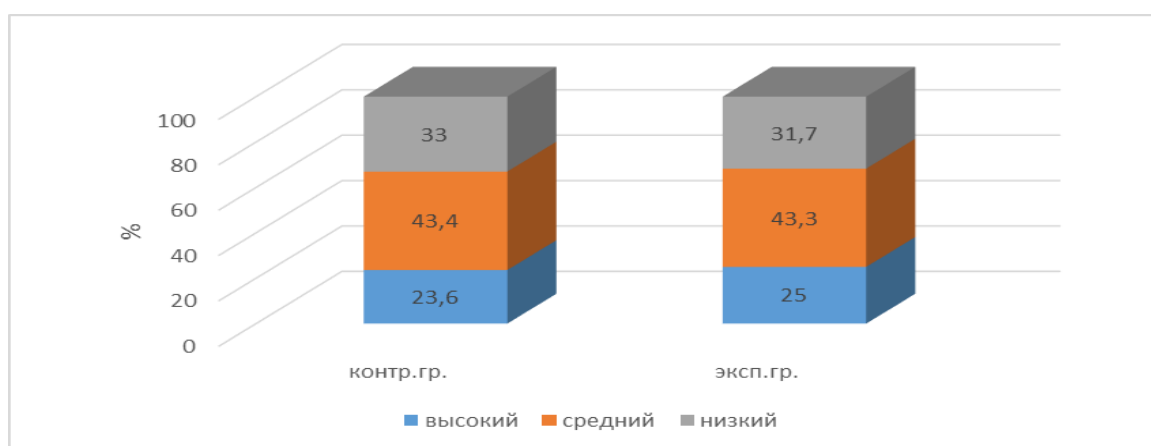


engaging in mental labor, creativity, finding the right information, volitional efforts to achieve the goal, diligence, etc.

Based on the data in Figure 4, it can be noted. That at the ascertaining stage of the experiment, the subjects of the two analyzed groups did not have significant differences in the levels of cognitive activity. The majority of high school students demonstrated an average level of development (43.4% in the control group and 43.3% in the experimental group).

**Figure 4**

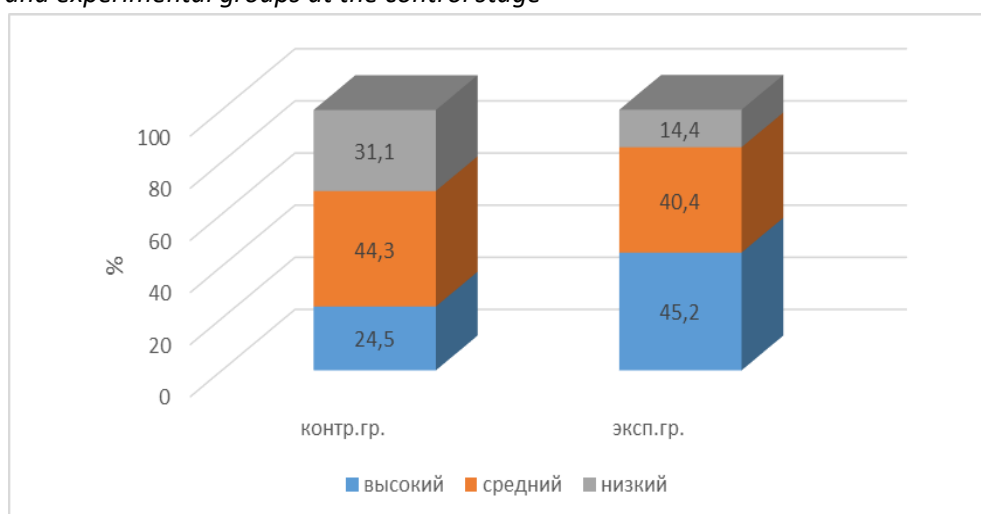
*Results of the level of cognitive activity according to the questionnaire of Pashnev (2018) in the control and experimental groups at the ascertaining stage*



After the experiment was implemented, we see significant differences in the levels of cognitive activity in all the compared groups (Figure 5).

**Figure 5**

*Results of the level of cognitive activity according to the questionnaire of Pashnev (2018) in the control and experimental groups at the control stage*



Thus, senior schoolchildren who entered the experimental group 45.2% show a high level of cognitive activity, while in the control group this level was detected only in 24.5% of respondents. These differences were statistically confirmed ( $t_{em} = 2.4$ , with  $t_{теор} \leq 1.98$ ;  $p < 0.05$ ). This tendency can



characterize the students participating in the experiment as showing interest and striving to penetrate the essence of phenomena and their interrelations, to master the ways of applying knowledge in changed conditions, and perhaps to find a new way for this purpose. Their characteristic feature may be the manifestation of high-willed qualities, perseverance and perseverance in achieving goals, and broad and persistent cognitive interests.

The average level of cognitive activity did not reveal differences between the analyzed groups - 44.3% of high school students in the control group and 40.4% of high school students in the experimental group demonstrated an average level of development, which can characterize these students as striving to identify the meaning of the studied material, seeks to know the connections between phenomena and processes, to master the ways of applying knowledge to a greater extent only in unchanged conditions. A characteristic indicator of such students is the relative stability of volitional efforts, which manifests itself in the fact that the student strives to bring the matter to an end, if difficult, does not refuse to complete the task, but accepts help or looks for solutions.

A low level of cognitive independence was determined in 31.1% of the subjects of the control group and only in 14.4% of the subjects of the experimental group ( $t_{em} = 2.31$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ). Such students show passivity, react poorly to the requirements of the teacher, and do not show a desire for independent work. This level is characterized by the instability of volitional efforts, the lack of interest in deepening the student's knowledge, and the absence of questions like: "Why?".

Significant differences were revealed in comparing the dynamics of cognitive activity indicators of the experimental group in two sections in high indicators ( $t_{em} = 2.58$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ) and in low indicators ( $t_{em} = 2.43$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ). And also in comparison of the control group at the stage of initial diagnosis and the experimental group at the end of the experiment. Differences were also found in high ( $t_{em} = 2.17$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ) and low ( $t_{em} = 2.11$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ) cognitive activity.

Another parameter for evaluating the creative-activity component of cognitive independence of high school students was an expert scale, which was filled in by teachers for each student, and then the average score for each criterion was averaged. Diagnostics at the initial stage in two groups of subjects revealed a number of criteria that experts assessed in high school students at a fairly low level of development. students do not have a sufficiently expressed creative approach. Manifestation of cognitive activity, readiness, and striving for new knowledge on their own. In the control group, there were only minor shifts in these indicators, as evidenced by a re-evaluation at the end of the experiment. At a fairly high level, experts appreciated the desire and ability of all high school students to act according to their views and beliefs and the ability to navigate a new situation.

The analysis allowed us to determine the presence of significant differences in the indicators of independence before and after the experiment in the experimental group. In particular, high school students became more ready to search for various solutions without outside participation (4.6) ( $t_{em} = 2.77$ , with  $t_{teor} \leq 2.62$ ;  $p < 0.01$ ), began to show cognitive activity (3.9) ( $t_{em} = 2.25$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ). High school students have become more active in their initiative (3.6) ( $t_{em} = 2.8$ , with  $t_{teor} \leq 2.62$ ;  $p < 0.01$ ), independence of volitional efforts has become more pronounced (3.6) ( $t_{em} = 2.2$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ), they show readiness and desire for new knowledge on their own (2.6) ( $t_{em} = 2.22$ , with  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ), students began to show creativity (2.4) ( $t_{em} = 2.4$ , at  $t_{teor} \leq 1.98$ ;  $p < 0.05$ ).

When comparing the control and experimental groups after the experiment, I also revealed several significant differences.

#### **4. Discussion**

The analysis of the data obtained using the methods of mathematical statistics showed that during the formative stage of experimental work, the levels of components of cognitive independence of schoolchildren of the experimental group significantly increased.

In the motivational and value component, schoolchildren were mainly focused on the beginning of the experiment to get emotional satisfaction from the learning process, they were more aware of the social need for this than the personal one. It was important to take a certain position in relations with others, get approval from them and establish stable communicative ties. The training was mainly directed by virtue of duty, duty. The motivation to engage in physical education at a lower-than-average level was predominant among the majority of high school students. In general, the school attracts such high school students with extracurricular activities. Such children feel quite well at school, but more often go to school to communicate with friends, with a teacher. The cognitive motives of such children are formed to a lesser extent, and the educational process attracts them little. There is no expressed interest in physical education lessons.

After the experiment was implemented, high school students became more focused on the content of educational activities and the process of its implementation began to strive to master new knowledge and new learning skills, show interest in the essential properties of phenomena, patterns in educational material, principles, key ideas. For these high school students, it has become important to achieve success, to be actively involved in the implementation of the set goal, and to independently choose the means aimed at achieving it (Kosholap et al., 2021; Matayev et al., 2021).

The level of orientation towards the assimilation of ways of obtaining knowledge has increased. The students of the experimental group became more interested in the methods of independent acquisition of knowledge, methods of cognition, methods of self-regulation of academic work, and rational organization of their academic work. There is a pronounced interest in physical education, there is no negative attitude to the teacher of physical education, nor to the lesson itself (Rekaa, Hanisch, & Ytterhus, 2019).

In the cognitive-reflexive component of cognitive independence, it turned out to be quite difficult for senior schoolchildren at the stage of the ascertaining section when carrying out projects, to set tasks, then solve them and find new ways to perform them, conduct self-control, and further reflection on independent activity (Tus, 2020). At the secondary level, high school students coped with the ability to compose tasks on the topic, use various sources of information search, process information, and prepare messages on the topic. Such methods of project activity used by high school students like the ability to formulate questions on a topic and the ability to work in a team received a higher assessment from experts.

After the implementation of the experiment on the development of cognitive independence in physical education lessons, the experts evaluated the high school students who entered the experimental group at an average and high level in almost all indicators of project performance. Thus, the ability of high school students to process information and formulate questions on the topic was evaluated as highly as possible. High school students began to make better use of various sources of information, compose tasks on the topic and prepare messages and presentations; they learned to set goals and objectives more consciously, solve tasks and find new ways to accomplish

them, make an activity plan. The reflexive component has also changed – high school students began to competently reflect on the independent activity and conduct self-control in the process of its implementation.

## 5. Conclusion

In the creative-activity component of cognitive independence, at the ascertaining stage of the experiment, the students demonstrated an insufficiently expressed creative approach. Cognitive activity, readiness, and striving for new knowledge on their own were low. High school students showed the desire and ability to act according to their views and beliefs and the ability to navigate a new situation.

At the end of the experiment, senior schoolchildren who entered the experimental group began to show a high level of cognitive activity, interest, and desire to penetrate the essence of phenomena and their interrelations, to master the ways of applying knowledge in changed conditions. Dynamics in indicators of readiness to search for various solutions without an outsider, the appearance of cognitive activity was determined. High school students have become more active in their initiative, the independence of volitional efforts has become more pronounced, readiness and desire for new knowledge on their own have become manifest, and students have begun to show creativity.

Thus, all the revealed differences allow us to state the effectiveness of the conducted experiment on the development of cognitive independence in physical education lessons among high school students in terms of motivational-value, cognitive-reflexive, and creative-activity components of cognitive independence.

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