FORMATION OF COGNITIVE UNIVERSAL EDUCATIONAL ACTIONS OF STUDENTS IN THE PROCESS OF TEACHING BIOLOGY

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Abstract. The article presents the key characteristics of cognitive UEAs of a secondary school student, their structure, and also the features of their formation. Also, pedagogical tools for the formation of cognitive UEAs of students of the primary school were identified. Criteria signs of the levels of formation of cognitive UEAs of a secondary school student are presented. As part of the study, a set of laboratory works was developed and tested aimed at the formation of cognitive UEAs of students in biology classes and in extracurricular activities. Diagnostic results of the level of formation of cognitive UEAs of eighth-graders testify to their effectiveness and practical significance. The results can be used in the theory and practice of basic education in order to improve the quality of education through the formation of cognitive UEAs.

Keywords: cognitive universal educational actions, pedagogical tools, laboratory work, basic school, level of mental development, critical thinking.

1 Introduction

One of the most priority areas for improving modern education is the holistic development of personality by mastering the ways of activity by students, through the formation of universal educational actions that are the invariant basis of the educational process. Universal educational actions offer independent successful assimilation of new knowledge, skills and competencies, including the independent organization of this process. Learning UEAs by students acts as the ability to self-development and self-improvement through conscious and active development of new social experience.

In accordance with the Federal State Educational Standard, UEAs includes personal (self-determination, meaning-making, moral and ethical assessment), regulatory (goal-setting, planning, control, correction, assessment, forecasting), cognitive (general educational, logical, symbolic-symbolic) and communicative UEAs (Asmolov, 2011; Chulanova, 2017).

Cognitive UEAs are a system of ways of knowing the world around us, building an independent search process, research, as well as a set of operations for processing, systematization, generalization and use of the information received (Solovyeva & Smirnova, 2016).

Currently, the formation of precisely cognitive UEAs among students is one of the most important challenge of modern education, as the experience of practical teachers shows that students still find it difficult to effectively use teaching aids in situations close to real and in non-standard educational and practical conditions (Dulatova & Lapshina, 2018).

2 Methods

The authors of these articles used theoretical and empirical methods: theoretical analysis of scientific literature, normative documents in the field of educational policy; pedagogical experiment, testing, methods of mathematical data processing.
The developed set of laboratory works on biology was tested in 8 classes at the MAOU "Gymnasium No. 139 - Education Center", the Volga region of Kazan. The control group involved 8th grade students of the secondary school No. 171 with in-depth study of individual subjects, the Sovetsky district of Kazan.
The experimental (EG) and control (CG) groups included 27 people, a total of 54 people in the study.

To identify the initial level of formation of cognitive UEAs, we used a package of diagnostic methods, including: mental development school test ("MDST").

The MDST included 6 subtests aimed at identifying general awareness, the ability to establish analogies, logical classifications, generalizations, and finding the rules of the number series.

3 Results and Discussion

According to the FSES recommendations, each educational organization develops and approves the Program for monitoring the level of education of the primary educational institution for general education on the basis of the methodological recommendations of the "Exemplary program of psychological and pedagogical support of educational institutions during the transition to FSES CE" (Chulanova, 2017).

The effectiveness of the process of the formation of cognitive UEAs will depend on the set of pedagogical conditions of the educational institution, the interaction style of the teacher and students (authoritarian or democratic), the form of organization of educational activity and the choice of pedagogical means (Rodko, 2018, Kondratieva et al., 2016).

The result of the formation of cognitive UEAs is the ability to analyze, synthetize and compare; establish causal relationships, implement an advanced search for information, create and transform models and schemes for solving various problems, use symbolic and symbolic means, etc. (Vozniak et al., 2017; Grevtsev, 2017).

We should note the importance of laboratory work in teaching biology, which contribute to the improvement of students' skills, deeper and more meaningful study, the formation of experimental skills, the development of creative thinking, the establishment of links between theoretical knowledge and practical human activities, which facilitate understanding of factual material, increase interest students in the subject (Koriagin, 2015; Kabanov, 2016).

Figures 1–7 show the results of the summative stage of the experiment (SES), of which Figures 1-5 show the MDST method.

Figure 1 shows the obtained average values of the mental development of students in the control and experimental groups. The data obtained indicate that students did the "Awareness 1", "Awareness 2" and "Numeric series" subtests almost identically. The generalizing tasks were least successfully completed, which indicates difficulties in generalizing any material.

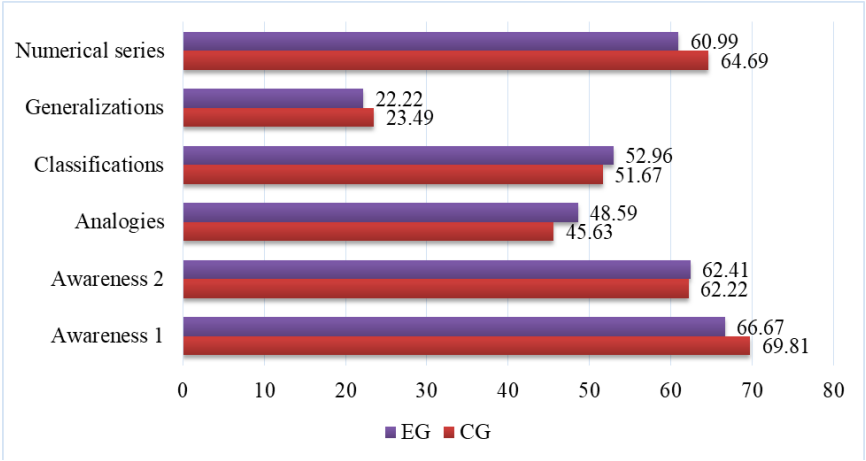

Fig 1: The levels of mental development of students (%) on the SES.

A comparative analysis of the experimental and control groups showed that the groups according to the data obtained are similar, i.e. we referred most of the students in the experimental and control groups to the category with an average level of mental development, which is natural.

For a more complete analysis of the mental development of students, we carried out a qualitative analysis of the results obtained by subtests. Thus, the data obtained for the first subtests of the EG showed that the awareness of students in concepts related to the scientific and cultural sphere slightly exceeds awareness in the socio-political sphere (Fig. 2). The control group showed the similar situation, which allows us to judge that students most often use scientific and cultural terms and concepts in their active and passive speech than social and political ones.

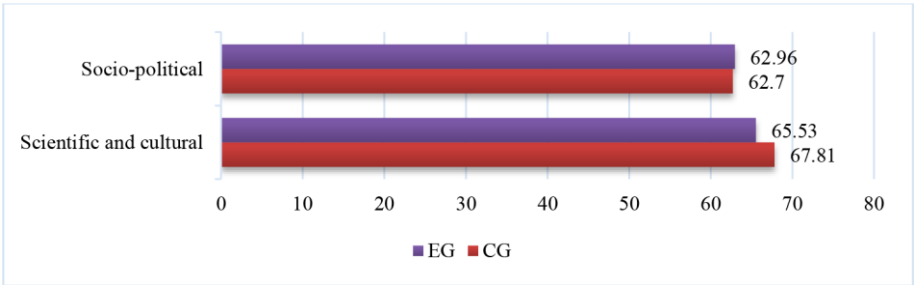

Fig 2: Awareness of students in the scientific, cultural and socio-political fields (%) during the SES.

Features of mental activity of identifying analogies, classifying the information presented and generalizing information by determining the relevance of subtest assignments to different school subjects showed that, in particular, on the subject of "Biology", students completed an average of 45.56% of the tasks in the EG and 39.26% tasks in the CG (Fig. 3). The results obtained indicate that the basic concepts from the school biology course, students have learned from a smaller part of students, which requires correction of the educational process.

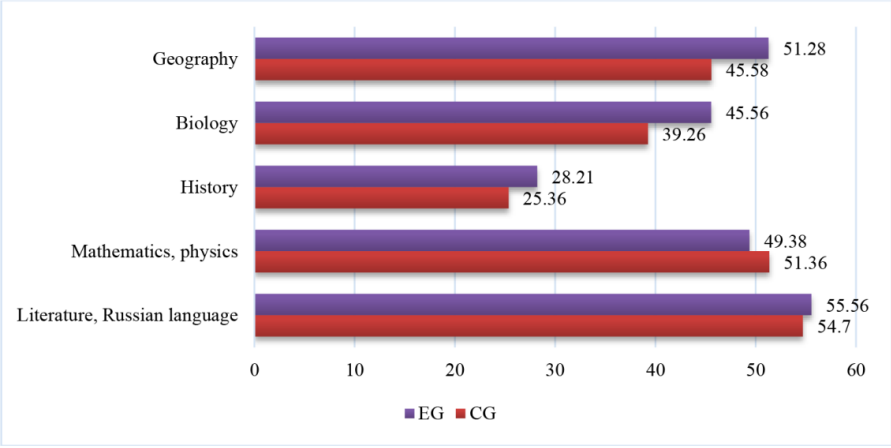

Fig 3: The total result of the "Analogies", "Classifications", "Generalizations" subtests by referring to different school subjects (%) during

The subsequent qualitative analysis for the "Analogy" subtest only was aimed at identifying students with analogue thinking as thinking in terms of criteria, classification, comparison (Fig. 4).

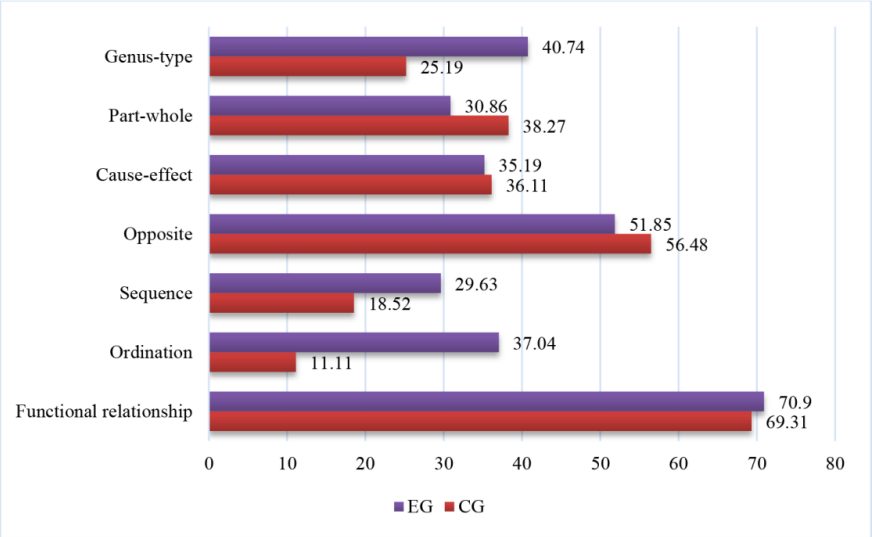

Fig 4: Formation of types of logical connections (%) during the SES.

This subtest revealed in both groups that the most successful students establish functional relationships and identify opposites, which is also signal information for the teacher regarding the improvement of the learning process.

When performing tasks with different types of concepts in the experimental and control groups, it was noted that the greatest number of errors was made in tasks with abstract judgments (Fig. 5).

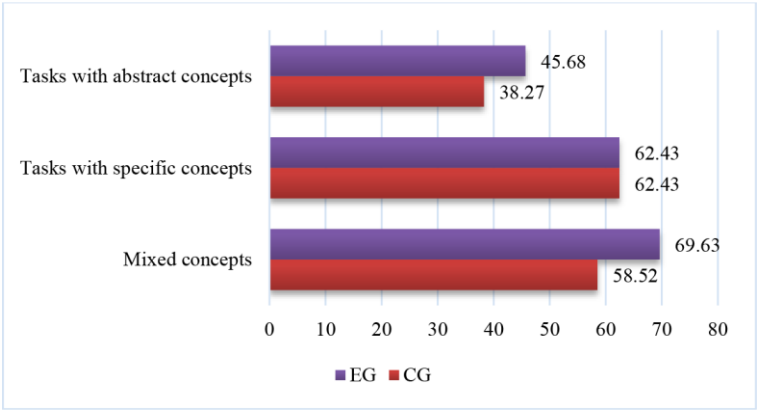

Fig 5: Level of skills to perform various types of tasks (%) during the SES.

Summarizing the results of the MDST summative experiment it should be noted that most students of the experimental and control groups have an average level of mental development.

Diagnostics aimed at determining intellectual lability according to Kostromina, namely determining the ability of students to switch attention without making mistakes (Fig. 6), revealed in EG ЭГthat the largest number of students (15 people - 55%) have average lability. Only one student from the group made more than 7 errors, that is, he may be unsuccessful, presumably in any activity.

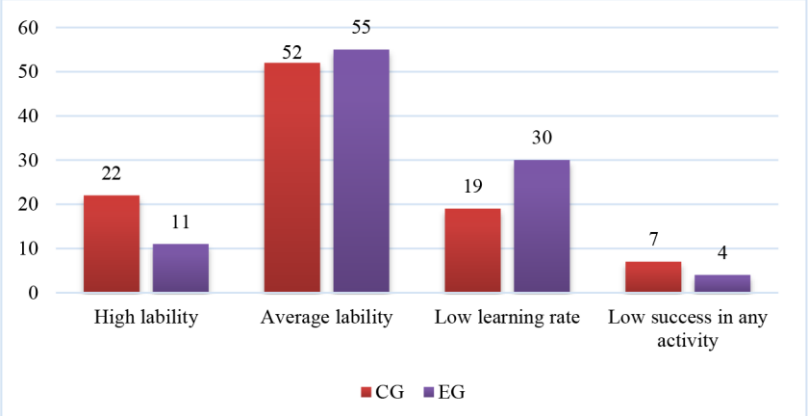

Fig 6: Intellectual lability of students (%) during the SES.

The results obtained in the CG showed that there were more students with high lability than in the EG - 6 people (22%). Low learning ability was noted only in 5 people (19%), less than in the EG. However, in the CG, two students (7%) made more than 7 mistakes.

Thus, the largest number of students in the EG and CG completed more than 80% of the tasks, which testifies to the ability of students to quickly move from solving one type of problem to another, with the minimum number of mistakes.
Diagnostics aimed at assessing the formation of reading skills (Fig. 7) showed that the largest number of students have the average level (zone 3) of reading skills. There were no students with a high level of reading skills (zone 5).

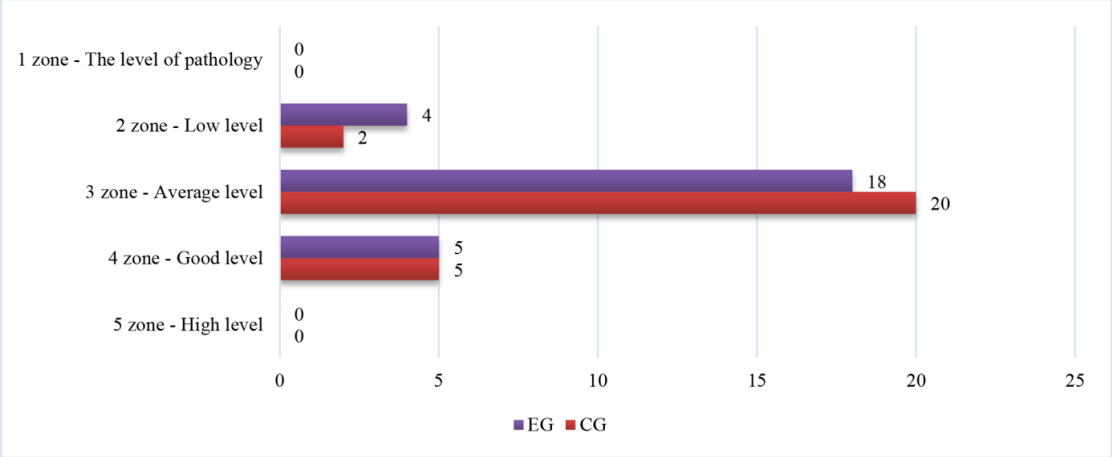

Fig 7: Level of formation of reading skills in the students (person) during SES.

Thus, according to the results of this technique, it should be noted that the majority of students in the experimental and control groups have a "fragmentary" perception of the text.

The experimental work was a set of laboratory works developed by us and aimed at the formation of cognitive UEA of eighth-graders in the process of teaching biology. The purpose of creating a laboratory course was the formation of a positive motivation to study the subject through practical activities; systematization and deepening of students' knowledge about the structural features of the life of the organic world; providing the opportunity to conduct fruitful practical activities in the study of theoretical material on specific topics.

The novelty of the works lies in the fact that they include both the theoretical part, consisting of analytical questions, and the practical part, including work with living organisms, a microscope, collections, herbaria. The course of laboratory work used in the process of teaching biology was based on some of the techniques of the Critical Thinking Development Technology. The main objective of this technology is to teach students to think critically. The use of various techniques of technology contributes to the information perception, systematization and evaluation.

One of the most important tasks of the school biology course is to develop the skills of thorough and consistent knowledge of the object of study, instilling a critical attitude to the acquired data. The deductive method of cognition, originating from Rene Descartes, is considered fundamental for all areas of scientific activity, which is why it is the methodological basis for school laboratory work in biology. School laboratory work can be considered as a complete methodological basis for developing critical thinking: when studying general scientific methods of cognition, individual work is the best to develop the necessary degree of skepticism in the students' minds.

The content of laboratory work ensures the achievement of a basic level of biological knowledge, the development of creative and naturalistic skills, a scientific worldview, as well as instilling independence, industriousness and responsible care with living organisms.

According to the subject of our study, semantic reading tasks were also applied. Reading skills are the foundation of all subsequent education, as students develop skills in understanding and searching for specific information, commenting on text, restoring a wide context, etc.

According to the quantitative processing of the data obtained during repeated testing of students using the MDST method, we found that the EG students improved their performance, which indicates the positive effect of the developed laboratory work on the level of mental development of students.
Figures 8-14 show the results of the control stage of the experiment (CES).

Figure 8 shows the indicators for each subtest.

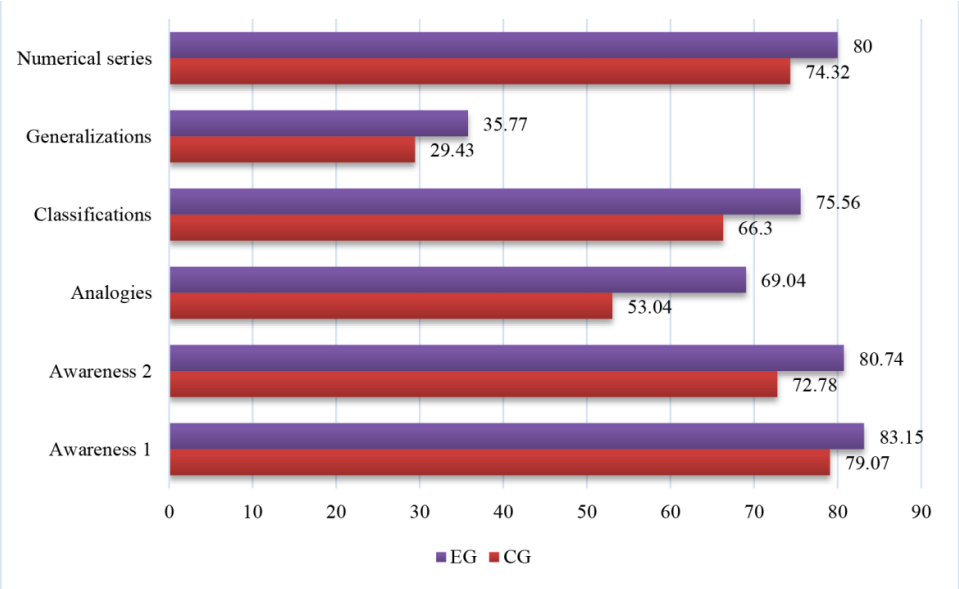

Fig 8: The levels of mental development of students (%) on the CES.

In the EG, a microgroup with a high level of development included a significant number of students. The presence of positive dynamics in the CG of students is explained by objective reasons, for example, the time factor, and also because the teaching methodology in this class can be quite effective, and students master the educational program, increasing their intellectual abilities. However, the scores of this group are lower compared to the EG.

The next three subtests – "Analogies", "Classifications", "Generalizations", showed that students of the EG improved their indicators for each of the school subjects (Fig. 9). The highest percentage on average was noted in Biology - 77.41%.

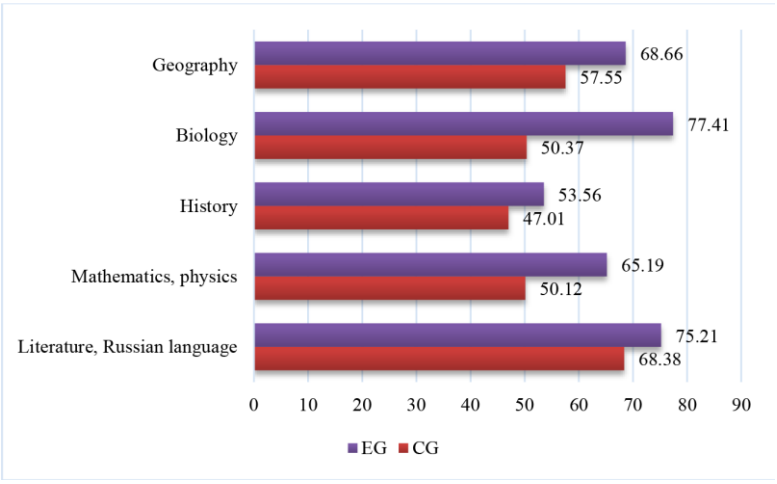

Fig 9: The total result of the "Analogies", "Classifications", "Generalizations" subtests by referring to school subjects (%) during the CES.

The results indicate that the students of the experimental group have better mastered the basic concepts of the school biology course, since there is a clear positive trend. The control group showed no positive dynamics.

The analysis of the obtained data of the "Analogy" subtest showed that the average indicators of the CG and the EG have slightly changed (Fig. 10). The EG improved its indicators for each type of logical links.

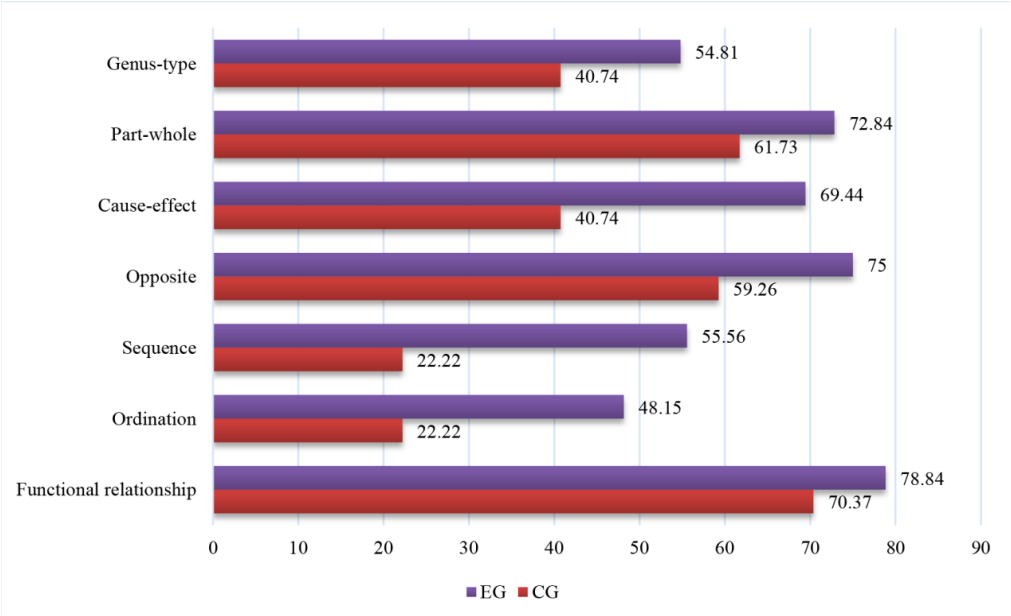

Fig 10: Level of formation of types of logical connections (%) during the CES

Interpretation of the results of the EG showed the successful completion of tasks with specific concepts (78.84%) and tasks consisting of mixed concepts (74.81%). However, one of the main results of introducing the developed laboratory course into the educational process is to consider the fact that when performing tasks with different types of concepts, tasks with abstract judgments, which, before the experiment, caused the greatest number of errors, were performed much better (Fig. 11).

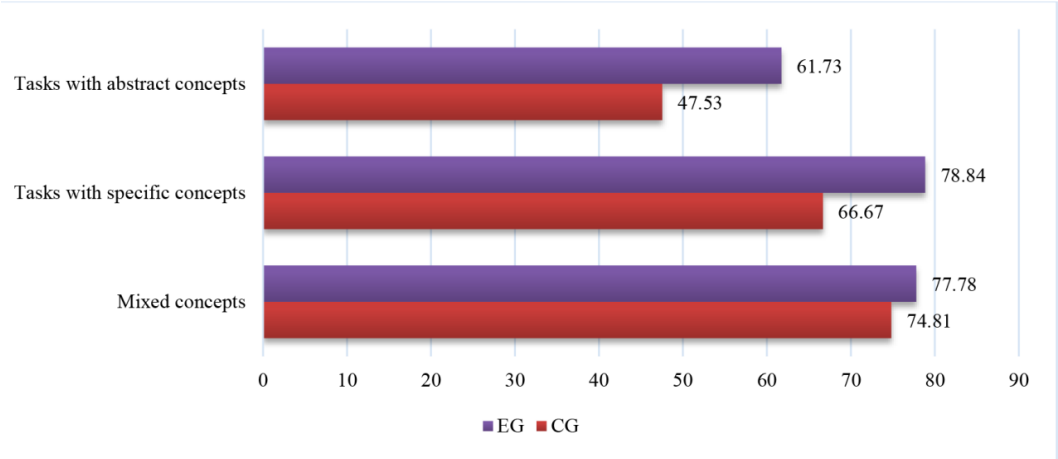

Fig 11: Level of skills to perform various types of tasks (%) during the CES.

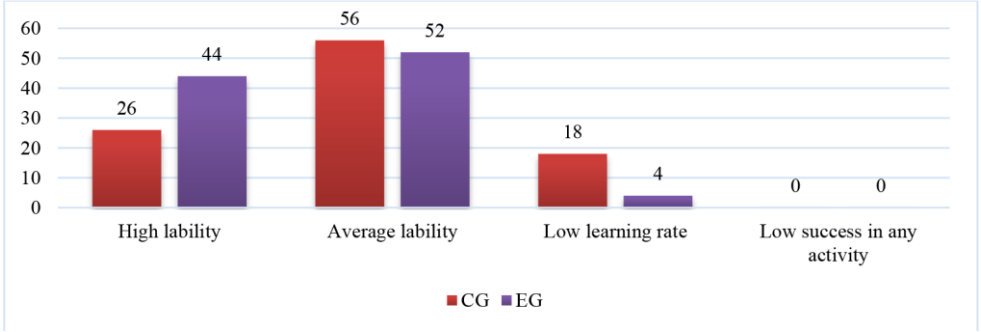

Fig 12: Intellectual lability of students (%) during the CES.

The largest number of students with high lability was noted in the EG. None of the students made more than 7 mistakes.

Repeated diagnostics of the formation of reading skills in the EG showed that the largest number of students (13 people) has a good level (zone 4) of the formation of reading skills (Fig. 13). In the CG, the largest number of students was noted with an average level of reading skill - 17 people. None of the students in the CG had a high level of reading skills.

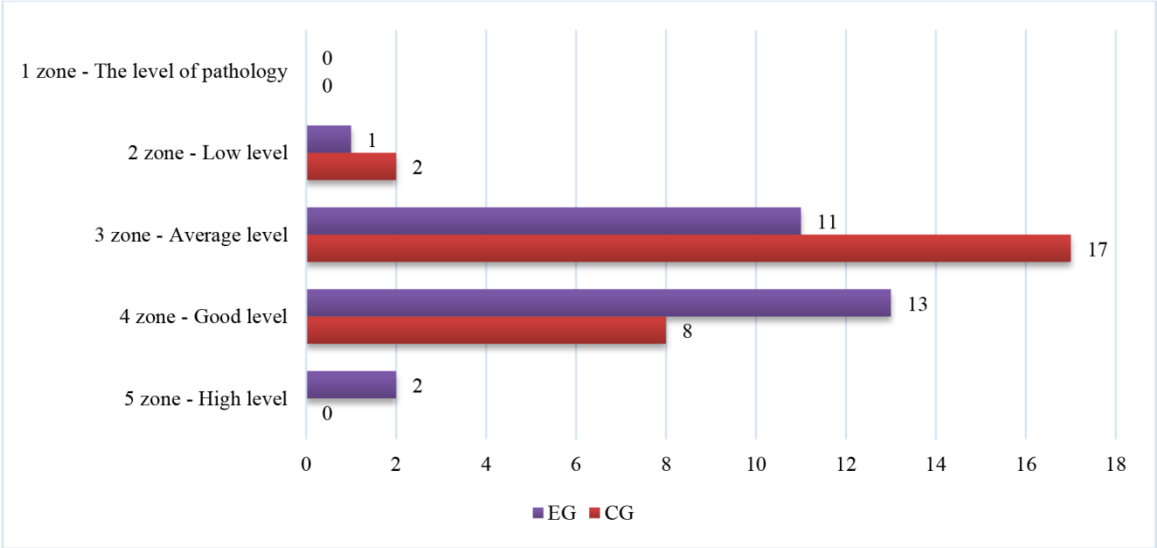

Figure 13: Level of formation of reading skills in the students (person) during KES.

Thus, according to the results of this technique, it should be noted that the majority of students of the control groups also have a "fragmentary" perception of the text, which was originally noted, but the EG showed positive dynamics.

4 Summary

1. The formation of cognitive UEAs in the educational process is a necessary requirement of time, which is considered as the subject's ability to self-development, self-improvement and independent assimilation of new knowledge and skills, including the management of this process.

2. The effectiveness of the formation of cognitive UEAs will directly depend on the teacher's choice of pedagogical means and creation of pedagogical conditions in the educational institution.

3. The use of laboratory works in biology classes developed on the methodological basis of the techniques of Critical Thinking Development Technology has great advantages for the formation of cognitive UEAs.

5 Conclusions

Cognitive UEAs are the most demanded in the modern educational process, as they provide the learner with the ability to search and find, analyze and use information, depending on the task. The use of modern teaching methods contributes to the formation of various psychological processes necessary for a person, and the development of abilities to solve any life problems, using the available knowledge and skills, which contributes to the education of a competent person.
A set of laboratory works, designed in accordance with the requirements of the Federal State Educational Standard, has a beneficial effect on the formation of cognitive UEAs. The designed set of laboratory works can be used by teachers in organizing the educational process at educational institutions.

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