THE EFFECTIVENESS OF TEACHING BIOLOGY AND HEALTH EDUCATION BY USING INTERACTIVE METHODS

Rositsa Davidova[1], Irena Valcheva[2]

[1]*Konstantin Preslavsky University of Shumen, Department of Plant Protection, Botany and Zoology, 115 Universitetska street, Shumen, Bulgaria, e-mail: r.davidova@shu.bg*
[2]*"Hristo Botev" school, 11 Stantsionna Str., Aytos, Bulgaria, e-mail: irena_65@abv.bg*

Corresponding author: r.davidova@shu.bg

Abstract
The aim of the article is to research the effectiveness of teaching health education by using interactive methods in Biology and Health Education lessons. The experiment covers 108 students, divided into two groups - experimental (E1) and control (E2). The analysis of the research results is carried out according to the following indicators: amount of knowledge; meaningfulness of knowledge; knowledge transfer. The results show that the use of interactive methods in teaching the subject matter to 7th grade students produced better results in all three experimental topics compared to lessons taught only by using a traditional teaching model. The students' knowledge of E1, where different interactive methods were applied, such as the method of associations using mind maps, role-plays and case studies, was more complete. The students of E1 did better, as in all three lessons they worked in teams, discussed, debated, analyzed and drew conclusions, while the students of E2 showed more gaps in their knowledge. E1 students did better when solving tasks that put them in a non-standard situation, in contrast to E2 students, who had greater difficulties in applying theoretical knowledge to practice.
Key words: amount of knowledge, meaningfulness of knowledge, knowledge transfer

INTRODUCTION

In English, the word "interactivity" comes from "interaction", which is in fact the key to better education. The use of interactive methods in teaching offers a lot of opportunities for both teachers and students. It gives the teachers the opportunity to teach creatively, to look for new combinations that will be effective in their work with students. The use of these methods increases the interest of students, and learning becomes more desirable, interesting more social (Georgieva, 1992, Stavreva, 2002, Stoimenova, 2002, Krasteva, 2004, Ivanov, 2005, Gyurova et al., 2006). The effectiveness of teaching is directly related to students' personal motivation, interests and needs. Student engagement in active learning is directly related to increasing the results of the learning process.
Interactive methods occupy an important

place in modern education. It is an interaction during which not only the transfer of information about facts and regularities included in the educational content is carried out, but this information is transformed into practically usable knowledge. Interactive methods lead to the acquisition of new knowledge and the formation of skills by placing students in situations where empathy is achieved on the basis of personal experience. In the use of interactive methods, constant feedback is provided through attracting students' attention and searching for common solutions to the tasks. This new interaction between teacher and students is aimed at the students' personal development. Interactive methods provide the opportunity to build a new educational reality based on joint search, dialogue and discussion of decisions between the teacher and the students when they work in a group.

Interactive teaching methods are associated with practice based on active learning, team-based, multi-directional interaction in the learning process. They are based on the principle that without practical application, students often fail to fully understand the subject matter (Rizhov, 2008).

The use of interactive methods in the classroom leads to a lot of positive results, among which are:

• Keeping students on task so that every student can work and be evaluated;

• Increasing students' interest and enthusiasm, which allows the teacher to diversify the learning activity;

• Improving students' communication skills;

• Developing rapport between the students and the teacher (Ivanov, 1993).

Rapport established through interactive methods, strengthens the belief in one's own abilities and stimulates the desire to succeed.

These practices are based on the understanding that the learning activity is not just for the accumulation of knowledge, but leads to the overall development of the personality.

Research methodology

Aim of the study: To research the effectiveness of teaching health education by using interactive methods in Biology and Health Education lessons. Achieving the aim is related to solving the following tasks:

1. To plan lessons in "Biology and health education" for 7th grade with the use of interactive methods.

2. To conduct a pedagogical experiment regarding the acquisition of subject matter in "Biology and Health Education" for 7th grade students, in an experimental (using interactive methods) and a control group.

3. To develop and implement a diagnostic toolkit for assessing students' knowledge in biology.

4. To present and analyze the obtained results and make the relevant conclusions and recommendations.

The object of the present research is the teaching process in "Biology and health education" in the 7th grade at "Hristo Botev" secondary school in the town of Aytos.

The subject of the research is the application of interactive methods in the process of teaching "Biology and Health Education" in the 7th grade at "Hristo Botev" school with the aim of increasing the effectiveness of the teaching process.

In connection with the set goal in the experimental setup, the following **hypothesis** was accepted: If interactive methods are used in teaching "Biology and health education" in the 7th grade, more specifically the section "Unicellular organisms" and the topics "The role of prokaryotic organisms in nature and their importance for man" and "The role of eukaryotic organisms in nature and their importance for man", and in the section "Multicellular organisms" - the lesson "Thallus plants. Algae", this will lead to higher student achievement and increase the effectiveness of health education in the teaching of Biology and Health Education.

MATERIALS AND METHODS

In connection with the conducted experimental work, the following methods were used:

1. Theoretical study and analysis of interactive methods in relation to the researched problem, and in the subject matter of "Biology and health education" for the 7th grade.

2. An experiment conducted in the course of teaching "Biology and health education" to 7th grade students in two variants.

3. Test method for controlling the students before the start of the experiment, after conducting the experimental lessons, through which the effectiveness of the

applied methodology is established according to the relevant indicators.

4. Quantitative and qualitative analysis of the results.

5. Mathematical-statistical methods: The following statistical values were used to process the results: average success - X, mode - M_0, dispersion - S^2 and Student's t-test – t kp. In this way, the degree of credibility of the formulated hypothesis is checked.

The analysis of the research results is carried out according to the following indicators: amount of knowledge; meaningfulness of knowledge; knowledge transfer.

The assessment is carried out using a point system, allowing a comprehensive analysis of all elements (Bizhkov, Kraevski, 2007). A uniform scale is used to convert the points into a grade when checking the control work.

Place of conduct and participants the study: The didactic experiment was conducted with all students from the 7th grade of "Hristo Botev" school in the town of Aytos during the academic year 2023/2024.

The following methodological units were experimented in the lessons of "Biology and health education" as a compulsory subject: "Role of prokaryotic organisms in nature and their importance for man"; "Role of unicellular eukaryotic organisms in nature and their importance to man"; "Thallus plants. Algae" (Ovcharov et al., 2018, 2024).

The experiment covers all 108 students from grades 7th a, b, c, g, divided into two groups - control and experimental:
• Experimental group (E1): 7th b; 7th d – 55 students
• Control group (E2): 7th a; 7th c – 53 students

RESULTS AND DISCUSSIONS

To measure the level of acquired knowledge and skills, four control tests were carried out (see Appendices 1, 2, 3, 4). In accordance with the adopted indicators, each control test includes three questions, respectively, checking the amount of knowledge acquired, its meaningfulness and application to a new situation. The initial test Ko was conducted before the training experiment. The results of the didactic experiment were obtained by conducting control tests K_1, K_2, K_3 after teaching the respective topic.

Presentation and analysis of the results of Ko test.

The control test is attached in Appendix 1, and its results are presented in Table 1.

The obtained results show similar, very good and good success rates in both groups regarding all three tasks of the test. The average grade in the two groups is insignificantly different. In both groups E1 and E2, the number of students who received Very Good (5) and Good (4) grades is high. In both groups there are students who did not cope with the third task and therefore received a Poor (2) grade, and the percentage in both groups is equal - for E1 it is 1.81% and for E2 it is 1.89%. The mode in both groups is the same, Very good (5) for the first and third task and Good (4) for the second. Student's t-test has values from 0.42 to 0.63, which shows that there is no statistically significant difference in the answers of students from both groups E1 and E2.

Presentation and analysis of K_1 test results.

K_1 test was conducted after the lesson: "The role of prokaryotic organisms in nature and their importance for man". According to the accepted criteria and indicators, the test includes 3 questions (Appendix 2). The results are presented in Table 2. The comparative analysis shows a higher success rate of the students of the

experimental group E1 compared to the students of the control group E2 in the first

Table 1. Results of the initial Ko test.

Questions	Groups	Grades										X	M	S²	T$_{kp}$	Valid hypothesis
		2	%	3	%	4	%	5	%	6	%					
1.	E₁	0	0	4	7,27	14	25,45	22	40	15	27,27	4,87	5	1,59	0,42	H₀
	E₂	0	0	3	5,66	18	33,96	20	37,74	12	22,64	4,77	5	1,37		
2.	E₁	0	0	7	12,72	20	36,36	18	32,72	10	18,18	4,56	4	1,20	0,52	H₀
	E₂	0	0	8	15,09	22	41,51	14	26,42	9	16,98	4,45	4	1,11		
3.	E₁	1	1,81	8	14,55	20	36,36	21	38,18	5	9,09	4,38	5	0,98	0,63	H₀
	E₂	1	1,89	12	22,64	16	30,19	20	37,74	4	7,55	4,26	5	1,00		

Table 2. Results of K₁ test.

Questions	Groups	Grades										X	M	S²	T$_{kp}$	Valid hypothesis
		2	%	3	%	4	%	5	%	6	%					
1.	E₁	0	0	2	3,63	8	14,55	28	50,91	17	30,90	5,09	5	1,81	1,03	H₁
	E₂	0	0	4	7,54	21	39,62	20	37,74	8	15,09	4,60	4	1,04		
2.	E₁	0	0	4	7,27	15	27,27	25	45,45	11	20,00	4,78	5	1,35	0,70	H₀
	E₂	0	0	5	9,43	19	35,85	16	30,19	12	22,64	4,62	4	1,37		
3.	E₁	1	1,81	9	16,36	16	29,09	22	40,00	7	12,72	4,45	5	1,24	2,85	H₁
	E₂	2	3,77	18	33,96	19	35,85	12	22,64	2	3,77	3,88	4	0,87		

Table 3. Results of K₂ test.

Questions	Groups	Grades										X	M	S²	T$_{kp}$	Valid hypothesis
		2	%	3	%	4	%	5	%	6	%					
1.	E₁	1	1,81	6	10,90	16	29,09	15	27,27	17	30,90	4,74	6	1,72	1,77	H₁
	E₂	2	3,77	5	9,43	21	39,62	22	41,51	3	5,66	4,35	5	0,90		
2.	E₁	0	0	5	9,09	20	36,36	17	30,90	13	23,23	4,69	4	1,33	1,86	H₁
	E₂	2	3,77	8	15,09	24	45,28	10	18,87	9	16,98	4,30	4	1,19		
3.	E₁	2	3,63	4	7,27	25	45,45	14	25,45	10	18,18	4,47	4	1,22	1,81	H₁
	E₂	3	5,66	13	24,53	20	37,74	10	18,87	7	13,20	4,09	4	1,21		

Table 4. Results of K₃ test.

Questions	Groups	Grades										X	M	S²	T$_{kp}$	Valid hypothesis
		2	%	3	%	4	%	5	%	6	%					
1.	E₁	0	0	5	9,09	13	23,24	28	50,90	9	16,36	4,74	5	1,28	1,61	H₁
	E₂	1	1,89	10	18,86	15	28,3	21	39,62	6	11,32	4,40	5	1,21		
2.	E₁	0	0	4	7,27	10	18,18	26	47,27	15	27,27	4,47	5	1,67	1,00	H₁
	E₂	3	5,66	13	24,53	18	33,96	7	13,21	12	22,64	4,23	4	1,54		
3.	E₁	1	1,81	3	5,45	16	29,09	22	40,00	13	23,64	4,41	5	1,46	1,93	H₁
	E₂	2	3,77	16	30,19	20	37,74	10	18,87	5	9,43	4,00	4	1,03		

and the third task. The number of concepts included in the first task are acquired better by E1 students – in their group the number of excellent and very good grades is significantly higher compared to those in E2 group.The average grade in E1 group is Very Good (5.09), while in E2 group it is Very Good (4.60). There is also a difference in the mode (M), which in E1 is Very Good (5), while in E2 it is Good (4). The third task requires students to know well the subject matter related to beneficial bacteria and the substances called preservatives. The analysis of the results shows that 12.72% of E1 students gave a complete and accurate answer and received an Excellent (6) grade, while the percentage is only 3.77% in E2 group. The same ratio is observed with students who received Very good (5) grade: for E1 it is 40.00% and for E2 it is 12.64%. In both groups E1 and E2, there are students who did not cope with the task, in E1 - 1 student - 1.81%, and in group E2 - 2 students - 3.77%, who received a Poor (2) grade. The mode (M) in E1 is Very good (5) compared to Good (4) for E2, which is reflected in the average success rate, which for E1 is Good (4.45), while for E2 it is Good (3.88). The Derived Student's t-test in both tasks proves the validity of the alternative hypothesis H1, namely, that there is a statistically significant difference in the two options. Better results are shown by the students trained by using option E1, achieved by applying interactive methods in teaching, compared to the group that is taught in the traditional way.

The analysis of the results of the second task of the test shows that 20% of the students in E1 and 22.64% of the students in E2 understand the differences between bacteria and cyanobacteria and skillfully apply the acquired knowledge without making mistakes, so they received an Excellent grade (6). A significant difference is also observed in the percentage of students who received a Very good (5) grade - 45.45% for E1, and 30.19% for E2. 7.27% of the students in group E1 have a very low results for underastnding subject matter, and the percentage is even higher in group E2 – 9.43%. Students have significant gaps in their knowledge and find it difficult to complete the table for comparing bacteria and cyanobacteria. There are no poor grade in either groups. The mode (M) also differs, as in E1 it is Very Good (5), while in E2 it is Good (4). The average success rate in E1 is slightly higher (4.78) compared to that of E2 (4.62). The derived Student's t-test is 0.70. The obtained results show that there is no statistically significant difference between the two groups and the validity of the null hypothesis is confirmed.

Presentation and analysis of K_2 test results.
Test K_2 was conducted after the lesson "The role of single-celled eukaryotic organisms in nature and their importance for man". The content of the test is given in Appendix 3, and the results are presented in Table 3.
The analysis of the data from Table 3 shows that the students of the experimental group, in which the lesson was taught by using interactive methods, achieved a higher success rate compared to the students of the control group on all three tasks.
30.90% of E1 students have acquired the knowledge about the role of unicellular eukaryotic organisms and have skillfully applied it in the test, as a result of which they received an Excellent (6) grade on the first task, while in the E2 group only 5.66% gave a full and correct answer. Student responses rated Very good (5) in E1 were

27.27%, compared to group E2 where they were 41.51%. In both groups, there are students who did not cope with the task because they had not mastered the subject matter, and as a result received a Poor (2) grade. The percentage of poorly performing students in E1 is 1.81%, while in E2 it is 3.77%. Due to the prevailing excellent grades, the mode (M) is Excellent (6) in E1 group and Very Good (5) in E2 group. A difference is also observed in the average grade, which differs by 0.38, being Very Good (4.74) for E1 and Good (4.35) for E2. The analysis of the data for the second task shows that 23.23% of E1 and 16.98% of E2 students have mastered the subject matter related to unicellular eukaryotes. A difference also exists in the group of those who received very good grades – 30.90 % for E1, and 18.87% for E2. The poor grades are only in group E2 – 3.77%, there are none in group E1. The third task requires not only to know about the unicellular parasites, but also to propose rules for prevention and dealing with them. The analysis shows that 18.18% of students who received excellent grades were in group E1, and only 13.20% were in group E2. 25.45% of the students in E1 answered correctly, only with a few errors, and as a result they received a Very good (5) grade, in contrast to E2, where there were fewer very good grades - 18.87%. In the group of students who failed and received poor (2), in E1 there are 3.67%, and in E2 the percentage is higher - 5.66%. The value of the Student's *t*-test for all three tasks of the test confirms the validity of the alternative hypothesis, which leads to the conclusion that the use of interactive methods leads to better learning and understanding of the subject matter.

Presentation and analysis of K3 results.
Test K3 was carried out after the lesson "Thallus plants. Algae ". The content of the test is presented in Appendix 4.

The comparative analysis of the data in Table 4 shows that the students of the experimental group coped better with the assigned tasks. On all three tasks of the test, the number of students who received grades excellent 6 and very good 5 was significantly higher in group E1. Answers to the questions rated Good (4) and average 3 are more in group E2. The students of group E1 did not receive poor grades on the first and second tasks, in contrast to group E2, where 1 and 3 students respectively did not cope with the task. Regarding the second and third tasks of the test, the mode (M) differs between the two groups, being higher in group E1 - Very good (5), while in group E2 it is Good (4). There is also a difference in the achieved average success, which is always higher at E1.

The high value of tkp shows that there is a statistically significant difference in the results of the students taught by using either of the discussed options, which gives us reason to accept the alternative hypothesis. The use of the interactive methods in group E1 has led to a more complete and successful assimilation and better understanding of the subject matter related to the thallus plants.

CONCLUSIONS
The results show that the use of interactive methods in teaching Biology and Health Education has many advantages.

1. The use of interactive methods in teaching the subject matter to 7th grade students produced better results in all three experimental topics compared to lessons taught only by using a traditional teaching model.

2. With regard to the "amount"

indicator, the knowledge of students taught by means of Option E1 was more complete when a variety of interactive methods were applied, such as the method of associations with the use of mind maps, role plays, and case studies.

3. In relation to the "meaningfulness of knowledge" indicator, the students of E1 option did better, as in all three lessons they worked in teams, discussed, debated, analyzed and drew conclusions, while the students of E2 showed more gaps in their knowledge.

4. E1 students did better when solving tasks that put them in a non-standard situation, in contrast to E2 students, who had greater difficulties in applying theoretical knowledge to practice. The results of the conducted research showed that the formulated hypothesis was confirmed and the set goal was fulfilled.

ACKNOWLEDGEMENTS

REFERENCES

Bizhkov, G., Kraevski, V. (2007). *Methodology and methodology of pedagogical research*, ,,Sv. Kliment Ohridski", p. 35.

Georgieva, M. (1992). *Development of interaction skills*, Publ. house TsIUURK, Sofiya.

Gyurova, V., Bozhilova, V., Valkanova, V., Dermendzhieva, G. (2006). Interactivity in the learning process, *Agentsiya Evropres*, 47-67.

Ivanov, I. (2005). *Interactive learning methods.* In: Obrazovanie i kvalifikaciya na pedagogicheskite kadri – razvitie i proekcii prez XXI vek, Nauchna konferenciya s mezhdunarodno uchastie "50 godini DIKPO" Varna, p. 27.

Ivanov, I. (1993). *Pedagogical research, methodology and methods*, ,,Otvoreno obshtestvo", p. 16.

Krasteva, A. (2004). *Innovations in school education. Theoretical and Applied Aspects*, ,,Astra", Plovdiv, p. 21.

Ovcharov, V., Dimitrov, O., Yotovska, K., Hristova, M., Dimitrova, T. (2018). *Biology and health education 7th grade.*, "Bulvest-2000", p. 149.

Ovcharov, V., Dimitrov, O., Yotovska, K., Hristova, M., Dimitrova, T. (2024). *Active Learning Biology and Health Education Notebook*, "Bulvest-2000", 8-9, 14-15, 22-23.

Rizhov, I. (2008). Interactive methods for the development of personal and social skills in primary school age, *,,Sauchastie"*, 8-10.

Stavreva, G. (2002). *Methodology of teaching biology.* Publ. house ,,Paisiy Hilendarski", Plovdiv, 252-253.

Stoimenova, M. (2002). *Interactive methods and artistic and creative possibilities*, Publ. house ,,Profesor Asen Diamandiev", Plovdiv, p. 33.

Appendix 1

Worksheet

Test K_0

1. Fill in the gaps in the following text:
……………………..includes all organisms: ……………………, ……………………, ………………………, ………………………. and human beings. Organisms have ……………………………………………….. Each cell contains ………….…………. and is enveloped in …………………….. .

2. Put these animals in the respective groups in the table: woodpecker, pelican, giraffe, wolf, cow, antelope, squirrel, mouse, doe, human being.

Herbivores	Carnivores	Omnivores
giraffe	pelican	woodpecker
cow	wolf	mouse
antelope		human being
squirrel		
doe		

3. Explain the expression: „Unity of animate and inanimate nature".

<div align="center">

Appendix 2

Worksheet
Test K₁

</div>

1. Fill in the gaps in the following text:
Without ………………… life on Earth is impossible. Bacteria decompose ………….……… to inorganic. In this way they enrich the soil with …………………………… are a main part of ………………………… of substances in ……………………………………… .

2. Compare bacteria to cyanobacteria: What is their role in nature and for the human beings?

Bacteria	Cyanobacteria
I. Role in nature	I. Role in nature
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
II. Meaning for humans	II. Meaning for humans
1.	1.
2.	2.
3.	3.

3. Preservatives kill good bacteria.
Answer the questions:
   1. What are the reasons for using preservatives?
   2. What are the consequences of their use for people and why should we avoid foods containing preservatives?
   3. Suggest ways of avoiding the use of preservatives.

<div align="center">

Appendix 3

Worksheet
Test K₂

</div>

1. Fill in the gaps in the following text:
Flagellate ……………………… with independent ……………………….. contain chlorophyll and carry out the process ………………… Marine ……………………… are part of the plankton.
Chemical and ……………… leads to the development of various …………………… This is called ……………….. of water.

2. Match the representatives of unicellular eukaryotes from column A with their role in nature in column B.

Column A	Column B
A) ciliates in the rumen of ruminants	1. water pollution indicator
B) shell unicellulars	2. part of the plankton that marine life feeds on
C) marine rhizopods	3. release oxygen for the respiration of organisms
D) unicellulars in rivers and seas	4. food processing
E) self-feeding flagellates	5. building limestone cliffs

3. Can the spread of malaria and sleeping sickness be curbed? Give your ideas for prevention.

Appendix 4

Worksheet
Test K$_3$

1. Fill in the gaps in the following text:

Algae are ………………………… …………………………….. All algae contain ……………………………. and feed on …………………….. through ……………… Algae take ………………………

and minerals from the surface of the thallus. Thallus plans don't have specific …………………… and ………………… .

2. Match the three types of algae to the numbers on the left:

Type	Class	Answer
1. Spiral toadstool 2. Kelp 3. Sea salad	A. Green algae	
4. Porphyry 5. Macrocystis	B. Red algae	
6. Coraline 7. Fucus	C. Brown algae	

3. Air bubbles form in the thallus of the brown algae. Explain the significance of this feature in its structure.