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Development of an optimal methodology for the formation of research skills of pupils in biological education (on the example of laboratory work)

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Abstract

This article deals with the ways to create an optimal methodology for the formation of pupils' research skills in the section "Reproduction, growth and development" for pupils in the 7th grade of biological education. High research results were achieved in the direction of schoolchildren for research, the formation of their research skills, and research work was carried out on the basis of the optimal methodology for achieving effective results in the study of the topic "Reproduction, Growth and Development" section of plants. In biological education, the scientific and theoretical bases for studying the anatomical and morphological features of apricot varieties have been clarified. To determine the level of assimilation of the biological characteristics of the studied apricot varieties, a questionnaire was taken from 7th grade pupils who participated in the research work. It was revealed that 1 pupil wanted to get additional information, and 1 could not master this research. The results of the survey and essay revealed the effectiveness of the proposed methodological system in the educational process. A methodology has been developed by comparing the anatomy and morphology of different varieties of apricots in the botanical garden for the formation of educational and research activities. Creating an optimal methodology for the formation of research skills of schoolchildren in biological education as an aid to school teachers,

the effectiveness of teaching using the Indoor labs methodology was determined during the research work of pupils, during the defense of their work at scientific projects and scientific conferences.

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Keywords

Research skill, biological education, Indoor labs, project method, pupils, teaching, competence.

Introduction

At present, the main goal of the education system is not only the formation of research knowledge of the younger generation, but the formation and development of personal qualities that are able to find and analyze the information they have generated, as well as rationally use it, live and work with dignity in today's changing times is the main goal.

Therefore, in the modern world, in the era of continuous development of various fields of science and education, when technologies are updated from year to year, manufacturing industries are introduced, the training of educated, qualified, talented, competitive specialists is becoming an urgent issue. Various changes and additions are being made to the legislation of the country's educational system from year to year. The challenge is to prepare a competitive, up-to-date pupil with research skills, creativity, in-depth knowledge, inquisitive, hands-on skills. We have the task of educating a person who is competitive, armed with modern knowledge, research skills developed by pupils, possessing creative abilities, possessing deep knowledge, inquisitive, able to think deeply and able to apply their knowledge in practice.

Article 8 of the Law of the Republic of Kazakhstan «On Education» specifies that «one of the main foundations of the education system is the introduction of new active learning technologies, as well as informatization of education, access to international global communication networks» [Sydykov, Abilkasymova, 2008].

The teacher not only forms interest, reveals, develops creative abilities, introduces the pupil to scientific research by teaching methods of scientific research, but also contributes to the self-development and deepening of knowledge of each pupil in accordance with his abilities. An important task of the modern educational sphere is to train the pupil for searching activities, and acquire research skills and abilities.

Every pupil has his own research skills. Nowadays, teaching the pupil scientific searching activities and acquiring research skills are the most important tasks of the educational system. Even in the classroom, using the best methods and techniques, it is possible to organize research activities of pupils, carry out work of various kinds. Pupil is not only researcher, and doesn't only acquire science and knowledge, but also «recreator of science». When studying from this point of view, the pupil's educational and cognitive system is considered as a system similar to scientific cognition. In the course of the research system, the pupil re-develops the rules and requirements and analyses again, in the

course of the educational and cognitive system, a system of the pupil's critical attitude to his work, to his activity is formed [Walter, 2016].

Special attention should be paid to the following criteria of a pupil who is most accustomed to research activities:

– Pupil's desire to perform the work being studied at a high level;
– Active desire to master new knowledge and new science;
– Desire to prove their point of view even if it does not coincide with the opinion of another person;
– Desire to compete with other pupils in the form of certain research work;
– Ability to demonstrate their research skills when defending a research project;

Taking into account the opinion of Peter Klein: «the more a child will be allowed to explore voluntarily, the better he studies», one of the main tasks of the teacher is to create conditions for independent learning of the pupil, and forming research skills. The use of forms of educational process designed to improve research activities will undoubtedly have a great impact [Zheksenbaeva, 2005].

Two varieties of apricot (Armeniaca vulgaris, Armeniaca ruderalis) grown in the Botanical Garden of the International Kazakh-Turkish University were obtained as the object of the study. Apricot is a fruit crop belonging to the Rosaceae family, reaching a height of 8-15 meters. Apricot tree lives up to 100 years, bears fruit 25-40 years. The fruit ripens in July. In Kazakhstan, in Zhambyl, Turkestan, Almaty regions, one species – common apricot (A. vulgaris) is grown. The main varieties of apricots are: Kyzylbet, Ambrosia, Luisa, Shalah, Khosrowsham, Khurmai, Bukhara, Tovarish, Ansu and others. I.V. Michurin produced 8 new varieties of ordinary apricots, they are grown in Kazakhstan and Central Asia.

In this direction, foreign scientists also considered in their research. One of them are Chinese scientists (Xi Yang, Ruoyu Zhang) in their article "Machine learning for cultivar classification of apricots (Prunus armeniaca L.) based on shape features" showed that the features of the shape are important characteristics for determining varieties of fruits, analyzed features of the shape of four species of apricots, as a result, the four varieties of apricot have significant differences in shape [Sarsekeeva, Ukenova, 2011].

In addition, in an article of Katya Carbone, Mariano Polietto "chemometric classification of early-ripening apricot (Prunus armeniaca, L.) germplasm based on quality traits, biochemical profiling and vitro biological activity" eight early-ripening varieties of Italian and international apricot germplasm using a chemometric approach were evaluated for their qualitative characteristics, biochemical composition, antiradical ability and hydroxycorinic acid (hca) profile (2013-2015) during three years of research. Among the analyzed varieties, it was found that the largest fresh mass is in the Mayan variety (106 ± 3 g), and the lightest fruits are in the Ottavian variety (51 ± 4 g). It is concluded that qualitative, biochemical analysis of traits and the effectiveness of chemometric methods can be used as a consistent procedure to provide selectionist with useful information on the identification and characterization of the most promising early-ripening genotypes for both consumption and processing of fresh apricots [Kropaneva, 2002; Zhuniskyzy, 2001; Solov'eva, 2017; Chemometric classification…, 2017].

Influence on temperature. Apricot is a thermophilic plant that experiences a short period of rest.

It is characterized by early blooming (at an average daily temperature of +8...+ 9.5 ºC) and early fruit ripening. Flowers are often damaged in spring due to return frosts and cold, which leads to irregular fruits. Flowers are often damaged in spring due to recurrent frosts and colds, which leads to irregular fruits. In general, apricots are drought-resistant, heat resistant and relatively salt resistant [Xi Yang, Ruoyu Zhang, 2019; Kahle, 1985; Kantsaeva, Gorina, 2015; Sholokhov, 1989].

Apricot trees are not damaged for 3-4 days when frozen at temperature -25C°. Even -31...- 32C° frost is not dangerous if the duration does not exceed one day. If 35 ... - 38C° frost lasts for a long time (1-2 days), the trees can freeze hard and destroy completely [Kamolov, 2006].

Effect on humidity and drought-resistant plant. The root system it suffers from waterlogging, so when choosing places for apricots, it is wrong to choose wet places. Stagnation of groundwater has a detrimental effect on the root system.

There are many varieties and species of apricot trees in the botanical garden. However, their biological features, the ways to increase fertility are not fully studied. In order to solve this problem, the compilation of the results obtained by conducting research in various directions is an urgent problem and the development of an effective methodology for studying it for future pupils meets the requirements of the present day.

Actuality of the work: in biological education it is relevant to develop an optimal method of improving the research skills of schoolchildren, on the basis of which the formation of a person with developed research abilities capable of conducting comprehensive study.

The purpose of the work: to develop an optimal method of formation of research skills of schoolchildren, not only to increase their research skills and search abilities, but also to realize the purpose of the updated content of education.

The main goal of our research work is to educate the pupil's creative personality, self-development, self-improvement, formation of personality with developed research abilities, development of an optimal methodology for improving the research skills of pupils in teaching.

To achieve these purposes, a number of objectives have been set:

– the optimal method of formation of research skills of pupils was developed;
– familiarization of pupils with general scientific skills (work with a textbook, scheduling, written control, practical control, formation of thinking in written and oral response, self-control, independent analysis);
– the ability to analyze, compile, and summarize the necessary information and generate results using the information they need in their activities (mastering specific material on the discipline, the work under study is analyzed).

Methodical part

During the research work, the work on the development of an optimal methodology of research skills of pupils in biological education was considered. Research works were conducted with the pupils of the 7th grade of Uzbekali Zhanibekov IT-school-lyceum. For the formation of research skills of schoolchildren, research was carried out on the reproduction, growth and development of plants. In biological education, effective methods were used in the formation of research skills of schoolchildren, including Indoor labs, design, control, comparative, interactive methods.

During the research work the method of «Indoor Labs» the author of which is Mary Savina was used. One of the methods that makes a big contribution to the training of a professional specialists. The closed laboratory consists of experimental and research materials, models and other devices. That is the method that takes place indoors. This closed laboratory basically takes one or more hours. In a closed laboratory, the test substance could have been collected from inside or outside the laboratory. In a closed laboratory, pupils work in an informal environment. They do not only describe things and phenomena, but also work directly with them. The laboratory also uses interactive whiteboards, visual aids and group work. The organization of a closed laboratory requires pedagogical and logistical

combination [Kryukova, 1989; Kruzhkov, 2006; Batyrkhanov, 2001; Ven'yaminov, 1970].

The effectiveness of the project method in the lesson is that the pupils are not only come together on the basis of the textbook chapter, but the pupils also learn to prove their own conclusions. Having strengthened their theoretical knowledge, they master to formulate biological concepts in a scientific sense. The pupils were also assigned to carry out research work on the research topic "growth, development and reproduction of plants". Pupils were provided with various accessible tools, a mobile phone, a camera, as well as replicas of plants, dried plants, etc. in the biology room. Pupils successfully summarized the research work during the lesson using this project method.

Observation is a very common and effective method of research. With the help of the observation method, pupils carried out a observation work on the topic of research «growth, development and reproduction of plants». Observational studies were successful.

The comparison method is considered to be one of the most common. In the comparison process systematics, morphology of studied plants were studied. It teaches pupils to compare and identify changes occurring in nature and to carry out experimental work with them, motivates research activities, teaches to make decisions correctly, to draw conclusions about the studied work, and develops creative abilities of thinking.

All these methods are interactive teaching methods according to modern education [Dinova, Imanbaeva, 2014; Korzin, 2008; Akhmatova, Kardanov, 2008; Vitkovskii, 2003].

Biometric analysis and statistical methods are methods of research used in research planning, material collection, processing, and presentation of results. Statistical methods used in pedagogy are used to study the phenomenon. But you can't draw conclusions based on them. In research work statistical method revealed differences in biological characteristics of two species of apricot (Armeniaca vulgaris, Armeniaca ruderalis) in tabular form. Using the statistical method, the survey found that 85% of pupils participated in research work at a high level, 11% at the middle level, and 4% could not master research work. Pupils formed 30% of the theoretical knowledge of the research work through the presenting a report.

With the help of questionnaire method and essay writing, you can trace the result of research work. That is, it helps to determine the impressions received by pupils from research work, how they have improved their knowledge. Methodology of formation of research activities of pupils was created by the method of essay writing.

Results, analysis and discussion

The system of education for the development of pupils' research skills has two main objectives: teaching a subject and research activities.

Type of research activity requires solving problems in achieving the goal of training: age characteristics of pupils, knowledge, scientific knowledge and ability, knowledge of the research methodology related to the research topic, ability to analyze the problem, ability to do laboratory work and control work, and to draw conclusions.

We have divided the study of selected topics for didactic purposes into the following ways:

– studying new material;

– revision;

– consolidation;

– accumulation of knowledge;

– control;

– mixed classes.

We have divided the research activities for pedagogical purposes into the following types. For example:

– lessons on the selection of the research topic or method;

– conducting an experiment;

– working with sources of information;

– laboratory work;

– protection of the scientific project.

Research works were conducted with pupils of the 7th grade of Uzbekali Zhanibekov IT-school-lyceum. For the formation of research skills of schoolchildren, research was carried out on the reproduction, growth and development of plants. First, group work of schoolchildren was carried out using visual aids to conduct research works. Pupils studied indoor plants, as well as plants growing in the yard, using observation methods. And the experiment on the ways of development, reproduction of plants was conducted in the laboratory.

Using the method Indoor labs for growing plants in the laboratory, not only a description of the plants studied, but also direct work was carried out with them. Interactive whiteboards, visual aids and group work were used in the laboratory.

The indoor plants studied by the pupils absorbed water with nourishing salts through the roots and gradually depreciated the soil, so the pupils planted them in a new soil. Planting was done only when the plant did not grow properly, the leaves withered or the roots covered all the lumps of the soil.

Before planting the seedling, the pupils watered until the lumps of the soil soaked. The plant was taken out of the clay pot with the earth, after shaking, it was transplanted into another pot. If the plant does not need seedlings, you can also transplant it by placing fresh soil into a wide pot. It is necessary to start changing the soil when the plant blooms, because at this time it will not harm the germination and maturation of the plant. It is important to loosen the soil when planting plants in a large container without holes for water, in this case you need to water the plant very skillfully.

After planting the plants by transplanting or replacing the soil with a shovel, the pupils compacted the soil around the stem with a stick or finger, leaving a place for watering. Then the plant was watered and placed in a place far from the wind, where direct sunlight did not hit.

Fertilizing the plant. In meeting the nutrient requirements of plants, it is necessary to systematically apply mineral and organic fertilizers and replenish their reserves in the soil. The fertilizer should be dissolved several times after 1-2 weeks during the growth and flowering of the plant. There is no need to fertilize newly planted or diseased plants.

The pupils poured clean water 2 hours before applying the fertilizer solution, so that the granules of the soil were completely soaked. Potassium salt and superphosphate were used as mineral fertilizers. During germination, a mixture of 2 tablespoons of ammonium nitrate, 1 tablespoon of superphosphate and 1/2 tablespoon of potassium nitrate mixed with 10-12 liters of water should be poured to the plant. And the plant before flowering and during flowering poured a dissolved mixture of ammonium nitrate with 1/2 tablespoon, a superphosphate 2 tablespoon and potassium nitrate in 10 liters of water. The ready fertilizer solution should also be used with its rule. Although the use of organic fertilizers has a good effect on the growth of plants, it is very difficult to prepare them at home. Therefore, it was made only in laboratory conditions and applied to research work. The water that washed the raw meat was also a good additional fertilizer.

Figure 1 - View of the procedure for transplanting plants or replacing the soil with a shovel and ways to water them

Pupils at reproduction of plants: Houseplants grew from their own seeds or parts, i.e. cuttings (stalks, leaves, seeds). To do this, they were separated from stems, tubers, root shoots.

The pupils carried out experimental work on the indoor plant Ficus. It is known that the Ficus grows to 2-2, 5 meters in height. Plucked one petal of the flower and put it in water. The first 1-2 weeks grow roots in 15 days germinate roots of 5 cm length. Planted in fertile black soil. They gave special medicines of the flower. Inside it, they mixed flower food with 2 liters of water and poured it, and a large plant grew from a small leaf.

Vegetative reproduction is used more often than seed reproduction. Cuttings are cut obliquely from young, healthy, well-aged plants at the end of the stem, and young shoots must not have more than 1-3 leaves. Cut off 1-2 leaves from the cut. Then, it was planted not so deep into the manure or its mixture and sand, compacting the soil around it.

Figure 2 - Manifestations of vegetative propagation of plants

Cuttings need moist air for rooting. Therefore, cuttings were placed in pots or clay pots covered with glass or film, filled with water and placed in a bright place. Until the cuttings took root, pupils kept them away from direct sunlight. The glass was cleaned and wiped several times a day, and the cut is sprayed with water 2-3 times a day. When it began to grow, the glass was slightly raised, and then removed completely. Depending on the type of plants, rooting lasted from 2-3 days to 2 months. Cuttings of some plants, for example Uzambar houseplant, scindapsus, ivy root well in water. Some plants, such as Ficus, can be propagated by cuttings from the leaves of each species. For this, the leaves were planted in wet sand, tied to wooden sticks and covered with glass. The optimum temperature for

rapid rooting was 25°C.

Plants need light, heat, air, water and nutrients for germination and growth. A growing plant is closely related to nature. If most or some of these specified factors are lacking, the growth process of the plant slows down and it grows and produces only according to the least factor, that is, the less factor cannot be replaced by any other factor. Thus, good growth of the plant and high yields are ensured only when all the necessary conditions are met. Sunlight provides energy for photosynthesis. When sunlight hits the leaves, chlorophyll grains appear in its pores. It absorbs sunlight and uses that energy to synthesize organic substances from carbonic acid and water. And organic substance is important for plant growth, and at the same time, after the flower is pollinated, it turns into grain and becomes a source of nutrients. A plant grown in a dark or shady place is thin, weak, and falls down when the wind blows or rains, and the yield is low. Due to the low amount of carbohydrates in such grain, its quality is also low. Pupils used these nutrients to create conditions for better plant growth.

Heat. A certain average daily heat is necessary for good plant growth. Plants do not grow at temperatures zero degree or below. A certain set of general temperatures is necessary for the growth and development of the plant. It depends on the duration of the growing season and the average daily temperature. Average daily temperature for most plants is around 25-35°C. Some plants tolerate short-term frost, and others (winter crops) tolerate frost. This can be given by hardening. In this case, sugar increases in plant cells, cell juice thickens and resistance increases. After sowing, plant germination takes place even at a certain temperature. The seeds of cold-resistant plants germinate at 1+5°C, and thermophilic plants germinate at 8+12°C.

Air. Oxygen, nitrogen, carbon dioxide, and water vapor are used as nutrients to provide enough air to plants. The air in the earth's crust is used by the roots of the plant for respiration, and the microorganisms in the earth's crust cannot live without air. Those organisms convert mineral substances from the earth's crust into a water-soluble form that can be used by plants, and some (nitrabacteria) absorb nitrogen from the air and use it for plant nutrition. And the plant itself uses oxygen for respiration, carbonic acid for photosynthesis, and water vapor is useful for the movement of nutrients in the plant.

First of all, water is needed for the germination of the plant, after it has grown, it needs to absorb nutrients from the ground. Without water, enzymes cannot work. For seed germination, it absorbs half of its mass of water, and moist soil also causes root growth.

As a result of the conducted research, the biological characteristics of two varieties of apricot trees adapted to the climate of Turkestan region (resistance to cold, drought, adaptability to moisture and light) were determined. Below, figures 3-4 show cut half of the fruits of the research object (A. vulgaris, A. ruderalis).

Figure 3 - Kyzylbet (A. ruderalis) fruit

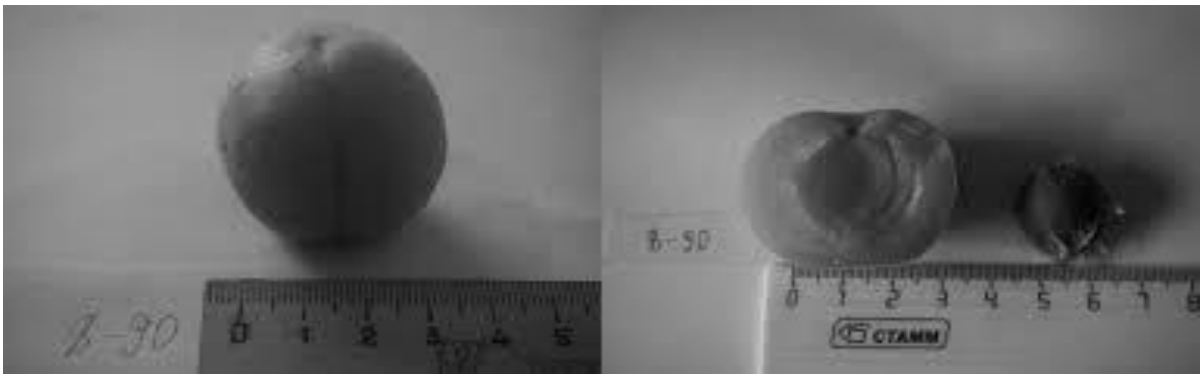

Figure 4 - Ordinary apricot (A. vulgaris) fruit

The land of Turkestan region is Turan type, the climate is strictly continental. The annual average temperature in January is -7 - 9°C in the north, -2 - 4°C in the south. Summers are long, hot, dry and windy. The annual average temperature of July is 25-29°C. The average annual rainfall in the desert region is 100-150 mm, 300-500 mm in front of the mountains, 800 mm in the highlands. Due to these climatic features, the main massifs of apricot varieties and forms adapted in the botanical garden were studied taking into account the local weather features.

The monitoring of their biological features (cold, drought, water and light resistance, resistance to pests and diseases due to adaptation to the external environment) was conducted and the results were determined.

The length of the growing season of apricot species was determined by phenological control. The duration of the vegetation periods of the studied varieties is shown in Table 1. The shortest vegetation period is kyzylbet (red-cheeked) variety (146 days), and the longest vegetation period is the common apricot (158 days). Flowering is observed after the phenological phase. The earliest flowering (7.05) is characteristic of the Chelyabi variety, the latest flowering (11.05) is the Snezhinsky variety. The duration of flowering varies among varieties.

The beginning of fruit ripening starts from (4.08) (Chelyabi) and until (9.08) (ordinary apricot variety) and the last phase of phenological observation is the beginning and end of leaf fall. The fall of leaves started (1.10) in the Chelyabi variety, the latest leaf fall (7.10.) is the ordinary apricot variety.

Table 1 - Phenological monitoring of apricot varieties (planted in 2010)

Apricot variety name	Beginning of budding	Beginning of flowering	End of flowering	Duration of flowering	Fruit ripening	Beginning of leaf fall	End of leaf fall	The length of the vegetational season
An ordinary apricot	2.05	8.05	22.05	12 days	9.08	7.10	18.10	158 days
Kyzykbet	3.05	9.05	18.05	9 days	6.08	4.10	11.10	146 days
Chelyabi	1.05	7.05	15.05	8 days	4.08	1.10	7.10	148 days
Snezninsky	5.05	11.05	20.05	9 days	8.08	3.10	10.10	156 days

In order to take into account the cold resistance of apricots, it is necessary to assess the general condition of trees. In general, all trees are assessed annually, but due to data processing for this indicator, plants whose general condition has deteriorated due to anthropogenic factors are excluded. When entering the average assessment score, the general condition of all plant varieties is taken into account [Dzhigadlo et al., 1999].

The levels of cold resistance of studied apricot varieties are shown in Table 2. According to the average score of the general condition of the trees, the ordinary apricot variety showed the lowest indicator (2.0), and the Snezinsky variety showed the highest. (4.2).

Table 2 - Degree of cold resistance of apricot varieties

Apricot variety name	Average score of the general condition of varieties	The number of varieties studied	General degree of freezing of varieties
An ordinary apricot	2.0	14	1,9
Kyzykbet	3,7	12	2,6
Chelyabi	3,5	10	2.0
Snezninsky	4,2	12	3,3

The results of the study showed the effectiveness of the methods chosen in the biology class.

A questionnaire was taken from the 7th grade pupils who participated in the research work in order to determine the level of mastering the biological characteristics of the studied apricot varieties. As the results of the survey are shown in Figure 5, it was found that 11 of the 15 participating pupils mastered in a high level, 3 pupils wanted additional information, and 1 could not master this research.

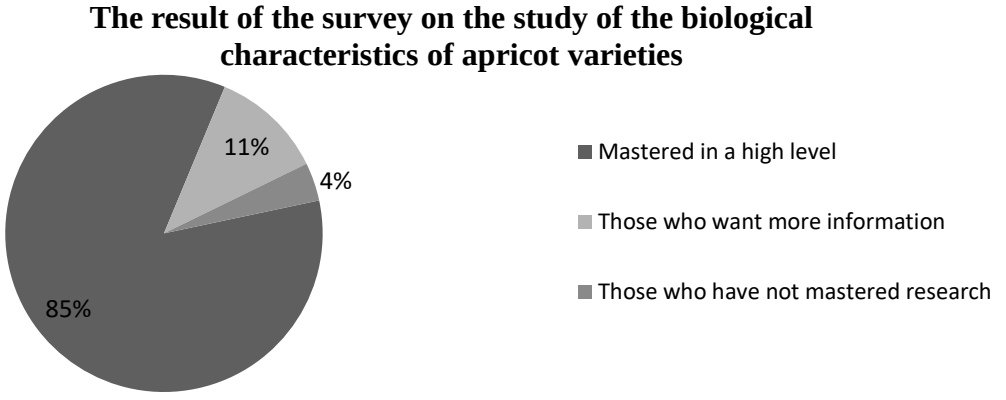

Figure 5 - Results of the research survey

There are several stages of development of the research activity of pupils in the development of the methodology.

The first stage is an experimental classroom research activity in order to develop interest at the lesson and to define the role of research at school and further education activities.

Pupils are offered research tasks, the results of which are known in advance. Tasks of this period:

– development of cognitive activity by carrying out individual practical experiments;

– affect the emotional-sensual sphere through the opening situation and non-standard tasks;

– formation of the ability to independently search for knowledge by promoting the problem and creating an action plan.

The second stage is problem search which aims to develop self-reliance and activity based on mastering and understanding of problems and new information. Pupils get this information by analyzing the literature on a given topic, comparing the opinions of different scientists, their own knowledge and research methods. At this stage, the teacher knows the course of action, plays the role of a consultant, and the pupil comes to the result by himself.

In the second stage, pupils learn to express their opinions, as well as to listen and accept the

opinions of their peers.

The third stage is the organization of the search-research activity, the content of which is not defined. Pupils independently (under the supervision of a teacher or research supervisor) determine the goals and objectives of the research and make a plan of their actions to achieve the goal.

A research methodology adapted to specific situations is chosen. At this stage, the activity and independence of pupils in organizing research, their desire to prove the importance of research results develops.

The result of the research activity is the performance of these pupils at the competition of educational and research works.

Conclusion

Scientific activity in the form of a research workshop allows to consolidate, expand, clarify, and develop the creative knowledge acquired in the classroom, rather than formally. As the results of scientific researches show, carrying out research activities in nature is one of the most effective methods of implementing the main principle of education in the process of interrelationship of theory and practice, life.

The basic principles of formation of pupils' research skills were determined and based on them, the requirements for the classification of research skills, the tasks of researching natural objects, the process of pupils' educational and cognitive activities were determined.

During the research, the following results were achieved: increased interest in the educational process, level of independence in mastering research skills, pupils' activity in studying natural objects, effectiveness in preparation and defense of scientific research works. At the same time, it became known that pupils face a number of difficulties in transferring theoretical knowledge to research activities, making hypothetical predictions and using research methods.

A questionnaire was taken from the pupils who participated in the research work. As a result of the survey, it was found that 85% of the pupils have mastered at a high level.

Armeniaca vulgaris, Armeniaca ruderalis apricot varieties successfully passed the phenological stages of development and were found to be very suitable for growing in industrial gardens in Turkestan region. These apricot varieties can be offered for breeding, aimed at creating winter-resistant, large-fruited and quality apricot varieties in the botanical garden of Khoja Akhmet Yassawi International Kazakh-Turkish University. And conducting scientific research using the Indoor labs method is used in general secondary institutions, in the field of science.

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References

1. Akhmatova Z.P. (2008) *Abrikos i znachenie ekologicheskikh faktorov pri ego vyrashchivanii* [Apricot and the importance of environmental factors in its cultivation]. Nalchik.
2. Batyrkhanov Sh.G. (2001) Novye i perspektivnye sorta persika i abrikosa [New and promising varieties of peach and apricot]. In: *Sbornik nauchnykh trudov Dagestanskoi selektsionnoi opytnoi stantsii plodovykh kul'tur* [Collection of scientific works of the Dagestan breeding experimental station of fruit crops]. Makhachkala.
3. (2017) Chemometric classification of early-ripening apricot (Purunus armeniaca, L) and in vitro biological activity. *Scientia Horticulturae*, 227, pp. 187-195.
4. Dinova G.D., Imanbaeva A.A., Kosareva O.N. (2014) Sortoizuchenie abrikosa v aridnykh usloviyakh Mangistau [Variety study of apricot in arid conditions of Mangistau]. *Hortus botanicus*, 9, pp. 99-110.
5. Duskabilova T.I. (2009) *Plodovye kostochkovye kul'tury: osobennosti razmnozheniya v Sibiri* [Fruit stone fruit crops:

features of reproduction in Siberia]. Novosibirsk; Abakan.
6. Dzhigadlo E.N. et al. (1999) *Programma i metodika sortoizucheniya plodovykh, yagodnykh i orekhoplodnykh kul'tur* [Program and methodology of variety study of fruit, berry and nut crops]. Orel.
7. Kahle J.B., Matyas M.L. (1985) An assessment of the impact of science experiences on the career choices of male and female biology pupils. *Journal of research in science Teaching*, 22, pp. 385-394.
8. Kamolov N. (2006) Pishchevaya tsennost' semyan abrikosa [Nutritional value of apricot seeds]. *Doklady TASKhN* [Reports of the Academy of Sciences of the Republic of Tajikistan], 9-10, pp. 40-50.
9. Kantsaeva U.I., Gorina V.M. (2015) Morfo-biologicheksie priznaki abrikosa obyknovennogo (Purunus armeniaca, L) i ikh znachenie dlya provedeniya espertizy sortov na otlichimost', odnorodnost' i stabil'nost' (OOS) [Morpho-biological characteristics of common apricot (Purunus armeniaca, L) and their significance for the examination of varieties for distinctness, uniformity and stability]. In: *Sbornik nauchnykh trudov GNBS* [Collection of scientific works of the State Nikitsky Botanical Garden].
10. Korzin V.V. et al. (2008) Zasukhoustoichivost' introdutsirovannykh rastenii abrikosa (Prunus armeniaca L.) i ee svyaz' s tolshchinoi listovoi plastinki [Drought tolerance of introduced apricot plants (Prunus armeniaca L.) and its relation to leaf blade thickness]. *Plant Varieties Studying and Protection*, 2 (8), pp. 51-57.
11. Kropaneva G.A. (2002) Uchebno-issledovatel'skaya deyatel'nost' shkol'nikov kak tekhnologiya razvivayushchegosya obrazovaniya [Educational and research activity of schoolchildren as a technology of developing education]. *Issledovatel'skaya rabota shkol'nikov* [Research work of schoolchildren], 1, pp. 118-126.
12. Kruzhkov A.V. (2006) *Biologicheskie osobennosti i khozyaistvennaya tsennost' sortov abrikosa i alychi v usloviyakh srednei polosy Rossii. Doct. Dis.* [Biological features and economic value of apricot and cherry plum varieties in the conditions of central Russia. Doct. Dis.]. Michurinsk.
13. Kryukova I.V. (1989) Botanicheskaya klassifikatsiya i geograficheksoe rasprostranenie [Botanical classification and geographic distribution]. In: *Abrikos* [Apricot]. Moscow.
14. Sarsekeeva Zh.E., Ukenova A.K. (2011) Osobennosti organizatsii issledovatel'skoi deyatel'nosti uchashchikhsya v innovatsionnoi shkole [Features of the organization of research activities of students in an innovative school]. *Vestnik KarGU* [Bulletin of the KarSU]. Available at: https://articlekz.com/article/5744 [Accessed 05/05/2023]
15. Sholokhov A.M. et al. (1989) Zimostoikost' [Winter hardiness]. In: *Abrikos* [Apricot]. Moscow.
16. Solov'eva A. et al. (2017) Kobeyu, osu, zhane damu. 7 synyp. In: *Biologiya Atamura*.
17. Sydykov T.S., Abilkasymova A.E. (2008) Okushylardyn tanymdyk belsendiligin kalyptastytudyn didaktikalyk negizderi. *Almaty jurnal*, 280, pp. 111-118.
18. Ven'yaminov A.N. (1970) Issledovaniya po biologii i selektsii abrikosa [Research on the biology and selection of apricot]. *Selektsiya, biologiya i agrotekhnika plodovykh kul'tur. Zapiski sel'skokhozyaistvennogo instituta im. K.D. Glinki* [Breeding, biology and agrotechnics of fruit crops. Notes of Glinka Agricultural Institute], 41, pp. 200-223.
19. Vitkovskii V.L. (2003) *Plodovye rasteniya mira* [Fruit plants of the world]. St. Petersburg.
20. Walter L.F., Chris Sh.A., Arminda P. (2016) Implementing and operationalizing integrative approaches tosustainability in higher education: the role of project-oriented learning. *Journal of Cleaner Production*, 133 (1), pp. 126-135.
21. Xi Yang, Ruoyu Zhang (2019) Machine learning for cultivar classification of apricots (Prunus armeniaca L.) based on shape features. *Elsevier BV*, 256, pp. 102-104.
22. Zheksenbaeva U.B. (2005) Okushylardyn gylymi-zertteu jumystaryn ujimdastyru. *Abai atyndagy KUPU Khabarshy Vestnik*, 2 (22), pp. 45-51.
23. Zhuniskyzy K. et al. (2001) Osimdikterdin kobeyui, damuy, osui. 6 synyp. *Biologiya Atamura baspasy*, 138.

Разработка рациональной методики формирования исследовательских навыков учащихся в процессе биологического образования (на примере лабораторной работы)

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Аннотация

В данной статье рассматриваются пути создания оптимальной методики формирования исследовательских навыков учащихся по разделу «Размножение, рост и развитие» для учащихся 7-го класса биологического образования. В результате исследовательской работы учащиеся 7-го класса экспериментировали с размножением, ростом и развитием растений в лаборатории на уроке биологии, проводили внеклассные наблюдения и добились оптимальных результатов. В исследовании описывался интерес учащихся к учебе, мотивация к самостоятельной деятельности, способность контролировать и оценивать собственные действия. Чтобы определить уровень усвоения биологических особенностей изучаемых сортов абрикоса, был проведен опрос учащихся 7-х классов, участвовавших в исследовательской работе. Было выявлено, что 1 ученик хотел получить дополнительную информацию, а 1 не смог освоить это исследование. Результаты опроса и эссе выявили эффективность предложенной методической системы в образовательном процессе. Разработанная рациональная методика формирования исследовательских навыков школьников в биологическом образовании может быть использована в качестве подспорья школьным учителям, и эффективность обучения по методике Indoor labs, определенная в ходе исследовательской работы с учащимися, а также во время защиты их работ на научных проектах и научных конференциях.

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Ключевые слова

Исследовательский навык, биологическое образование, закрытые лаборатории, проектный метод, учащиеся, преподавание, компетентность.

Библиография

1. Ахматова З.П. Абрикос и значение экологических факторов при его выращивании. Нальчик, 2008. С. 124-125.
2. Батырханов Ш.Г. Новые и перспективные сорта персика и абрикоса // Сборник научных трудов Дагестанской селекционной опытной станции плодовых культур. Махачкала, 2001. С. 70-79.

3. Веньяминов А.Н. Исследования по биологии и селекции абрикоса // Селекция, биология и агротехника плодовых культур. Записки сельскохозяйственного института им. К.Д. Глинки. 1970. Т. 41. С. 200-223.
4. Витковский В.Л. Плодовые растения мира. СПб., 2003. 529 с.
5. Джигадло Е.Н. и др. Программа и методика сортоизучения плодовых, ягодных и орехоплодных культур. Орел, 1999. 608 с.
6. Динова Г.Д., Иманбаева А.А., Косарева О.Н. Сортоизучение абрикоса в аридных условиях Мангистау // Hortus botanicus. 2014. № 9. С. 99-110.
7. Дускабилова Т.И. Плодовые косточковые культуры: особенности размножения в Сибири. Новосибирск; Абакан, 2009. 109 с.
8. Камолов Н. Пищевая ценность семян абрикоса // Доклады ТАСХН. 2006. № 9-10. С. 40-50.
9. Канцаева У.И., Горина В.М. Морфо-биологичексие признаки абрикоса обыкновенного (Purunus armeniaca, L) и их значение для проведения эспертизы сортов на отличимость, однородность и стабильность (ООС) // Сборник научных трудов ГНБС. 2015. С. 14-23.
10. Корзин В.В. и др. Засухоустойчивость интродуцированных растений абрикоса (Prunus armeniaca L.) и ее связь с толщиной листовой пластинки // Plant Varieties Studying and Protection. 2008. №2 (8). С. 51-57.
11. Кропанева Г.А. Учебно-исследовательская деятельность школьников как технология развивающегося образования // Исследовательская работа школьников. 2002. № 1. С. 118-126.
12. Кружков А.В. Биологические особенности и хозяйственная ценность сортов абрикоса и алычи в условиях средней полосы России: автореф. дис. … канд. с.-х. наук. Мичуринск, 2006. 23 с.
13. Крюкова И.В. Ботаническая классификация и географичексое распространение // Абрикос. М., 1989. С. 9-22.
14. Сарсекеева Ж.Е., Укенова А.К. Особенности организации исследовательской деятельности учащихся в инновационной школе // Вестник КарГУ. 2011. URL: https://articlekz.com/article/5744
15. Шолохов А.М. и др. Зимостойкость // Абрикос. М., 1989. С. 42-64.
16. Chemometric classification of early-ripening apricot (Purunus armeniaca, L) and in vitro biological activity // Scientia Horticulturae. 2017. 227. P. 187-195.
17. Kahle J.B., Matyas M.L. An assessment of the impact of science experiences on the career choices of male and female biology pupils // Journal of research in science Teaching. 1985. 22. P. 385-394.
18. Solov'eva A. et al. Kobeyu, osu, zhane damu. 7 synyp // Biologiya Atamura. 2017. P. 126-132.
19. Sydykov T.S., Abilkasymova A.E. Okushylardyn tanymdyk belsendiligin kalyptastytudyn didaktikalyk negizderi // Almaty jurnal. 2008. 280. P. 111-118.
20. Walter L.F., Chris Sh.A., Arminda P. Implementing and operationalizing integrative approaches tosustainability in higher education: the role of project-oriented learning // Journal of Cleaner Production. 2016. 133 (1). P. 126-135.
21. Xi Yang, Ruoyu Zhang. Machine learning for cultivar classification of apricots (Prunus armeniaca L.) based on shape features // Elsevier BV. 2019. 256. P. 102-104.
22. Zheksenbaeva U.B. Okushylardyn gylymi-zertteu jumystaryn ujimdastyru // Abai atyndagy KUPU Khabarshy Vestnik. 2005. № 2 (22). P. 45-51.
23. Zhuniskyzy K. et al. Osimdikterdin kobeyui, damuy, osui. 6 synyp // Biologiya Atamura baspasy. 2001. 138.