DIDACTIC POSSIBILITIES OF TEACHING THE SUBJECTS OF THE DEPARTMENT OF GENETICS IN HIGHER EDUCATIONAL INSTITUTIONS

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ANNOTATION: this article describes the didactic possibilities of teaching genetics in the agricultural sector - the deep theoretical and practical basis of the content of the subject; the possibility of interdisciplinary integration, the possibilities of problem-based and research-oriented education, the consolidation of knowledge through practical exercises, the use of information and communication technologies, and the dependence on the diversity of didactic tools, based on scientific analysis.

KEY WORDS: quality of education, genetic diversity, heredity, variability, biotechnology, problem-based and research-based education, practical training, DNA isolation, PCR, electrophoresis, 3D model.

INTRODUCTION

The development of education is an important factor in the sustainable development of society. A quality education system serves the economic, cultural and social development of society by forming the knowledge, skills and moral values of the younger generation. Education not only increases the professional qualifications of an individual, but also strengthens equality, legal culture and civic activity in society. Modern education ensures the adoption of innovations and the integration of society into global processes. Thus, through the development of education, the foundations of social stability, justice and prosperity are created in society. Innovations and quality improvement strategies in the education system give impetus to cultural and economic growth in society. Also, education is of incomparable importance in solving social problems in society and in educating healthy and active citizens. Therefore, the development of education plays an important role in all spheres of social life.

Regulatory framework. Indeed, the development of education determines the intensive development of all spheres of society. In our country, a number of regulatory documents have been created to provide a legal basis for the development of education. In particular, the Decree of the President of the Republic of Uzbekistan dated January 28, 2022 No. PD-60 “On the Development Strategy of the New Uzbekistan for 2022-2026” is a vivid example of our idea. This decree developed specific goals for the development of the “Agrarian Sector”. Goal 30 of the Decree: To increase the income of peasants and farmers by at least 2 times through the intensive development of agriculture on a scientific basis, to increase the annual growth of agriculture to at least 5 percent [1]; It is also appropriate to highlight priority goals such as the foundations of education reform at all stages of continuous education, as reflected in this Decree, Goal 39: Bringing the quality of education in the preschool education system to a new level; Goal 42: By 2026, completely revise and implement curricula and textbooks based on advanced foreign experience; Goal 44: Improving the quality of education in schools, bringing the knowledge and skills of teaching staff to the international level; Goal 47: Targeted preparation of 10 potential higher education institutions to enter the QS and TNE international rankings by 2026[1].

Main part. Issues of improving the didactic possibilities of teaching genetics in higher education institutions are highlighted in the research of J. Smith, L. Johnson, R. Martinez, H. Lee, B. Ahmadjonov, T. Rasulov, F. Collins, H. Varmus, A. J. F. Griffiths, S. Wessler, S. Carroll, J. Doebley, R. Harden, K. Illeris, J. Savery, H. Barrows, S. Kumar, A. Rai, M. Ibodova and other scientists.

It is worth noting that “Teaching topics of the Genetics Department” plays an important role in training highly qualified specialists in the field of science and innovation, as well as in the development and implementation of modern technologies. In particular, in priority areas such as agriculture, medicine,

biotechnology and ecology, genetics knowledge serves to create new genetic resources, develop effective drugs against diseases, and ensure the rational use of natural resources [2]. This knowledge is an important factor in achieving the goals set by the Presidential Decree, such as intensive development of agriculture on a scientific basis, raising the quality of education to a new level, and strengthening the country's economic stability [1]. Also, in-depth scientific research in genetics and training qualified personnel contribute significantly to the development of the national innovation system, the creation of new generation technologies, and increasing the country's global competitiveness [3]. At the same time, genetics knowledge is also important in improving human health and maintaining ecological balance.

In accordance with the content of the above normative framework, it is appropriate to dwell on the didactic possibilities of teaching the topics of the genetics department in higher educational institutions. Didactic possibilities of teaching the topics of the genetics department in higher educational institutions are a set of pedagogical, technological and substantive tools and conditions created to enable students to not only gain deep and systematic knowledge during the educational process, but also to actively engage in independent analytical thinking, critical thinking and scientific research. These possibilities arise from the complex and multifaceted nature of genetics, as well as the mutual integration of modern educational standards and requirements. Through didactic possibilities, students not only deepen their knowledge theoretically, but also develop practical skills, analyze data based on scientific methodology and create new knowledge. Thus, pedagogical approaches, educational resources and modern technologies used in teaching genetics serve to further develop students' abilities and prepare them for independent scientific activity. As a result, this process has a direct impact not only on the individual development of the student, but also on increasing the scientific and technical potential of the country.

The didactic possibilities of teaching the topics of the genetics department in higher educational institutions were determined based on the analysis of pedagogical, methodological and scientific literature. Thus, the didactic possibilities of teaching the topics of the genetics department are as follows:

1. The content of the subject has a deep theoretical and practical basis;

The theoretical foundations of genetics are based on fundamental laws such as heredity, variation, the structure and function of DNA and RNA molecules, and are widely used in all areas of biology - including agriculture, medicine and ecology. These laws guide students to understand the complex processes of biology, as well as to develop scientific thinking and analytical skills [4].

In the education system of the Republic of Uzbekistan, great attention is paid to the development of modern genetics and selection, medicine and biotechnology. Genetics is especially finding its place in genetic diagnostics and treatment of diseases, gene therapy, as well as in the creation of highly productive crops and livestock species in agriculture. This will increase professional interest and motivation among students, as they will have the opportunity to apply their knowledge to ensure the health and economic stability of the country [1, 4]. Also, scientific research in the field of genetics and biotechnology in Uzbekistan serves to create new technologies and increase the country's innovative potential. Therefore, in-depth study of these disciplines in the educational process is of great importance in preparing highly qualified personnel and making them internationally competitive [5].

In our opinion, the theoretical foundations of the Department of Genetics create an important foundation for the formation of deep scientific understanding and practical skills in various areas of biology. This department is based on fundamental theories and laws of heredity, variation, and the structure and function of nucleic acid molecules, and is widely used in such areas as agriculture, medicine, and ecology. The great attention paid to modern genetics and biotechnology in the educational system of Uzbekistan, especially in genetic diagnostics, gene therapy, and the creation of high-yielding agricultural products, increases the practical importance of this discipline. This increases professional interest among students and their motivation to apply knowledge in practice. At the same time, since scientific research conducted in the country serves to develop new innovative technologies, in-depth study of genetics in the educational process is of great importance in training highly qualified and competitive specialists[15].

2. Possibility of interdisciplinary integration

Due to its complexity and versatility, genetics is closely related to other disciplines and can be taught in an integrated manner with such fields as biology, chemistry, mathematics, computer science, and even philosophy. This integration makes the educational process more effective and deep and teaches students to think in a complex and systematic way [6]. For example, the use of biostatistical methods in genetic research is important for correctly analyzing the results obtained and drawing conclusions. At the same time, the theory of chemistry serves as the basis for understanding the molecular structure of genetic material. Computer science, on the other hand, allows for the rapid and efficient processing of large amounts of information about genes and their expression through bioinformatics tools [7]. In this way, interdisciplinary integration not only increases students' interest in various disciplines, but also develops their ability to understand many fields together. This is an important tool in the formation of specialists who meet the requirements of modern science and technology [6,7].

In our opinion, the complexity and versatility of the topics covered by the Department of Genetics directly and indirectly require its close integration with related disciplines. Interconnection with such areas as biology, chemistry, mathematics, computer science and philosophy increases the effectiveness of the educational process and teaches students to think in a complex, systematic way. Interdisciplinary integration allows the use of methods such as biostatistics, molecular chemistry and bioinformatics in genetic research, ensuring a deeper analysis and application of scientific results. Thus, an integrated approach not only increases the interest of students, but also ensures their formation as specialists who understand many areas together and meet the requirements of modern science. This plays an important role in training highly qualified personnel and developing innovations in the country.

3. Problem-based and research-oriented learning opportunities;

The use of problem-based learning methods in teaching genetics allows students to actively engage in independent thinking, scientific research, and problem solving. Lessons organized on the basis of problematic questions and real-life scientific problems encourage students not only to memorize knowledge, but also to analyze, synthesize, and create new knowledge. This process develops students' critical thinking skills and forms the skills to apply the studied theoretical materials in practice [8].

Research-oriented learning methods, on the other hand, direct students to deeply master the basics of scientific methodology, conduct experiments, and analyze the results analytically. Through this process, students consolidate the educational material not only on paper, but also in a practical context, fully understand all stages of scientific research, and develop the skills to create new knowledge for themselves [9].

The peculiarity of problem-based and research-based approaches in genetics is that this science includes not only theoretical knowledge, but also experimental research. Therefore, it is very important for students to participate in laboratory work, organize their own experiments and analyze the results on a scientific basis. This increases their interest in scientific research, stimulates independent thinking and a creative approach. Thus, problem-based and research-oriented educational methods are an important factor in forming students as active, independent and critical-thinking specialists not only in the educational process, but also in their future scientific and professional activities. This approach, in turn, is of great importance in training highly qualified personnel who serve the development of science and innovation in our country [8; 9].

In our opinion, the use of problem-based and research-oriented teaching methods in teaching the Department of Genetics directs students to the skills of deep understanding, independent thinking and decision-making based on scientific analysis. Such approaches serve to test the theoretical knowledge acquired by the student in real scientific situations, to substantiate his point of view with evidence by organizing experiments. Especially taking into account the experimental nature of the Department of Genetics, these methods form a culture of scientific research, critical thinking and the potential for creating new knowledge in students. At the same time, such teaching methods are considered an important factor in preparing personnel who are competitive and meet the requirements of modern science in the future, as well as in forming the intellectual resources necessary for innovative development.

4. Strengthening knowledge through practical exercises;

Practical exercises in teaching the Department of Genetics are pedagogically important not only for strengthening theoretical knowledge, but also for ensuring the active involvement of students in the learning process. These exercises are organized on the basis of interactivity and experience, which makes the learning process more effective and interesting for students. From a pedagogical point of view, practical work encourages students to be active, independent thinking and creative, as they have the opportunity to apply their knowledge to solve practical problems [10].

Methodologically, practical exercises are organized on the basis of the following basic principles:

problem-based and research-oriented education;

- students plan their own experiments based on the problem tasks given in class, collect data, and analyze the results. This approach involves them in independent scientific research, teaches them to apply theoretical knowledge in a practical context, and develops scientific thinking skills [8].

active learning:

- during practical exercises, students participate as active participants, not just observers. They manage their own laboratory work, make measurements, and discuss the results. This process increases students' responsibility and independence and enhances the effectiveness of learning.

teamwork:

- many practical exercises are carried out in groups. Students acquire communication and cooperation skills by working together, exchanging ideas, and solving problems. This prepares them for professional activities [12].

multisensory learning:

- practical exercises allow students to learn using different senses, such as vision, hearing, and touch. This method increases long-term memory and understanding in education, as students see and feel theoretical knowledge directly in practical work.

use of technology:

- using modern laboratory equipment and ICT tools makes classes more interesting and effective for students. For example, through virtual laboratories, simulators or bioinformatics programs, students are given the opportunity to learn complex processes interactively.

From the point of view of pedagogical methods, practical training is carried out based on the following educational principles:

- educational principle: students learn mutual respect, teamwork, and responsibility.
- active principle: the teacher participates as a leader and guide, not a controller.
- the principle of differentiation: the abilities and needs of each student are taken into account, their educational activities are organized individually and in groups.

At the same time, laboratory exercises teach students to think critically, solve problems, and draw conclusions based on scientific methodology. This helps them to be successful not only in the educational process, but also in their future scientific and professional activities [13].

In our opinion, the organization of practical classes within the genetics department plays an important role not only in adequately transforming theoretical knowledge into practical skills, but also in preparing students for a modern scientific and professional environment. The methodological approaches based on problem-based, active and collective learning applied in these classes direct students to in-depth analysis, research and creative thinking. Multisensory and technological approaches significantly increase the didactic quality and motivational power of the educational process. Such activities, built on pedagogical principles, especially form skills such as independence, responsibility, critical thinking and substantiation of scientific results in students. Thus, practical classes in teaching genetics appear as the main methodological tool that ensures the theoretical and practical integration of education and serves to train highly qualified, innovative thinking specialists.

5. Use of information and communication technologies;

The effective use of information and communication technologies in improving the teaching methodology of topics in the Department of Genetics is becoming an integral part of the modern educational process. This approach allows for increasing student engagement, developing independent thinking skills, and explaining complex biological processes on a visual and practical basis [12].

- C. Smith, K. Jones, P. Roberts noted that the learning process is enriched with digital technologies through virtual laboratories, bioinformatics programs (e.g. BLAST, Ensembl) and online simulators. This process prepares students for modern experimental approaches along with theoretical knowledge. As a result, their knowledge is more thoroughly formed and practical skills are strengthened [13].
- There are a number of pedagogical approaches to improving the methodology of teaching topics covered by the Genetics Department. In this process, it is advisable to organize lessons based on ICT based on the following pedagogical principles:
- active learning – students develop analytical and research skills by independently performing laboratory work and applying theoretical knowledge in practice;
- interactivity – genetic processes are taught interactively through visual simulations, which increases motivation;
- differentiated approach – an individual approach is provided by assigning tasks appropriate to the level of mastery of each student.
- It is also necessary to pay attention to methodological approaches in teaching the genetics department. The following methodological principles are followed when using ICT in the educational process:

- problem-based learning - students strive to independently solve tasks based on life or scientific problems;
- research-oriented learning - students analyze genetic information using bioinformatics programs and conduct their own research;
- teamwork - social and professional competencies are formed among students through working in groups.

Virtual laboratories and bioinformatics tools are of particular importance in improving the teaching methodology of topics covered by the Genetics Department. The following skills are formed through modern digital tools: visualization - complex genetic processes are presented using visual simulations, which makes them easier to understand; practical exercises - practical methods such as DNA isolation, PCR, electrophoresis are simulated through virtual laboratories; bioinformatics analysis - students independently analyze genetic data using programs such as BLAST, Ensembl; distance learning - education through online laboratories can be conducted anywhere, which makes the learning environment flexible.The following digital platforms are widely used in teaching genetics: Rosalind platform - teaches solving genetic problems based on bioinformatics algorithms; VGEC - Virtual Genetics Education Centre - an interactive genetics education portal developed by the University of Leicester; PraxiLabs - a modern educational tool that presents virtual laboratories in 3D format, in which experiments such as PCR, DNA isolation and electrophoresis are simulated.

In our opinion, information and communication technologies are widely used as an effective tool in teaching genetics. They allow us to explain complex biological processes in interactive and practical ways, which significantly deepens students' knowledge and improves their practical skills. Virtual laboratories and bioinformatics programs adapt the educational process to digital platforms and encourage students to conduct independent scientific research. Such an approach not only increases students' interest, but also involves them in critical thinking, problem solving, and teamwork. Thus, the role of ICT in education is of great importance not only in consolidating theoretical knowledge, but also in preparing them for modern professional and scientific activities. The effective use of ICT in the educational process is an important

factor in preparing the next generation of specialists in accordance with the requirements of the digital age.

6. Variety of didactic tools*;*

The use of a variety of didactic tools in teaching the genetics department is an important factor in increasing the effectiveness of the educational process. These tools facilitate not only the transfer of information, but also its comprehension, memorization and practical application. In particular, 3D models of the DNA helix, visual materials reflecting the structure of chromosomes, interactive graphics, slides, electronic textbooks and video lessons help students form a clear idea of complex biological and genetic processes. Such tools are especially important in illustrating the spatial and dynamic characteristics of genetic processes.

Teaching using didactic tools provides an approach that is appropriate for different learning styles of students - visual, auditory, kinesthetic. This optimizes the process of receiving and processing information in accordance with the individual characteristics of students. The use of appropriate didactic tools at different stages of education and in different disciplines significantly increases the effectiveness of learning. Also, through didactic approaches based on modern ICT tools, students develop skills in independent learning, analytical thinking and the use of advanced technologies.

Mahfuza Ibodova noted that electronic pedagogy is engaged in revealing methods and forms of education and upbringing in a high-tech information educational environment, studying, classifying and editing learning processes [14]. Also, the use of didactic tools in various formats serves to increase the effectiveness of education, taking into account the individuality of each student in learning. This, in turn, ensures a deep mastery of the science of genetics and prepares for future scientific and practical activities.

In our opinion, the role of didactic tools in teaching genetics is manifested as one of the necessary factors for ensuring the active participation of students in the modern educational process and effective assimilation of knowledge. Their use in various formats allows organizing education in accordance with visual, auditory and kinesthetic methods. At the same time, through electronic educational resources, modeling and simulations, students develop spatial and systematic ideas about the subject. Through didactic approaches, students' competencies in analytical thinking, independent research and the use of modern technologies gradually develop. As a result, the quality of education increases, the content of the subject is mastered more deeply, and the student is thoroughly prepared for future scientific and practical activities[16].

Conclusion. Teaching the genetics department in the agricultural sector system plays an important role in the development of science, innovation and modern technologies. In the country, on the basis of regulatory documents on educational reform, including Decree No. PF-60, special attention is paid to the development of all stages of education, including the field of genetics. In this context, the following didactic opportunities play an important role in teaching the genetics department:

- strength of theoretical and practical basis - the foundations of genetics are widely used in biology, medicine, ecology and agriculture. This science serves not only fundamental knowledge, but also modern practices;
- interdisciplinary integration - genetics is inextricably linked with biology, chemistry, mathematics, computer science, statistics and even philosophy. This interdependence teaches students to think in a complex way;
- problem-based and research-oriented teaching - students are encouraged to think independently, conduct scientific research, and develop a critical approach.
- the advantage of practical training - theoretical knowledge is strengthened and professional skills are formed through active participation in laboratory work.
- the use of information and communication technologies - the effectiveness of education increases through virtual laboratories, simulators, bioinformatics programs (BLAST, Ensembl).
- a variety of didactic tools - complex processes are illustrated visually and intelligibly through 3D models, interactive graphics, electronic textbooks, and video lessons.

Thus, teaching genetics based on modern methods, technologies, and pedagogical approaches equips students not only with theoretical knowledge, but also with modern scientific and practical skills. This process, in turn, plays an important role in training highly qualified specialists who serve innovative development.

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