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## Research Article

# METHODOLOGY FOR DEVELOPING THE COMPETENCE OF STUDENTS TO SOLVE PROBLEMS AND EXERCISES IN BIOLOGY

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## ABSTRACT

The article describes the scientific information about some aspects and their solutions in the development of the competence of solving problems and exercises of biology students taught in secondary schools.

## KEYWORDS

Biology, professional competence, competence approach, problem solving, energy exchange, transcription, reverse transcription, DNA, RNA.

## INTRODUCTION

One of the urgent issues of today is to continuously improve the professional level and qualification of the personnel working in the educational system of our

republic, professional-pedagogical competencies following the requirements of the time.

In this regard, Decree No. PF-4947 of the President of the Republic of Uzbekistan dated February 7, 2017 "On the Strategy of Actions for Further Development of the Republic of Uzbekistan", September 26, 2017 "Training of Pedagogical Personnel, Public Education Decision No. PQ-3289 on measures to further improve the system of retraining employees and improving their qualifications, as well as Decision No. PF-60 of the President of the Republic of Uzbekistan dated January 28, 2022 "For the years 2022-2026 The main goal is to improve the content of teacher training processes based on modern requirements and to continuously improve their professional competence.

In the process of implementing the tasks specified in these decrees and decisions, in cooperation with the professors and teachers working in the Ministry of Primary and Secondary Special Education and the Ministry of Public Education, DTS, programs, textbooks, based on the new version of the competence approach, as well as o Curricula are being radically updated based on the best experiences in the educational process of the developed countries of the world.

### **The main results and findings**

Modules included in the curriculum of network centers for retraining and professional development of pedagogical personnel operating in our country are scientifically oriented to the development of

knowledge, skills, and professional competencies of pedagogues.

Acquiring modern knowledge, skills and qualifications of pedagogues, as well as improving their professional competence, will be a solid foundation in the process of delivering a well-rounded generation to our society during their pedagogical activities. In order to train competitive personnel, it is necessary to have professional competence from every specialist, to improve it regularly.

Therefore, it is important for our pedagogues to clarify the content of the concepts of competence and professional competence.

"Competence" (incl. "competency" - "ability") is the ability to effectively use theoretical knowledge in activities, to demonstrate high-level professional skills, skills and talents.

The concept of "competence" entered the field of education as a result of psychological scientific research. From a psychological point of view, competence is "how a specialist behaves in unconventional situations, unexpected situations, engages in communication, takes a new way in relations with opponents, performs ambiguous tasks, uses conflicting information, consistently develops and possessing a plan of action in complex processes.

And professional competence is the acquisition of knowledge, skills and qualifications necessary for professional activity by a specialist and their practical application at a high level.

Professional competence does not mean the acquisition of separate knowledge and skills by a specialist, but the assimilation of integrative knowledge and actions in each independent direction. Also, competence requires constant enrichment of professional knowledge, learning new information, understanding important social requirements, finding new information, processing it and being able to use it in one's work.

In order to activate the cognitive activity of students in the literal study of the science of biology, it is necessary to determine the knowledge, skills and abilities acquired by the students from the previous topic, their systematization, and the knowledge and skills acquired from the new topic. It is appropriate to use biological problems and exercises in the process of controlling and evaluating skills and abilities, as well as in the process of learning a new subject.

Improving the professional competence of biology teachers of general education schools directly serves to raise the quality and efficiency of education to a higher level.

In the course of their pedagogical activities, biology teachers use exercises and problems related to various

questions, identifying biological objects, studying the external and internal structure of plants, animals, microorganisms and even their cellular structure, drawing pictures and schemes. Having scientific information about the diversity of the organic world causes students to develop a competence approach.

One of the aspects of improving the problem-solving competence of students in the teaching of biology in general secondary schools is the use of direct biological problems and exercises during the lesson. For this, it is important for the teacher to follow the following.

In the textbook of Biology (fundamentals of cytology and genetics) approved for students of the 9th grade:

- Using problems and exercises on the cell chapter;
- Problems and exercises related to the chemical structure of living organisms;
- Problems and exercises from molecular biology;
- Issues and exercises related to protein and protein biosynthesis;
- Problems and exercises on the subject of nucleic acids;
- Problems and exercises on energy exchange and photosynthesis;

- Problems and exercises related to cell division;
- Problems and exercises on the number of chromosomes and DNA;
- Using problems in teaching genetics and selection topics.

In the Biology textbook written for students of the 10th grade and academic lyceum and vocational college:

- Universal biological laws at the molecular level of life;
- Universal biological laws at the cellular level of life;
- General biological laws of life at the organismal level;
- General biological laws at the species and population level of life;
- It is necessary to use problems and exercises related to topics from the chapters of the basics of ecology and the biosphere based on the principle of systematicity, taking into account the age characteristics of students.

After all, the teacher, along with mastering biological problems and exercises, constantly trains students to solve and formulate problems, prepares the ground for a broader understanding of the essence of the subject,

understanding the interrelationships of cause and effect. Because problem solving and framing is the most important way of thinking.

Any action of the teacher, which is carried out in order to train students to solve and formulate problems continuously, encourages students to do scientific research and make scientific discoveries.

Due to the fact that teachers do not systematically use biological problems and exercises, a number of shortcomings in their professional activity are visible among the team of pedagogues. In particular, during the conducted research, teachers of general education schools who attended training courses and teachers who participated in workshops within the framework of the vocational school were informed of the "Information" for the subject of biology, published by the Ministry of Education under the Cabinet of Ministers for applicants entering higher educational institutions. Anonym was applied for a pedagogical experiment-test analysis with a number (20 of five difficulty levels) of problems and exercises given on separate pages and compiled for scientific research. In the process of working with the given problems and exercises, 24% of the pedagogues were able to complete the tasks, 35% of the pedagogues encountered various difficulties (they could work only when appropriate recommendations were given), and 41% of the pedagogues could not work with the given problems at all. These studies indicate that the

professional competence of the team of pedagogues in the process of solving biological problems is not sufficiently improved, and it is one of the important negative factors that prevent the formation of the competence of students in solving problems in biology. Let us dwell on the solution and analysis of some problems that pedagogues could not work on given problems during the pedagogical experiment-testing process.

Issue 1. Temur's body mass is 70 kg, and the total energy generated from carbohydrates consumed for one day is equal to 2050 kcal. The daily amount of protein and fat in food is equal, and the amount of carbohydrates is 2.5 times more. Calculate the amount of energy spent on digestion and work done overnight in kcal?

Solution to the problem:

This issue is related to the topic "Energy exchange" from the biology textbook, and during its work, the pedagogue should pay attention to the following:

1) First, the pedagogue needs to determine how many grams of carbohydrates are 2050 kcal. For this, we divide 2050 kcal of energy by 4.1 kcal of energy and determine how many grams of carbohydrate, based on the information given in the textbook, that 4.1 kcal of energy is generated from the oxidation of 1 g of carbohydrates.

2050 : 4.1 = amount of carbohydrate in 500 g.

2) Now we find the amount of unknown protein and fat in the content of the problem.

500 : 2.5 = 200 g, which is the total amount of protein and fat.

3) Through the third action, we find the separate mass of protein and fat and calculate how many kcal each produces energy.

a) 200 : 2 = 100 grams of protein and fat.

b) 100 × 4.1 = 410 kcal (protein)

c) 100 × 9.3 = 930 kcal (fat)

4) Determine the total energy of protein, fat and carbohydrate.

410 + 930 + 2050 = 3390 kcal total energy.

5) As we know from the textbook, energy exchange takes place in three stages, i.e.: first stage: energy spent on metabolism of basic substances;

second stage: energy spent on digestion;

the third stage: the energy spent on the work done overnight.

Temur's body mass is 70 kg. Based on this information, we can determine the amount of energy spent on the metabolism of the main substances: (Note: 1 kcal of energy is spent per 1 kg of body mass in 1 hour)



$70 \times 24 = 1680$  kcal of energy After determining the energy spent on the metabolism of basic substances, the amount of energy spent on digestion and the work done in one night is obtained by subtracting the total energy.

$$3390 - 1680 = 1710 \text{ kcal}$$

Answer: Timur spent 1710 kcal of energy for digestion and work done overnight.

Issue 2. If 5 molecules of glucose are broken down in the second step of the energy metabolism process in muscle tissue cells, find how much energy (kJ) is attached to the energy-rich phosphate bonds of ATF during this step?

Solving the problem: This problem is worked on based on the knowledge gained from the topic "Energy exchange" in the 10th grade Biology textbook.

When one molecule of glucose is completely broken down, 2800 kJ of energy is generated, and 200 kJ of this energy is generated in the II stage of energy metabolism. Based on the above information, we perform the following actions.

If 200 kJ of energy is produced from 1 mol of glucose,  $x=1000$  kJ of energy is generated from 5 moles of glucose.

After that, how much of the 1000 kJ of energy from 5 moles of glucose is bound to the energy-rich

phosphate bonds of ATF. 40% of the energy released due to the breakdown of glucose into lactic acid in the absence of oxygen is stored in ATF, and the rest is dissipated as heat energy. Based on these ideas given in the textbooks, we make a proportion.

If 100% is 1000 kJ,

40% will be  $x = 400$  kJ.

Answer: 400 kJ of energy is bound to the energy-rich phosphate bonds of ATF.

Issue 3. There are 80 urastil nucleotides in the i-RNA molecule in the cell. The number of cytosine nucleotides in one strand of the DNA molecule synthesized in the process of reverse transcription from this i-RNA chain is 3 times more than the number of uracil nucleotides in i-RNA, and the number of guanine nucleotides is 2 times less. If the amount of thymine nucleotides in this single strand of DNA is equal to half of the sum of guanine and cytosine nucleotides, find the number of hydrogen bonds in the double strand of DNA.

Solving the problem: The given problem is from the 9th grade Biology (fundamentals of cytology and genetics) textbook "Plastic exchange. Protein biosynthesis. Genetic code" and the information obtained from the topic "Cell is the hereditary unit of life" in the 10th grade Biology textbook.

It is possible to achieve the goal by understanding the content and essence of these processes while working on the problem. The solution to the problem lies in reverse transcription.

Transcription process

.....A G T G T G S T G A G.....

DNK dan

.....T S A S A S G A S T S.....

AG UG U G S U G AG

RNK

Transcription - the sequence of genetic information-nucleotides in one strand of DNA is copied into mRNA with the help of an enzyme. The process of reverse transcription

.....A G T G T G S T G A G.....

DNK

.....T S A S A S G A S T S.....

AG UG U G S U G AG

RNK dan

Reverse transcription is the synthesis of a double-stranded DNA molecule from a single-stranded RNA molecule

taking into account that the number of guanine nucleotides is 3 times more than the number of nucleotides, and the number of guanine nucleotides is 2 times less, we perform the following actions.

a) We find that there are  $U - 80 \times 3 = 240$  S in one strand of DNA.

b) We determine that there are  $80 U : 2 = 40$  Gs in that DNA chain.

2) Assuming that the amount of thymine nucleotides in this single strand of DNA is equal to half of the sum of guanine and cytosine nucleotides, the amount of thymine nucleotides is determined, i.e.:

a)  $240 (S) + 40 (G) = 280 (S+G) : 2 = 140 (T)$ .

b) according to the principle of complementarity, opposite to 80 U in RNA, one strand of DNA also has 80 (A) nucleotides. Based on this information:

atRNK 80 U

80 A, 240 S, 40 G, 140 T

at DNK

3) Based on the information given in the textbook, the number of hydrogen bonds is found. There are two hydrogen bonds between adenine and thymine, and three hydrogen bonds between cytosine and guanine. Accordingly, the number of adenine and thymine

nucleotides are added to each other (a), and then the number of cytosine and guanine nucleotides are added to each other (b), and the totals are doubled and tripled, and hydrogen bonds in DNA the total number of 's is found.

a)  $80 + 140 = 220 \times 2 = 440$  hydrogen bonds;

b)  $240 + 40 = 280 \times 3 = 840$  hydrogen bonds are determined.

4) Hydrogen bonds are added between adenine and thymine nucleotides and cytosine and guanine nucleotides.

There will be  $440 + 840 = 1280$  hydrogen bonds.

Answer: The DNA molecule synthesized on the basis of the i-RNA molecule in question has a total of 1280 hydrogen bonds.

Based on the above information, it was determined that the following are the main shortcomings that teachers make when solving biology problems and tasks::

- describing events without revealing the reasons;
- mixing causal relations with temporal relations;
- show the effect instead of the cause;

- mixing the primary cause with the secondary cause;
- it is permissible to emphasize such things as incorrect identification of causal connections.

At the time when our state is creating wide opportunities for fundamental reform of the education system, it is clear that the above opinions of pedagogues are unfounded. Because today, advanced pedagogues-methodologists and scientists of our Republic have developed "Pedagogical education", "Public education", "Continuous education", "Educational technologies", "Methodology of exact and natural sciences", "Scientific theoretical journals such as "Biology at School" continuously publish scientific methodical articles and theses on the latest achievements of science and methods of solving biological problems and exercises, as well as creating problems.

It should be noted that the professor of the Department of Biology Teaching Methodology of TDPU named after Nizomi, b.f.d., on solving biological problems and exercises. G. Shakhmurova, senior teachers I. Azimov, U. Rakhmatov co-authored the electronic textbook "Problems and Exercises from Biology" (2017), "Solving Problems and Exercises from Biology" training manual (2017), "Problems from Biology" and solving exercises" (fundamentals of cytology and genetics) instructional manual (2018),



"Solving problems and exercises from biology" (Man and his health) instructional manual (2017), "Solving problems and exercises from biology" (Zoology) methodical manual (2016), "Solving problems and exercises from biology" (Botany) methodical manual (2016), Test set from biology (2016), Tests for applicants from biology Collection (2017) is a clear proof of our opinion.

## CONCLUSION

In conclusion, in today's era of globalization, pedagogues must continuously research, self-analyze, analyze and synthesize, draw quick and clear conclusions, systematically apply biological problems and exercises to practice. as a result of improving professional competence such as the use of scientific and popular literature, the ability to effectively use the latest achievements of science in the course of the lesson, without being limited to theoretical information, it creates a basis for the formation of competence in solving problems and exercises in biology in students.

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