

## FORMATION OF FUNCTIONAL LITERACY AS A BASIS FOR IMPROVING THE QUALITY OF THE EDUCATIONAL PROCESS

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The modern world requires from a young specialist not only academic knowledge in his specialty, but also many other qualities, skills, skills that allow him to navigate the modern powerful information flow. Today, students have to learn a huge amount of complex, often incomprehensible material in all academic subjects. And even complete mastery of this material does not guarantee a young specialist competitiveness in the modern economic market. The formation of functional literacy among students allows not only to master theoretical knowledge, but also to apply the acquired knowledge in practice, to form skills and abilities, to build meta-subject connections. They must acquire the necessary knowledge and comprehend it, develop skills for applying the acquired knowledge in real life situations. In connection with the increasing globalization of the economies of most countries of the world, the problem of training specialists capable of adequately competing in the modern world economic market becomes urgent. The article gives the concept of natural science literacy as a necessary component of the development of students' functional literacy. The components of natural science literacy are revealed and an example of the formation of its competencies when passing the topic "Discovery of viruses" is given.

**Keywords:** functional literacy, meta-subject knowledge, science literacy, International Program for Student Assessment (PISA)

A distinctive feature of the life of modern society is the rapidly increasing variability of the surrounding world of things, ideas and technologies are replaced than generations of people. Such changes affect almost all aspects of human life, but first of all, the education system, since entering a post-industrial society has given rise to the problem of timely preparation of people for new conditions of life and professional activity. The modern world requires from a young specialist not only academic knowledge in his specialty, but also many other qualities, abilities, skills that allow him to navigate in the modern powerful information flow [1]. In the 21st century, a person is surrounded by an information field, in which it is not easy to navigate not only for young specialists, but also for the older generation [2, 3]. Today, students have to learn a huge amount of complex, often incomprehensible material in all academic subjects. And even a complete mastery of this material does not guarantee young specialist competitiveness in the modern economic market, which has intensified in connection with the globalization of the economies of most countries of the world. Modern education allows students not only to master theoretical knowledge, but also to apply the acquired knowledge in practice, to form skills and abilities, and to build Meta subject connections. They must acquire the necessary knowledge and comprehend it, develop the skills of applying the knowledge gained in real life situations. The term «functional literacy» is currently used to define this complex competence.

The term "functional literacy" was introduced back in 1957 by UNESCO, which was understood as "a set of reading and writing skills for use in everyday life and to satisfy everyday problems" and was applied mainly to the adult population.

In our country, according to a number of international experts, from 25 to 40% of the total population, due to functional illiteracy, experience significant difficulties in writing, reading and working with numbers [4].

Nowadays, modern education has an essential question: «Do 15-year-old students who have received compulsory general education have the knowledge and skills they need for full functioning in modern society, i.e. to solve a wide range of tasks in various spheres of human activity, communication and social relations.

### Materials and research methods

To monitor educational achievements, functional literacy among students in 1997, the Organization for Economic Cooperation and Development (OECD) developed a test that allows assessing the level of functional literacy among students. The result of this work is the Program for International Student Assessment (PISA).

PISA was first tested in 2000 and is conducted by the OECD every 3 years among adolescents aged 15 years. International research on monitoring functional literacy using the PISA test is carried out with the participation of leading international scientific organizations such as the Australian Council for Educa-

tional Research (ACER), the Netherlands National Institute for Educational Measurements (CITO), the United States Educational Testing Service (ETS), and the National Institute for Educational Research (NIER) in Japan, US Westat (WESTAT) and others. The study involves OECD countries, as well as those countries that interact with the OECD. The number of such countries is increasing every year.

The results of the PISA study allow us to determine the state of Russian education from the standpoint of international standards, as well as in what direction Russian education should be improved to increase the competitiveness of our graduates.

### Research results and discussion

To determine functional literacy, several indicators are used, the main of them are mathematical literacy, reading literacy and natural science literacy. The results of PISA-2018 among students of OECD countries, as well as those countries that interact with the OECD we see from Russia ranks 30th in functional literacy among the OECD countries. According to the results of the study conducted in 2018, students from Russia showed a slight decline in all three areas in comparison with 2015. As can be seen from the data in Table 1, the average score of Russians in 2018 was: in reading literacy 479 points against 495 in 2015; in natural science literacy – 478 points against 487 in 2015; in mathematical literacy – 488 points against 494 in 2015.

As a result, compared to the 2015 survey, Russia dropped from 26th to 31st in reading literacy, from 23rd to 30th in mathematics, and from 32nd to 33rd in science literacy. The data are presented in Table 2.

In the international report for 2000-2012 the place of the country is indicated taking into account the standard deviation. To date, the largest researchers in assessing the quality of education, in addition to PISA, are several recognized organizations – IEA, TIMSS. About 50 – 70 countries of the world take part in such studies, where the educational level of the younger generation is assessed.

International studies TIMSS (Trends in Mathematics and Science Study) in the field of mathematical and natural science knowledge showed that subject knowledge in these areas meets international requirements (in the studies conducted in 2015 and 2019, Russia takes 3-4 places in science literacy among 4 grades and 5-7 places among 8 grades, and in mathematical literacy 6-7 places in grades 4 and 8), and functional literacy remains below international standards.

If earlier there were debates about what is more important, academic knowledge or the competence of the student, now the need for deep academic knowledge and the importance of basing the competencies of students on them, allowing to apply this knowledge in real life, are obvious. The research, carried out according to the PISA program standards, focuses not so much on determining the formation of subject knowledge and skills, but on identifying the ability to solve practice-oriented problems based on information presented in different forms, identifying those knowledge and skills that will be useful to students in the future. According to the results of the study, Russian students occupy lagging positions in the ability to analyse life situations in order to identify and formulate modelling problems, and suggest ways to solve them.

**Table 1**

Research direction	The number of Russian points (on a 1000-point scale)						
	PISA-2000	PISA-2003	PISA-2006	PISA-2009	PISA-2012	PISA-2015	PISA-2018
Science literacy	460	489	479	478	486	487	478
Mathematical literacy	478	468	476	468	482	494	488
Reading literacy	462	442	440	459	475	495	479

**Table 2**

Research direction	Place of the Russian Federation among other participating countries						
	PISA-2000	PISA-2003	PISA-2006	PISA-2009	PISA-2012	PISA-2015	PISA-2018
Science literacy	26-29	20-30	33-38	38-40	34-38	32	33
Mathematical literacy	21-25	29-31	32-36	38-39	31-39	23	30
Reading literacy	27-29	32-34	37-40	41-43	38-42	26	31

In this regard, before the education of Russia there is a task to change the trajectory of students so as to apply knowledge to practice. In accordance with the May decree of President Vladimir Putin, Russia by 2024 should become one of the ten leading countries in the world in terms of the quality of general education. To do this, it is necessary to maintain the level of academic knowledge in TIMSS and increase functional literacy in PISA. In the tasks of the Unified State Examination and the OGE of recent years, practice-oriented tasks aimed at identifying functional literacy in children have already been included.

How can this goal of our functional literacy education be implemented? First of all, you need to know the requirements that are presented to teachers in PISA tests. Currently, a 6-level assessment system has been developed and used in PISA tests to assess the results of educational achievements (pic. 1).

According to the data from Table 3 and pic. 1, Russia is between the 3rd and 4th levels in functional literacy, occupying an average value on the international scale.

What problems need to be solved to increase the level of functional literacy?

First, we are used to building a model of education based on one single correct answer. With this approach, students do not develop creative thinking skills. Without mastering this,

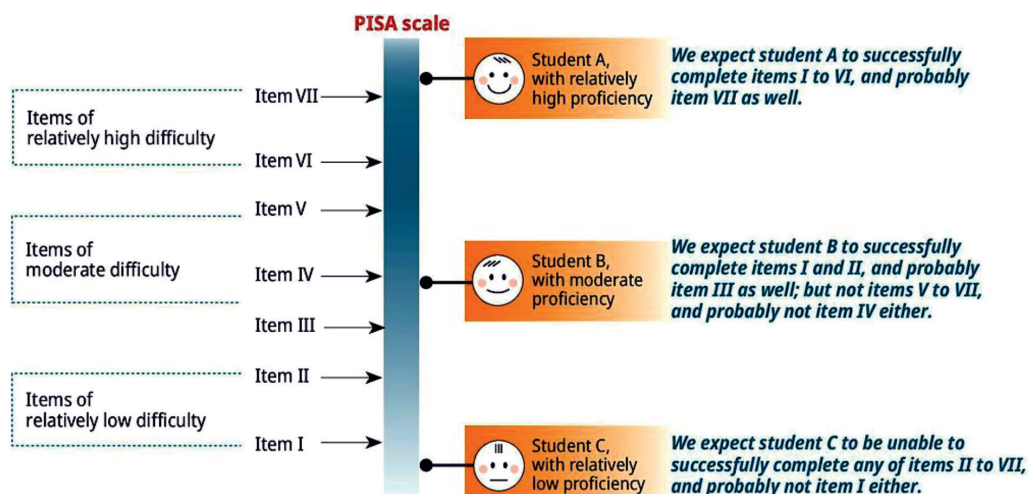
it is difficult for a modern person to navigate and develop in the rapidly changing conditions of the modern world. Accordingly, expanding the skills of solving problems with multiple solutions is a priority for the teacher.

Secondly, at the moment, the problem with education is that often academic knowledge is given in isolation from real life. And when students face real life, they often cannot determine in which area of knowledge the solution to a particular problem is located. The students do not have the integrity of the perception of the picture of the worldview. An important role in this is played by the formation of Meta subject knowledge. To form this competence in the educational process, it is necessary to give atypical tasks, real life situations, tasks where there is no obvious solution and requiring creative activity.

Thirdly, when building the trajectory of students' education, it is necessary to develop not only mathematical, reading and natural science literacy, but also global competencies of students, such as creative thinking and metacognitive abilities, which allow students to solve multiple life and professional tasks based on the acquired knowledge, skills and skills. Only such an integrated approach to the development of competencies will allow our students in the future to compete with dignity in the specialist market.

Table 3

	Reading literacy	Mathematical literacy	Science literacy
Russia	479	488	478
All OECD countries	487	489	489
Top ten countries with the best results	526	541	534



Levels of functional literacy of PISA research

In order to form the functional literacy of students, it is necessary to use new systems of teaching and learning situations. Introduce tasks, the main meaning of which is to translate passive knowledge into active knowledge. To do this, set multivariate tasks, tasks in which there are no explicit indications of the mode of action. To pose problems requiring the search for an answer outside the subject area, close to life situations and affecting the personality of students [5, 6]. And in this case, the basis of functional literacy is the formation of natural scientific literacy. What is natural science literacy and what does it consist of?

There are three main competencies, three groups of skills that characterize natural science literacy in PISA

- Explaining or describing natural science phenomena based on available scientific knowledge, as well as predicting changes.
- Recognition of scientific questions and application of scientific research methods.
- Interpreting data and using scientific evidence to draw conclusions.

For the formation of relevant competencies, it is necessary to introduce tasks aimed at the development of natural science literacy in the learning process [7]. There are basic requirements for such tasks. These tasks should be aimed at testing the skills that characterize science literacy, but at the same time should be based on situations that can be called life, real, or simply interesting for the children. These tasks are usually based on problematic material, including text, graphs, tables and related questions.

For example, consider the tasks for the formation of natural science literacy in the study of the topic "Discovery of viruses". In connection with the developing COVID-19 epidemic, the topic is relevant and the competencies acquired by students in the study of this topic are necessary for any person.

**Tasks for the formation of natural science literacy in the study of the topic "Discovery of viruses". Read the text and complete tasks 1-5.**

**Task 1. Discovery of viruses**

*Viruses have existed on earth for about 3 billion years. They are the most multiply biological form and are present in every ecosystem. Meanwhile, people have only recently learned about the existence of viruses.*

*This happened at the end of the 19th century, when a young Russian scientist Dmitry Ivanovsky studied the so-called mosaic disease of tobacco plants. He rubbed sickly tobacco leaves in a porcelain mortar and passed the re-*

*sulting juice through a bacterial filter. The filter had tiny pores through which bacteria did not pass. The resulting filtrate was applied to healthy tobacco plants, and after a while, discoloured areas appeared on these leaves. There were no bacteria, but the mosaic disease affected the plant. The leaves were examined under a light microscope, as a result, D Ivanovsky suggested that the causative agents of diseases are still unknown particles, which he called non-bacterial pathogens or "filtering" bacteria. Subsequently, these particles were called viruses. D Ivanovsky became their discoverer.*

*1. What research methods made it possible for D Ivanovsky to make an assumption about the existence of viruses?*

- 1) Observation
- 2) Modelling
- 3) Experiment
- 4) Filtration
- 5) Monitoring

Mark all correct answers.

As we can see from Task 1, students are offered to determine the research methods used by the scientists. This requires an analysis of the text read, updating knowledge on the topics studied. At the same time, the competencies of students are formed and consolidated in the application of various methods of natural science research to solve the assigned tasks.

**Task 2.** *Continuing the study, D.I. Ivanovsky conducted the following experiment. In a Petri dish on media with nutrients, he placed excretions from plants with a known bacterial disease and excretions from plants with "filtering" bacteria. It turned out that only in case 1, colonies grew on nutrient media, and in case 2 there were no colonies. What conclusions did Ivanovsky make after he had studied his experiments on the study of mosaicism of tobacco leaves?*

Mark all correct answers.

- 1) Tobacco leaves are contaminated with bacteria.
- 2) There is genetic material inside the viral particle.
- 3) The smallest particles pass through the bacteria filters.
- 4) Viruses develop in any cells (plants, animals, humans).
- 5) Cancer viruses infect only animal and bacterial cells.
- 6) "Filterable" bacteria are not cultivated on artificial nutrient environment.

In task 2, students are given the scientist's research and the data obtained by them. Students need to draw their own conclusions from the research results. Competencies of analysis



and interpretation of the received research information are formed

**Task 3.** *Can we assume that the experiments carried out by D.I. Ivanovsky gave the final confirmation of his hypothesis about the existence of viruses?*

Mark "Yes" or "No" and then write down an explanation of your answer.

YES –  NO –

Explain your answer.

If in tasks 1 and 2 students are asked to establish research methods, to understand the essence of the experiment, to determine its purpose, to guess that the scientist acted at the level of an assumption, that is, to put forward a hypothesis, then in task 3 they are asked to explain whether D.I. Ivanovsky confirm his hypothesis about the existence of a non-bacterial pathogen of tobacco disease.

**Task 4.** *Much later, using an electron microscope, viral particles of the TMV tobacco mosaic virus and other viruses were detected and studied. It revealed that a viral particle is a DNA or RNA molecule enclosed in a protein coat. For example, the TMV virus contains an RNA molecule, and its protein coat consists of 2130 identical polypeptide subunits. Currently viruses are believed to be non-cellular life forms. When viruses enter a cell, they rebuild the metabolism of the host cell, and it begins to produce (due to the building material of the cell and energy) new viral particles identical to the first virus.*

*What is the role of the genetic material (the DNA or RNA molecules) contained within the viral particle? Write down your answer.*

To complete this task, students need to explain the function of DNA and RNA as an integral part of a viral particle, indicating the important properties of nucleic acids: the presence of genetic information that determines all the signs of a viral particle, and the participation of nucleic acids in the reproduction of viruses.

**Task 5.** *Viruses live exclusively in living organisms: people, animals, plants, fungi and bacteria. Without viruses, the evolution of life on earth would be impossible, but at the same time, viruses are capable of causing disease in any living organism. Humanity knows massive viral diseases, epidemics and pandemics that claim hundreds of thousands, and sometimes millions of lives. The danger of an epidemic diminished sharply after the invention of the vaccine. For example, such a deadly viral disease as smallpox has almost completely disappeared from the earth thanks to mass vaccinations. However, the composition of vaccines*

*against some viral diseases must be changed frequently. For example, vaccines to prevent common seasonal flu are changed every year.*

*What property of viruses explains the need to be vaccinated against influenza every year? Please check one correct answer.*

- 1) Very small dimension
- 2) Ability to adapt to environmental conditions
- 3) The ability to penetrate the cells of a living organism
- 4) The ability to reproduce inside a living organism

When completing assignment 5, students need to explain the information that they know from life experience, competencies are formed to apply the knowledge gained in a life situation, the possibility to get vaccinated against influenza every year.

As we can see in these tasks, various competencies of natural science literacy are laid. Practice shows that the most difficult tasks for the students turned out to be tasks 3 and 4, which required detailed answers from the students. Not everyone succeeds in expressing their judgments, giving reasons, making generalizations.

So, in this example, we see that students develop such skills and abilities of natural science literacy as:

- use of natural science knowledge in life situations;
- identification of the features of natural science research;
- the ability to draw conclusions based on the data obtained;
- formulating the answer in a form that is understandable to all;
- an understanding of research methods;
- Identifying questions and issues that can be solved using scientific methods, etc.

No doubt it is not easy to set aside dedicated time to implement tasks aimed at developing functional literacy. The main study time in the modern curriculum is aimed at mastering the subject tasks of the discipline. But without linking the acquired academic knowledge to the realities of the life situations of students, the educational process loses its topicality. The effectiveness of the educational process is sharply reduced and at the end we have specialists who are often unable to apply their knowledge in personal and professional activities.

Therefore, our task is to develop and implement in practice as many tasks as possible aimed at the development of natural science literacy, as an integral part of the formation of functional literacy, which allows future spe-

cialists to effectively solve personal and professional problems.

### Conclusion

To improve the quality of education and the level of functional literacy, it is necessary, through the joint efforts of the state, methodological workers and teachers, to form a modern educational environment for students. It is necessary to have a practical base for the implementation of design tasks, allowing you to apply the knowledge gained in practice.

An important and basic role in improving the quality of education belongs to a teacher who owns not only subject, but also meta-subject knowledge and a methodological system capable of gradually forming functional literacy in children. In this case, an important role is played by raising the qualifications of the teachers. After all only they determine the level of students, build an educational trajectory for the sequential formation of levels of functional literacy.

To accomplish these tasks, the teacher needs to master the basic concepts of functional literacy, master the technologies of their formation and be able to select and develop educational tasks aimed at applying theoretical knowledge in practice. In countries where functional literacy is well developed (Singapore, Finland, etc.), there are specialists in the field of the formation of functional literacy who help to expand the educational and meth-

odological resources of the teacher, analyse how to restructure the methodological work of the teacher.

Observing these conditions, it is possible to eliminate the main problems of training our students identified by international studies PISA and TIMSS and to increase the competitiveness of our specialists in the international market.

### References

1. Adieva A.A., Medzhidova M.G., Djamalova S.A., Izrailova G.M. General scientific research methods as a theoretical basis for improving the quality of the educational process. – European journal of natural history. 2015. No. 6. P. 41-42.
2. Medzhidov M.A., Medzhidova M.G., Adieva A.A. Formation of functional and natural science literacy when studying the topic: "Discovery of viruses" // Innovative scientific research. 2021. No. 4-2 (6). P. 119-136.
3. Natural science literacy. Collection of reference tasks. Issue 1;2: textbook. manual for educational organizations / [G.S. Kovaleva, A.Yu. Pentin, E.A. Nikishova, G.G. Nikiforov]; ed. G.S. Kovaleva, A.Yu. Pentina. – SPb.: Education. 2020. 95 p.
4. Innovative project of the Ministry of Education "monitoring the formation of functional literacy" main directions and first results Basyuk V.S. Kovaleva G.S. // Domestic and foreign pedagogy. 2019. T. 1. No. 4 (61). P. 13-33.
5. Kolosova O.N., Elovenko N.A. Open type tasks as a tool for the formation of functional literacy. // In the collection: New science: history of formation, current state, development prospects. Collection of articles of the International Scientific and Practical Conference. Ufa. 2021. P. 139-141.
6. The network complex of information interaction of the constituent entities of the Russian Federation in the project "Monitoring the formation of students' functional literacy". <http://skiv.instrao.ru>.
7. Results of the PISA study: [www.oecd.org/edu/pisa](http://www.oecd.org/edu/pisa), [www.fioco.ru](http://www.fioco.ru).