

Methods of Introducing Scientific Achievements Over the Last Seven Years into the Physics Course

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Abstract. A methodological approach is proposed in the work, which allows providing students with the achievements of physics of the last seven years and increasing the cognitive motive of learning. The goal is achieved by using an electronic preprint system updated annually. A collection of preprints of 2019 is announced. It includes topics related to the discoveries of the features of global synergetic processes.

The processes of the formation of blue oceans and the sky of the Earth, the mechanisms of climate formation and other global synergetic processes that have been discovered in the last seven years are considered. A feature of the electronic form of the manual is the ability to use a significant number of color illustrations that provide a non-verbal channel of information. Many years of experience in teaching physics to bachelors and masters of information specialties have shown the high efficiency of the proposed methodology for stimulating a cognitive learning motive. The proposed work is one of the first in which the synergistic interaction of learning motives is analyzed. A scheme of synergistic interaction of the four most important motives for learning is presented: professional, social, pragmatic and cognitive.

It was found that the introduction of the theme “Physics Achievements of the Last Seven Years” into the physics course helps to stimulate a cognitive motive and increase the professional motive. The electronic form of the publication ensures its dynamic nature, allows you to use it in various forms: classroom, distance and for students to work independently.

Keywords: Electronic Textbook, Advances in Physics, Non-Verbal Channel of Information, Learning Motives, Cognitive Motive, Synergetic of Pedagogy, Information Technology, Electronic data,

1 Introduction

The course of general physics serves as one of the foundations for shaping the worldview of university students. In addition, training students in technical specialties is impossible without mastery of the basic apparatus of physics. There is a decades-old

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technique for studying it. However, according to the authors of the communication, a crisis situation has now arisen. The course content is mainly based on a description of phenomena discovered more than 50 years ago. The teaching is based on such textbooks as the general physics course of I.V. Saveliev. Meanwhile, a scientific revolution has taken place over the past seven years. However, its content is not reflected in most textbooks.

In addition, a problem arose due to the fact that training courses in physics and natural sciences were excluded from training for a large number of specialties. It can be argued that there is an objective reason for this phenomenon. At present, more and more often, physics and science are treated as “dead languages,” that is, Latin and Greek. They were obliged to study at the beginning of the 20th century, any competent person. However, their practical application was absent. A similar attitude to physics and natural science, as a source of “dead” knowledge, led to the exclusion of these subjects, even among students of information technology.

The disadvantages of the traditional system of teaching physics can be attributed to the fact that it is based mainly on verbal methods of presenting material [12]. It is advisable to more widely use the visual channel of information. New physics, including in scientific journals, contains a huge number of colorful illustrations, discovered by physical phenomena. The new science also contains significant cognitive and transdisciplinary segments of knowledge. There is also the problem of students' cognitive learning motivation discussed below.

2 Formulation of the problem

In order to provide students with the most relevant knowledge in physics, the authors over the years developed a system of electronic manuals in physics. The advantages of using this form of benefit were as follows. The amount and content of benefits was updated every year. There was no such opportunity for paper editions. The electronic form allowed the use of color illustrations that enabled the use of a non-verbal, that is, a visual channel of information. The discussed form made it possible, if necessary, to provide remote work with students.

The authors created electronic manuals on the following topics:

1. Fundamentals of the synergetics of global physical phenomena.
2. Synergetic processes of planet Earth formation
3. The largest global geophysical disasters.
4. The basics of computer models for the development of the Earth's climate.
5. The solar wind.
6. The processes of heat-mass transfer and synergistic structures on the planets of the solar system.
7. Planetary magnetic fields and the problem of inversion of the Earth's magnetosphere.
8. Fundamentals of quantum computers.

It should be noted that the above system of benefits is a dynamic, constantly changing structure. The contents of the collection are developed and updated annually. In

particular, the 2019 edition excluded a number of less relevant materials, in particular, such as Earth's Atmospheric Physics, Lasers, Solar Structure, Black Holes, etc.

Key points of the contents of the first manual are reflected in our article [1], and in the book [2]. Let us now describe the most important features of the content of the second of the manuals announced in this paper.

The most important result of the development of science over the past seven years is that planet Earth represents an object that is developing according to catastrophic synergetic scenarios. The discussed manual presents the physical mechanisms that ensure the development of planet Earth. The classical model assumed that after compression and cooling of the gas-dust cloud, a structure was formed which included: the iron core of the Earth, a liquid-hard aluminosilicate mantle, oceans filled with salty transparent water, continents and a blue atmosphere saturated with oxygen. However, it turned out that the described structure represents only a short-term object that exists only 20% of the time the planet exists.

The widespread use of computer methods of data processing and mathematical computer modeling has shown that completely different structures consistently existed before that. Each of them was realized during approximately 25% of the Earth's existence. The catachea was characterized by the absence of atmosphere, water sphere, stable surface structure and the inner part of the planet. The surface was like a moon. The sky is black as on the moon.

Archea was the emergence of the core, mantle, and lithosphere. Stormy volcanic activity took place. The Earth's surface was flooded with lava, and similar to the surface of Venus. The atmosphere consisted of methane, chlorine, sulfuric and nitric acids, carbon dioxide and water vapor. The dense atmosphere did not let in sunlight. The primary oceans were filled with chlorides of iron, copper and other metals. The water of the seas was red.

In the Proterozoic, an oxygen atmosphere arose and sea water acquired a modern composition, that is, a blue sky and blue oceans arose. The metal chlorides of the Archean oceans turned into metal oxides and formed ore deposits. Physical conditions contributed to the development of life. The structure of mantle flows and the drift of continental plates formed, the formation and decay of supercontinents was carried out.

The last period, Phanerozoic, was characterized by a number of geological disasters, in particular Perm, in the processes of which up to 90% of species of living organisms died.

The following manual, "The Largest Global Geophysical Disasters", is devoted to the presentation of the main physical mechanisms that have caused global catastrophes of the last 500 million years. It analyzes the causes and mechanisms of the five largest disasters:

The most important, for the formation of a modern worldview, is the theme "Climate" - analyzed more than ten physical mechanisms that dramatically affect the climate. At present, the question is being solved - what awaits us, global warming, or a new ice age. Knowing the answer, you can solve very important investment issues. In addition, a university graduate should be able to form his civic position.

To date, in the textbooks of general physics there is no consideration of such a phenomenon of a physical phenomenon, important for human civilization, as "Solar

Wind". In recent years, its structure has been discovered, the most important details of the effect on atmospheric processes, the effect on living organisms (Chizhevsky effect), and radio communication have been clarified.

The last three years have been breakthrough in solving the following problems.

1. Processes of heat and mass transfer and synergetic structures on the planets of the solar system.
2. Planetary magnetic fields and the problem of inversion of the Earth's magnetosphere.
3. Fundamentals of quantum

3 Discussion

The main goals of the proposed methodology were not only to present the foundations of the modern, but also to stimulate students' cognitive motive for learning. Consider the problem of the formation and interaction of learning motives. As is known [3], the cognitive motive for learning consists in the need to learn new things about a chosen subject, for example, computer science, mathematics, biology, etc. However, a cognitive motive alone is usually not enough to ensure student learning activities [11]. The article [4] presents a theoretical review of approaches, classifications and studies of the motivation of educational and professional activities [13]. It should be noted that in addition to cognitive, it is necessary to take into account the effect of the following motives, [3, 4].

1) Professional, consisting in the desire to master a pre-selected profession, or to improve one's skills, to learn an already familiar specialty at a new level, more deeply. His excitement at the university is achieved, in particular, by professional-orientation activities, student research activities.

2) Social implies a sense of duty to parents, as well as the desire to obtain the status of a person with higher education. To a large extent, it is laid in the family and in the pre-university period.

3) Communicative represents a desire to participate in student life. For its implementation, the organization of extracurricular activities of students is of great importance.

4) Pragmatic motive - means a desire to obtain a diploma of higher education in order to continue to have a prestigious, well-paid job, or a way to avoid being called up for military service. In some cases, the purpose of obtaining a diploma replaces the goal of completing the curriculum. To correct a pragmatic motive, disciplinary measures, tests can be used.

The relationship of motives forms a kind of structure, the study of which has been devoted to a number of works of recent years (in particular, [5-7]). It is shown that the structure of educational motives changed depending on the age of students, the contingent, a particular educational institution, etc.

It should be noted that the most important feature of students' cognitive activity is the emergence effect, due to which the presence of a cognitive motive can enhance the effect of all other learning motives.

The effect of the emergence effect is illustrated in Fig.1

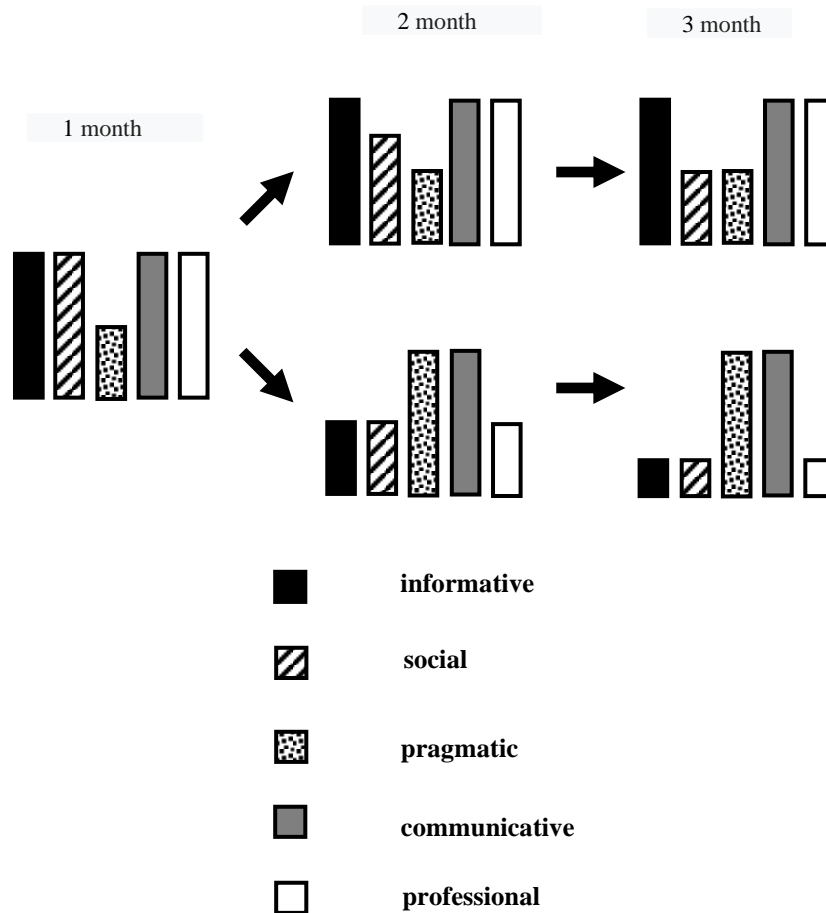


Fig. 1. Possible dynamics of motives during the first three months of study.

It describes the following scenario of motive change, characteristic of a freshman student. During the first month of training, the following motives are highest: cognitive, meaning curiosity for the new training system. Social - indicating pride in obtaining a student title. Communicative - caused by the opportunity to participate in student activities. A pragmatic motive is not dominant.

Further, a bifurcation of the motive system is possible. If lectures and other classes are uninteresting for a student, cognitive, professional social (lower diagrams) may fall sharply. The fall in professional motive means that doubts arise in choosing a profession. The decline in social means the decline in the prestige of university education. At the same time, by the third month of training, a structure can be formed in which the student willingly takes part in extracurricular activities, and training activities are carried out only under duress, that is, communicative and pragmatic motives dominate.

If the training sessions turn out to be interesting, the cognitive motive of learning retains or even increases its significance. At the same time, the desire to get the chosen

profession remains, the prestige of studying at the university is preserved. A pragmatic motive, that is, a formal attitude towards learning, does not have a dominant value. It should be noted that during this period the social motive may decrease. This is due to the emergence of fatigue and the disappearance of novelty.

A more detailed discussion of the problem of the dynamics of motives is beyond the scope of this post. We only note that the dominance of a student of a particular motive as a result of training leads to the formation of specialists of various types. In particular, a professional motive can be given by a competent specialist, engineer, lawyer, teacher, etc. The dominance of a communicative motive can lead to a transition to activities in the field of art. The pragmatic can lead to the formation of either an executor or a production manager. Social contributes to the formation of a conscientious member of society.

It can also be argued that the stimulation of a cognitive motive has a positive effect on the general motivation for learning.

Thus, it should be borne in mind that constant efforts of the teacher are necessary to stimulate the cognitive motive of learning. In addition to using the electronic manuals discussed above, one should constantly, throughout the course of lectures, use various techniques that restore interest in the subject being studied. In particular, it may be useful to identify at each lecture various "effects", that is, rather unusual manifestations of the stated laws. A tangible result in refreshing reflection is the appeal to interdisciplinary, domestic, and historical details. Some of the techniques discussed were presented by us in [8–10].

4 Conclusion

Information technology opens up new opportunities for the development of one of the most traditional training courses - General Physics. The scientific revolution of the 21st century requires the prompt introduction of more and more knowledge into learning. Meanwhile, the use of paper textbooks significantly slows down the formation of students' modern ideas about the world and the physical foundations of new technologies.

We have developed a methodology for using an electronic textbook, consisting of a system of electronic preprints, updated every year. Each of the preprints is devoted to one of the most pressing topics of physical research over the past seven years. In the 2019 edition, the most relevant achievements of physics seem to be the discovery of a number of patterns of global synergetic processes, in particular, climate.

The system of electronic manuals presented above was used to teach the subject "Physics" of bachelors and masters in the specialty "Information Technologies" of Ural Federal University, Yekaterinburg, also for the direction 11.03.02 Information communication Technologies and Communication Systems.

At the Ural Technical Institute of Communications and Informatics, Yekaterinburg. The experience of using the proposed methodology demonstrated the growth of a cognitive motive. In addition, it was possible to ascertain the presence of a synergistic pedagogical effect, which consists in the growth of a professional motive and general motivation for learning.

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