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Methodology for Solving Problems in Astronomy and the Role of Information and Communication Technologies in it

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ABSTRACT:This article highlights the methodology for solving problems in astronomy and the place in it of information and communication technologies. The importance of computer software in solving problems in astronomy is revealed.

KEYWORDS:qualitative tasks, quantitative tasks, graphic tasks, information technologies, software tools.

Tasks in astronomy can be classified according to various criteria, for example, by content, by purpose, by the level of implementation of some tasks, by the method of solution, by the method of presenting the conditions of the problem, by the level of complexity, etc. Qualified tasks by content can be divided into topics of the astronomy course. Tasks can be in spherical and practical astronomy, celestial mechanics, astronautics and astrophysics. The division of problems into these types is very conditional, since in most cases the conditions of the problem contain data from several branches of astronomy. Content objectives can be abstract or specific. The following tasks can serve as an example of tasks with abstract content:

1. On a terrain with latitude φ , determine the summer and winter solstices, the azimuth of the points, the height, the hour angle, the right elevation, and the deviation during sunset of the vernal equinox point. Draw a drawing.
2. The ancient Athenian astronomer Meton (5th century BC) determined such a period in the annual calculation, after which the young moon and the full moon again fall on the previous date of the solar calendar. Determine the length of this period, called the Metonic cycle or the lunar circle, if the average lengths of the tropical year and synodic month are known.

If the condition of the task indicates the use of a specific geographic latitude, then such a task is with a specific content. The advantage of tasks with abstract content is that the astronomical essence is emphasized separately and the details that do not affect its definition do not interfere. And the advantages of tasks with specific content lies in the fact that they reflect accurate data and are always related to living conditions.

Tasks with technical, industrial or agricultural production, transport or communication content are called tasks of polytechnical content. Such problems constitute a small part of the problems in astronomy. Basically, the tasks of determining the coordinates of the location of celestial bodies, the structure of the solar system, the movement of the planets make up most of the astronomical tasks.

A number of tasks have data of a historical nature: discoveries in practical astronomy, experiments in astrophysics, about inventions or historical legends, which differ mainly in interesting facts or the level of complexity of the task. While solving such problems in the classroom, there is a revival of students, and their interest in astronomy as a science increases.

Also, tasks in astronomy can be classified according to the level of complexity. Tasks that are not very complex in content, such as, for example, how to analyze the astronomical meaning of a formula, choose a system of units, find some astronomical value from a ready-made formula, as a rule, are solved when studying a new topic. And more complex tasks include a problem situation and elements of innovation. In astronomy classes, great attention is paid to just such problems, special time is allocated for their solution, in particular, separate classes for solving problems. These types of tasks do not have specific boundaries between themselves. Gradually complicating tasks, as in life, we approach tasks only with a problem that needs to be solved and without any quantities. Methodists call such tasks creative tasks.



According to the nature and methods of research, the tasks are divided into qualitative and quantitative. Tasks that require only clarifying the relationship among astronomical quantities are called qualitative. As a rule, when solving such problems, calculations are not performed. In the methodological literature, sometimes such tasks are called differently: tasks with questions, logical tasks, qualitative questions. And tasks that require the determination of a quantitative relationship between the desired astronomical quantities in the form of specific formulas and exact numbers are called quantitative tasks. When solving such problems, it is necessary to perform calculations. There is no complete answer to the question of the problem without calculations [1-7].

According to the methods of solving problems, they are divided into oral, experimental, computational and graphic. Since several methods are used to solve one problem, this division of tasks is very conditional. For example, the solution of an experimental problem requires verbal judgments, and in many cases computational and graphic work is required. Therefore, problems in the solution of which experiment is used to a certain extent are called experimental problems. Tasks that require solving graphic works are called graphic. The procedure for solving problems of various types is also different and depends on many conditions. In some cases, experimental problems are solved first, while in others, quantitative problems are solved first, and so on. However, in many cases, in order to determine the astronomical essence of the problem, it is advisable to solve first a qualitative or experimental problem, and then a quantitative or graphic problem.

The current state of development of the education system cannot be imagined without information technology. Indeed, the use of modern information technologies creates the foundation for improving the quality of education. At the same time, the content of the pedagogical process is being improved, innovative teaching models are being introduced, and joint activities of the student and teacher are also organized. In any educational institution, a necessary condition for the informatization of the learning process is the development of a unified policy and strategy for the introduction of modern information technologies, both in management and in the educational process.

Informatization of the educational process requires the solution of a difficult and multifaceted task related to technological, pedagogical and organizational aspects.

At the heart of the modern education system lies the definition of the purpose of creating an information and educational environment. Educational goals in pedagogical activity perform a systematizing task. A specifically established goal serves as the basis for choosing the content, purpose and organizational forms of education.

In order to overload the functions of education on the shoulders of the computer in the process of implementing the stages of education, first of all, it is necessary to analyze these functions in detail and highlight the main parameters that reflect educational activities. And this, in turn, requires the problems of involving students in the content of educational activities and in the process of reflecting educational activities, a detailed analysis of educational issues. For the effective use of a computer in the educational process, it is necessary to solve these problems. While studying astronomy with the help of electronic textbooks, students, along with mastering the content of the topic and many data on the topic of study, will be able to use the quantities, formulas and units of astronomical quantities used in astronomical tasks. And in order to master the theoretical data, one will have to observe photographs of many celestial bodies obtained with the help of space telescopes.

Any teaching should be understood not only as a production process, but as an effective creative activity. In the information technology environment, the process of developing educational activities in astronomy can be carried out based on the following approach:

- computerization of education;
- effective use of the Internet system;
- creation of electronic textbooks and their implementation in astronomy education;
- widespread use of software in laboratory and lecture classes;
- use of innovative pedagogical technologies with the introduction of information technologies in them;
- the use of interactive tests during the control and assessment of knowledge;
- in the process of developing the activities of independent education of students, the latter learn to use the acquired knowledge in solving didactic problems.

Today, all over the world, the course of astronomy is taught using software [8-10].

Students using an Excel spreadsheet to solve problems leads to high efficiency. Entering the appropriate tables into an Excel spreadsheet simplifies computational work, students will master the skills of working with an Excel spreadsheet, which in turn is important in their professional activities. For example, "The apparent magnitude of this



star is 10m, and the distance to it is 100 Ps. What is the absolute magnitude and luminosity of this star? We enter the task data in the first column of the Excel spreadsheet, enter the corresponding formulas in the second column, and enter the same formulas in the third column using the Excel spreadsheet form menu. As a result, the solution is displayed automatically.

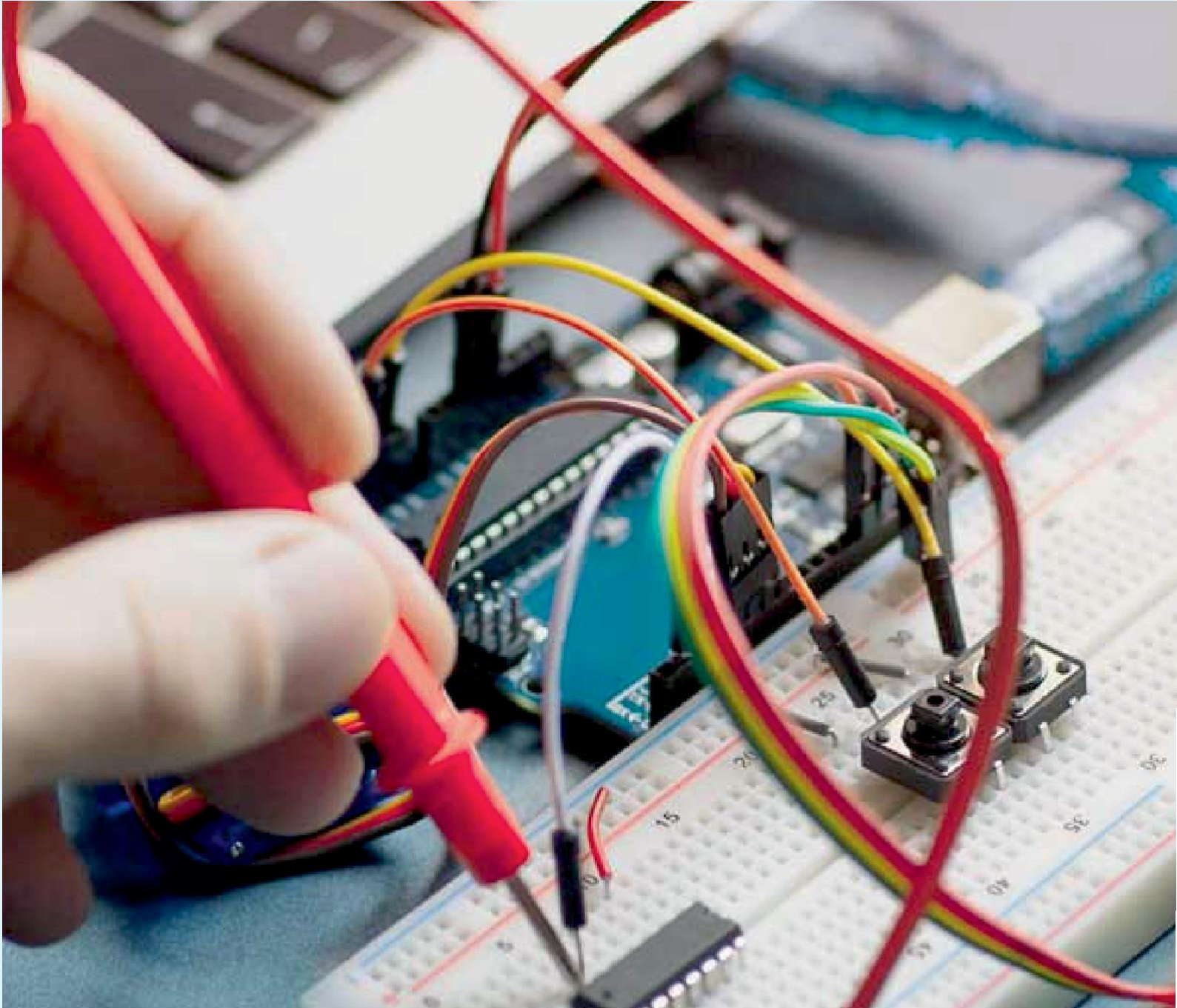
Given		Solving	Calculation
m=	10 m	$M=m+5-5\lg r$	5
r=	100 Ps	$\lg L=0,4(5-M)$	1
M=	?		
L=	?		

When solving problems, you can use not only an Excel spreadsheet, but also other software tools, such as Matlab, Maple, etc.

As can be seen from the above, in the environment of computer technology, not only the calculation of tasks, but also the teaching of astronomy also differs from the traditional form of education, it creates the possibility of demonstrating astronomical phenomena on a computer display, performing virtual laboratory work on astronomy, and analyzing them. Teaching astronomy with the help of computer tools develops students' skills of independent education.

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