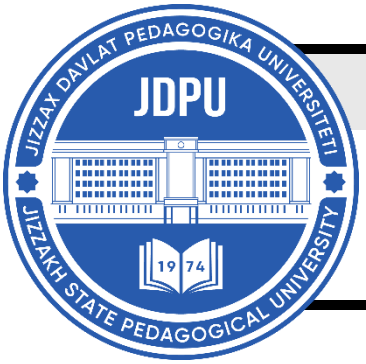
DOI: https://doi.org/10.37547/mesmj-V4-I1-19 Pages: 144-154

MENTAL ENLIGHTENMENT SCIENTIFIC – METHODOLOGICAL JOURNAL



MENTAL ENLIGHTENMENT SCIENTIFIC – METHODOLOGICAL JOURNAL

http://mentaljournal-jspu.uz/index.php/mesmj/index

MODERN FORMS AND METHODS FOR SOLVING PROBLEMS IN ASTRONOMY

Obid Saydayev
Jizzakh State Pedagogical University
Jizzakh, Uzbekistan
E-mail: obidsaydayev@gmail.com

ABOUT ARTICLE

Key words: methods of teaching astronomy, methods and forms of teaching, planetariums, observatories, latitudinal and actinometrical stations.

Received: 06.03.23
Accepted: 08.03.23
Published: 10.03.23

Abstract: Modern pedagogy gives a special place to the use of the visualization method in the classroom. The use of various visual aids in astronomy classes provides many opportunities. Project topics in astronomy can be proposed in advance, which will simplify the analysis of the results of their implementation in the study of the relevant topic and expand the value of astronomy as an academic discipline for achieving personal learning outcomes. The choice of the topic of the project is also possible after studying in the lesson the material that is completely or superficially related to this topic as a result of increasing the student's motivation to study this topic. Stimulation of the process of forming a sustainable interest in astronomy can be reflected in the reporting sessions, in which the results of any projects will be presented to the whole class, allowing you to refer to the previously studied material during the study of the subject.

INTRODUCTION

The originality of the methods of teaching astronomy is associated with the unity of the educational material and observations and with the extremely limited time allocated for the study of astronomical material in high school [1]. The study of astronomy consists of several elements:

- presentation of new material;
- observation of an astronomical phenomenon or process;
- problem solving;
- consolidation of the studied material;

- checking students' knowledge.

The effectiveness of teaching astronomy is achieved by coordinating and interconnecting various methods and forms of teaching. In some cases, inexperienced teachers often mix up the concepts of "form" and "method", for this reason we specify these concepts. According to N.V. Basova, the form of education is an organized interaction between the teacher and the student. The main thing here is the nature of the interaction between the teacher and students (or between students) in the course of obtaining knowledge and the formation of skills and abilities. Forms of education: full-time, part-time, evening, independent work of schoolchildren (under the supervision of a teacher and without), lecture, seminar, practical lesson in the classroom (workshop), excursion, industrial practice, elective, consultation, exam, individual, frontal, individually - group . They can be aimed at both theoretical training, for example, a lecture, seminar, excursion, conference, round table, consultation, various types of independent work of students, and practical training: practical classes, various types of design (design and research work).

Method (from Gr. methodos - “research”) is a way of studying natural phenomena, an approach to the phenomena being studied, a systematic path of scientific knowledge and establishing the truth; in general - a technique, method or mode of action; a way to achieve the goal, a certain way ordered activity; a set of techniques or operations of practical or theoretical mastery of reality, subject to the solution of a specific problem. The method can be a system of operations when working on certain equipment, methods of scientific research and presentation of material, methods of artistic selection, generalization and evaluation of material from the standpoint of one or another aesthetic ideal, etc. [2]

The main forms of conducting lessons in astronomy can be divided into groups and presented in the form of a block diagram based on the works of E.P. Levitan [3]. According to the form of the lesson, one can single out a lecture, a seminar, a practical lesson, a laboratory work, etc. The federal state educational standard of secondary general education obliged each student to complete an individual project in the process of mastering the main educational program. Project topics in astronomy can be proposed in advance, which will simplify the analysis of the results of their implementation in the study of the relevant topic and expand the value of astronomy as an academic discipline for achieving personal learning outcomes. The choice of the topic of the project is also possible after studying in the lesson the material that is completely or superficially related to this topic as a result of increasing the student's motivation to study this topic. Stimulation of the process of forming a sustainable interest in astronomy can be reflected in the reporting sessions, in which the results of any projects will be presented to the whole class, allowing you to refer to the previously studied material during the study of the subject . List of topics of several research projects:

- Design and installation of Nabokov's globe.

- Determination of the height of the mountains on the moon according to the method of Galileo.
- Determining the conditions for the visibility of planets in the current academic year.
- Seeing sunspots with a camera obscura.
- Determination of the temperature of the Sun based on the measurement of the solar constant.
- Determination of the speed of light from observations of the moments of eclipses of Jupiter's satellite.

An excursion is a form of organizing training in a natural landscape, production, museum, exhibition in order to observe and study by students various objects and phenomena of reality. A characteristic feature of the lesson is the study of objects associated with the movement of students.

FORMULATION OF THE PROBLEM

In the course of the subject "Astronomy" the objects of excursions can be planetariums, observatories, latitudinal and actinometric stations, various museums and exhibitions dedicated to the achievements of mankind in the exploration of outer space. Before the excursion, preparation is required for both the teacher and students, depending on the location and purpose of the excursion. So, observatories and planetariums can be visited before studying the educational material presented in the data of the complex, and already, relying on the knowledge gained by students, to base an explanation of certain issues of the astronomy course. To optimize the quality of assimilation of the acquired knowledge, the teacher needs to familiarize the students in advance with the technical base (devices, building design) and the methods (methods) of the research work of the observatory or planetarium.

Conference. Student study conferences first appeared in the 1960s. As a form of conducting the educational process, it has quite a lot in common with the traditional lesson, although it has a number of distinctive features. It can be attributed to the general fact that such conferences are held according to the schedule as a lesson, the group work of the class is combined with the individual work of students, the leading role is retained by the subject teacher. The difference lies in the fact that this form of conducting a lesson is based on the already existing knowledge of students, which they received by searching for information in various sources (scientific, popular science literature, the Internet, etc.). The duty of the teacher is to organize the speeches of students, discuss their reports, as well as make additions and clarifications.

For an astronomy course, educational conferences can play the role of generalizing lessons. With a work plan of 35 hours, the teacher is forced to put forward some important topics for independent study, and for a full check of the assignments, the teacher can allocate a lesson to a study conference. So, when studying the section “Nature of the bodies of the solar system” in the course of astronomy, it can put forward information about specific planets for independent study, having

considered only with the class the general characteristics of the terrestrial planets and giant planets and already summarize the knowledge of students in the form of a conference.

Astronomical observations. Modern pedagogy gives a special place to the use of the visualization method in the classroom. The use of various visual aids in astronomy lessons provides the following opportunities:

1. Supplementing students' self-observation with something that cannot be seen with the naked eye (photographs and computer models of space bodies and phenomena).

2. The ability to study the essence of many observed phenomena with the help of drawings, drawings, films, digital educational resources (DER).

3. Simplification of the process of students' understanding of the methods of astronomical research, a visual representation of the ways in which astronomical instruments work (schemes of installations, photographs, models of instruments, virtual laboratory work).

Observations, as mentioned above, are essential for the understanding and understanding of the information that is given in the course of astronomy. In the educational process, school astronomical observations are as important as demonstrations and laboratory work in physics. At the same time, the organization of these observations has its own specific features that differ from the principles of a physical experiment. Observations cannot be organized during the lesson (with the exception of observations of the Sun), due to the position of the heavenly bodies and the inappropriate time of day. At the same time, students should retain some short-term perceptions in their memory for use in subsequent astronomy classes, so the teacher is required to be attentive to the organization and conduct of observations [8].

Forms of extracurricular/extracurricular work:

Elective courses are elective courses. The federal basic curriculum offers the organization of extracurricular and project activities for schoolchildren for two hours a week in high school.

The program of the elective course can be chosen by the teacher from the ready-made ones or create your own, based on the equipment of the classroom.

The content of the elective course can:

1) offer an in-depth version of the study of astronomical material;

2) provide an introduction to one of the sciences, professions (astronomy, astrophysics, astronautics, etc.);

The circle is the main form of extracurricular work in astronomy. The main participants of the circle, in most cases, are students of a general education institution who are interested in astronomy.

The methodology for organizing circle work is based on voluntariness, the connection of circle work with educational work, the expansion of the student's zone of proximal development, and the development of creative abilities.

Entertaining "theoretical" classes form the basis for the beginning of work in the circle. Such classes can be accompanied by lectures of the head, reports of the circle members. The main principle of the implementation of theoretical classes is the maximum activity of the participants. When conducting lectures and reports, it is necessary to use the equipment and visual aids in astronomy available at the school.

The content of the circle work of students can be the manufacture of simple astronomical instruments, the preparation of reports, the observation of astronomical phenomena and objects, etc.

The role of observations in the circle is quite large. Schoolchildren throughout the year carry out the simplest practical work in astronomy. In the course of observations, students develop skills in tracking the Sun, Moon, stars and meteors. With a regularly working circle, schoolchildren make observations that, in their methodology, are close to the research work of amateur astronomers.

The result of the work of the circle, first of all, depends on the organization, control and accounting of the work carried out. In a special journal, it is advisable to record the results of completed work. At the end of the year, it is reasonable to hold a reporting conference, an exhibition of photographic reports based on the observations of the circle members. These educational complexes include developed methodological recommendations for teachers, which contain a description of the forms and methods of conducting classes in astronomy. However , the presented manuals do not fully disclose each of the topics of the astronomy course, for this reason, this paper will propose a teaching methodology for the section "Practical foundations of astronomy", which contains features of the study of theoretical material (modern forms and methods), a set of qualitative and computational tasks , laboratory and research work.

RESULTS AND DISCUSSION

For the successful implementation of teaching and conducting practical classes (observations) in astronomy, in a secondary school it is necessary to equip an astronomical corner or an astronomical training site with portable equipment in the physics classroom.

When disassembling and repairing astronomical equipment, older students can be involved in the work, this activity will benefit students and, in addition to developing the interest of many theoretical issues in spherical and practical astronomy.

Consider the necessary equipment of the astronomy classroom when studying the section "Practical Foundations of Astronomy":

- Seasonal star charts.
- Moving map of the starry sky.
- Devices for the approximate determination of the midday line by the North Star.
- Tellurium.
- Gnomon - to determine the noon line of the Sun.

- Model of the celestial sphere (armillary sphere).
- An instrument for determining the midday height of the Sun.
- Telescope.
- Device for approximate determination of the meridian and observations of culminating luminaries.

All these devices can be made by students under the guidance of a teacher. A detailed description of the device and its manufacturing process are given below. Seasonal star charts. The set of maps includes fifteen maps of the northern (near-polar) and southern (equatorial) sides of the starry sky for all four seasons of the year. You can buy season cards in any bookstore in the form of a star atlas. Similar cards can be made on your own, you can find star cards in good quality on the Internet, print them out and stick them on thick paper.

Fig1. Movable charts of the starry sky (PKZN).

By rotating the upper part of the PKZN (Fig. 1), you can find out exactly which constellations are visible at one time or another. The movable map is quite traditional, it is printed on paper. Devices for the approximate determination of the noon line according to the North Star consists of two rails, at one end of which cords with plumb lines are tied, while the others are pointed. By sticking the slats into the ground so that both cords and the North Star are on the same straight line, you can draw a line between the plumb lines, which will be the desired plumb line.

When studying astronomy, the first model encountered is the armillary sphere. Through it, students get acquainted with the main points and lines of the celestial sphere, the system of celestial coordinates, without the knowledge of which the process of studying astronomy is not feasible. Acquaintance with the indicated elements of the sphere takes place first of all in the office, and only then on the astronomical platform. However, not always, there is an armillary sphere in schools, so sometimes the teacher has to make the device on his own.

Fig.2. Model of the celestial sphere

The image (Fig. 2) shows the model of the celestial sphere proposed by Nabokov M.E., with the help of which the teacher will be able to describe the main elements of the celestial sphere. Consider the main components of the proposed device:

- a glass spherical flask half-filled with a weak solution of copper sulphate, which does not precipitate;
- an axis directed along the symmetry of the flask, made of a metal rod, so it does not react with the solution;
- stable stand that allows you to change the angle of the axis and at the same time the angle of the axis to the horizon;
- fixing the angle indicator;
- main elements of spherical astronomy: celestial equator (black line) and ecliptic (yellow line), known constellations, spring and autumn equinoxes, celestial meridian.

With this model, you can observe the movement of celestial bodies relative to the horizon. By changing the angle of inclination of the axis, it is possible to track the movement of stars at different latitudes and poles. You can also follow the length of the day at different latitudes by fixing the Sun on the ecliptic, explain various astronomical phenomena, polar days and nights, twilight, etc.

One of the most practical and useful instruments for studying astronomy is the theodolite. It serves for simultaneous measurement of the azimuth and height of a celestial object (see Fig. 5).

The next necessary device is a horizontal sundial (see Fig. 6). The watch device is represented by *Theodolite* as follows:

- the pointer (gnomon) is attached to the dial so that the top of the angle equal to the latitude of the place is in the center of the watch surface;
- the plane of the pointer was perpendicular to the plane of the dial
- a straight line joining the "centre" to the "12" mark should lie along the noon line.

With the help of this device it is possible to calculate the moment of true NOON.

Telescopes. Telescopes are an integral part of modern equipment designed for observations and laboratory work for the entire program of the astronomy course. These devices cover a wide range of

models and modifications. From telescopes that can only work in visually accessible areas, to instruments that can receive various ranges of radiation from high-frequency to radio waves that are not accessible to the human eye (Fig.3).

Fig.3. Telescop

In many modern modifications, telescopes are equipped with special software that expands the capabilities of the optical power of the device, the time of its use for observing celestial objects (can be recorded), opens up the prospects for remote use of equipment, simplifies the calculation of any physical characteristics of a space body (distance to object, linear radius, mass, average density, chemical composition, etc.).

To date, the following school telescopes are most common in educational organizations:

- A refractor telescope on an equatorial mount with an objective diameter of 80 mm and a focal length of 800 mm.
- Telescope-refractor on an azimuth mount with a lens diameter of 60 mm and a focal length of 600 mm.
- Telescope-reflector "Alcor" on the azimuthal installation with a primary mirror diameter of 65 mm and a focal length of 502 mm.

In addition, spotting scopes and binoculars can be used to observe the starry sky.

The magnification of the telescope is determined from the ratio: W = F/f, where F is the focal length of the objective, f is the focal length of the eyepiece.

The limiting resolution angle r characterizes the minimum angular distance between two stars or details of the planet's surface, at which they are visible separately.

$R = 140''/D$,

where D is the lens diameter.

The penetrating power of the telescope is determined by the limiting magnitude m of the stars visible in it on a clear moonless night, which is calculated by the formula:

$m = 2.1 + 5\lg D$,

where D is the lens diameter in millimeters.

School telescopes allow you to observe stars up to 11-12 magnitudes. To make good observations, the telescope must first of all be properly installed. Regardless of the place and method of installation (temporary or stationary) of the telescope, it is necessary that the southern region of the sky be completely open and available for review in a sector of about 160 °, i.e., approximately 80 ° west and east of the south direction. The telescope is always installed in the same place on the site, for which it is necessary to mark on it the exact location of the refractor tripod. This is necessary because the polar axis of the telescope is set in the plane of the celestial meridian.

It is important to note that the main criterion for an excellent learning result is the correct organization of testing the knowledge and skills of students. The student's work should be evaluated systematically for the following reasons: firstly, to create conditions for the orderliness of the student's actions; secondly, for a deeper understanding of the material studied, and thirdly, to maintain control over the assimilation of the material reported in the lessons.

The presented list of tasks should include various forms of tasks. Preference for the choice of forms, in most cases, is given to those in which cases the activity of students increases. These forms include:

- conversations with students;
- individual verification work (time 5-15 minutes);
- individual control tasks and a final lesson for the entire section (duration - 45 minutes).

With the help of a conversation, the teacher can highlight some questions on the topic covered, by involving students in the discussion, who themselves supplement and clarify each other's answers.

For an effective way to control knowledge of the current material, a test work is used. It includes various exercises, such as assignments with a star map, easy calculation tasks, questions that need to be answered by the student himself, within a few lines. The variability of tasks largely ensures the independence of the performance of such verification work. Of greatest interest is the original work, the implementation of which involves the use of a textbook, a star map, the "School Astronomical Calendar", etc. An important point, when grading, the teacher should not only report grades, but analyze the work and the main problems that arose when performing the test work together with the students.

Tasks can be borrowed from the textbook and specialized collections, such as a manual for the current and final control of N.N. Gomulina [8] , as well as tasks from Olympiads held at the federal and regional levels. Ultimately, the teacher can independently create problems based on the latest discoveries of scientists in the field of astronomy.

The choice of forms of accounting for knowledge is inseparably linked with the peculiarity of astronomical material, for this reason it is not advisable in astronomy to use the International System of Units SI in solving problems, since its use causes a number of difficulties in calculations and can

complicate the perception of phenomena, processes and quantities characteristic of astronomy. This problem can be circumvented by using, for example, the parsec as a unit of distance, and the magnitude as a unit of star brightness.

The content of the tasks should correspond to the individual characteristics of students, taking into account the subject, for example, to broad interdisciplinary connections with physics, mathematics, geography and chemistry.

The lack of time devoted to teaching astronomy encourages students to take into account homework and extracurricular activities.

The connection between theory and practice is the basis for the formation of the ability to develop for each person, first of all, this rule also applies to the younger generation. Laboratory work increases interest in the subject being studied, develops in the student such qualities as attentiveness, accuracy, perseverance, and expands his scientific picture of the world.

In the case of astronomy, all practical work in this section can be divided into 3 large groups: observations, frontal laboratory work, research / design work. If the educational organization does not have the necessary equipment, then it can be independently designed using the methodological recommendations of Levitan E.P. and Nabokov M.E., or use the DER and a virtual planetarium, for example, the Stellarium computer planetarium [5] .

Stellarium is a software project that allows people to use their computer at home as a virtual planetarium. It calculates the positions of the sun and moon, planets and stars, and draws how the sky would look to an observer based on their location and time. He can draw constellations and simulate astronomical phenomena such as meteor showers or comets, as well as solar or lunar eclipses.

The program can be used as an educational tool for studying the night sky, as an observation tool for amateur astronomers who want to plan night observations.

CONCLUSION

Due to time constraints (5 hours are allocated for the "Practical Foundations of Astronomy" section), the teacher and students cannot fully study all the theoretical material along with all the practical work that has been analyzed. For this reason, the teacher needs to rationally combine classroom and extracurricular activities. Part of the educational material can be issued for independent study, and some observations of celestial objects that do not require special equipment can be done by students at home. The content of the lessons should be focused on complex concepts and the most painstaking laboratory work.

REFERENCES

[1]. Kaufman III NJ Discovering the Universe. second edition. New York: W.H. Freeman and Company, 1990.

[2]. Picover Clifford A. Black holes (A travelers guide). USA, John Willey @Son. Inc., 1996. 210 p.

[3]. Zeilik Michael. Conceptual Astronomy. USA, John Willey .Son. Inc., 1993.

[4]. Astronomy. Methodological guide: 10-11 grades. Basic level: textbook . n allowance for teachers of general education . organizations / ed. V. M. Charugin . - M .: Education, 2017.

[5]. Astronomy .R F [Electronic resource]. All-Russian Astronomical Portal URL : kyr :// astronomy .r f (date of access: 20.04.19).

[6]. Bartunov O.S., Samodurov V.A. Astronomy and the Internet: the history of relationships // Earth and the Universe. 2010. No. 1. S. 49-59.

[7]. Baryshnikova A.N. The use of ICT in astronomy lessons in secondary school // Questions of the methodology of social sciences and the humanities: a modern context. - Belgorod: Agency for Advanced Scientific Research, 2018. - P. 65-67.

[8]. Basova N.V. Pedagogy and practical psychology. - Rostov D : "Phoenix", 2000. - 416 p.

[9]. Vakhrushev, A.A., The world around. 2 cl . : study . for organizations engaged in educational activities. At 2 h. Part 1 / A.A. Vakhrushev,

[10]. O.V. Bursky, A.S. Rautian . - Ed. 4th, revised . — M.: Balass , 2015. — 144 p.: ill. (Educational system "School 2100").

[11]. Vinnik M.A. To the question of the role of astronomical education in teaching and development of students // Bulletin of the Moscow State Regional University. Ser. Pedagogy. 2010. No. 2. S. 169-173.

[12]. Vorontsov-Velyaminov B.A., Strout E.K. Astronomy: textbook . for the 11th class . Wednesday , school / [Text] B.A. Vorontsov-Velyaminov - M .: "Bustbust", 2017. 240 p.: ill.

[13]. Vorontsov-Velyaminov, B.A. Astronomy: textbook . for the 10th class . Wednesday , school / [Text] B.A. Vorontsov-Velyaminov - M .: "Enlightenment", 1983. - 143 p.: ill.

[14]. Galuzo I.V. Didactic scenarios for astronomy lessons // Modern education of Vitebsk region . - 2017. - No. 4 (18). - S. 41-48.

[15]. Gomulina N.N. Astronomy: Verification and control work. Grade 11 / Gomulina . N.N. - M.: Bustard, 2018. - 80 s .