



СЕКЦІЯ 4
ТЕОРІЯ І МЕТОДИКА ПРОФЕСІЙНОЇ ОСВІТИ

UDC 378.091.313:53:374.7

**SELF-EDUCATIONAL ACTIVITY OF FUTURE TEACHERS
OF PHYSICS IN THE SYSTEM OF THEIR PREPARATION
FOR INNOVATIVE PEDAGOGICAL ACTIVITIES**

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У статті порушено проблему організаційно-методичного забезпечення самостійної навчальної діяльності майбутніх учителів фізики у процесі їх підготовки до інноваційної педагогічної діяльності. Модель самостійної роботи студентів структуровано за організаційно-змістовим, процесуальним та мотиваційним компонентами. Показано, що ефективна реалізація організаційно-змістового компоненту самостійної роботи поряд з її традиційним навчально-методичним забезпеченням має передбачати використання віртуального освітнього середовища (реалізованого за допомогою таких відкритих освітніх платформ, як Moodle, Lab CMS, Open edX Platform тощо), а також використання сторінок (сайтів) викладача, розміщених безпосередньо в інтернеті або у соціальних мережах. Процесуальний компонент самостійної роботи визначається аудиторними та позааудиторними формами навчальної роботи, що відіграють важливу роль у підготовці студентів до здійснення інноваційної діяльності та у набутті ними досвіду залучення до цієї діяльності учнів. Наведено варіант реалізації дистанційного проведення фізичного експерименту, пов'язаний із використанням програм для віддаленого управління комп'ютером через інтернет. Мотиваційний компонент пов'язаний із конкретними умовами, що сприяють підвищенню мотивації студентів до здійснення самостійного інноваційного пошуку.

Ключові слова: самостійна навчальна діяльність, майбутній учитель фізики, інноваційна педагогічна діяльність, організаційно-змістовий, процесуальний та мотиваційний компоненти самостійної роботи.

В статті затронута проблема організаційно-методичного забезпечення самостійної навчальної роботи майбутніх учителів фізики в процесі їх підготовки до інноваційної педагогічної діяльності. В структурі моделі самостійної роботи студентів виділено організаційно-змістовий, процесуальний та мотиваційний компоненти. Показано, що ефективна реалізація організаційно-змістового компонента самостійної роботи поряд з її традиційним навчально-методичним забезпеченням має передбачати використання віртуального освітнього середовища (реалізованого за допомогою таких відкритих освітніх платформ, як Moodle, Lab CMS, Open edX Platform тощо), а також використання сторінок (сайтів) викладача, розміщених безпосередньо в інтернеті або у соціальних мережах. Процесуальний компонент самостійної роботи визначається аудиторними та позааудиторними формами навчальної роботи, що відіграють важливу роль у підготовці студентів до здійснення інноваційної діяльності та у набутті ними досвіду залучення до цієї діяльності учнів. Наведено варіант реалізації дистанційного проведення фізичного експерименту, пов'язаний із використанням програм для віддаленого управління комп'ютером через інтернет. Мотиваційний компонент пов'язаний із конкретними умовами, що сприяють підвищенню мотивації студентів до здійснення самостійного інноваційного пошуку.

Ключевые слова: самостоятельная учебная деятельность, будущий учитель физики, инновационная педагогическая деятельность, организационно-содержательный, процессуальный и мотивационный компоненты самостоятельной работы.



Andrieiev A.M., Huliaieva T.V., Kulynych A.H. SELF-EDUCATIONAL ACTIVITY OF FUTURE TEACHERS OF PHYSICS IN THE SYSTEM OF THEIR PREPARATION FOR INNOVATIVE PEDAGOGICAL ACTIVITIES

The article considers the problem of organizational and methodological support of independent educational activity of future teachers of physics in the process of preparation for innovative pedagogical activity. The model of independent work of students is structured on the organizational and substantive, procedural and motivational components. It is shown that the effective implementation of the organizational – substantial component of independent work along with her traditional training and methodological support should include the use of virtual learning environment (implemented with the help of such open educational platforms like Moodle, Lab, CMS, Open edX Platform and others), and the use of pages (sites) of the teacher, posted directly to the Internet or social networks. The procedural component of independent work is determined by the classroom and outside the classroom forms of educational work, which play an important role in preparing students to carry out innovative activities and to acquire experience of involvement of students. Given the embodiment of a remote conducting a physical experiment, associated with the use of software to control a remote computer over the Internet. A motivational component is associated with specific conditions that increase the motivation of students to carry out independent innovative research.

Key words: *self-educational activity, future physics teacher, innovative pedagogical activity, organizational and substantive, procedural and motivational components of independent work.*

Statement of the problem. Independent learning activities (independent work) occupies an important place in the system of methodical training of future teachers. It is a variety of training activities carried out by students without the direct involvement of the teacher, but under his control, and can occur both during classroom and extra-curricular time. Well-organized self-activity of students, enhances their level of training, quality of learning, motivation to learning, broadens their Outlook. In the process of independent work to develop the mental abilities of the students and manifest their individual style of thinking and behavior that contribute to the formation of the author's system of activity of the future teacher of physics (which is manifested, in particular, the independence and originality of the implementation of teaching activities, creative application of existing and creation of author's technologies of training). An important problem concerning organizational-methodical provision of independent educational activity of future teachers of physics in the process of preparation for innovative pedagogical activity.

The relevance of the research. Didactic and methodological aspects of independent learning activities of students (including the teaching of physics) has dealt with in the scientific works of S.P. Velichko, T.P. Gordienko, O.I. Ivanitskii, P.I. Pidkasiistii, O.V. Slobodyanik, M.M. Soldatenko and many other scientists. Relevant questions are related to organizational and methodological features of independent educational activity of students – future teachers of physics in the context of their preparation for innovative pedagogical activity (in particular, in the process of forming readiness for the organization of innovative activity of students).

Among the General requirements, the implementation of which creates the preconditions for effectiveness of independent work, T.I. Turcot [1, p. 253] distinguishes, in particular, such as the development of motivational attitudes in students (the teacher should foster in the student an internal need for independent activity); systematic independent work; its proper planning (students must learn to plan their actions; to focus on main issues); implementation of pedagogical control of students independent work.

According to B.A. Sus [2], the most significant feature of independent work of the student during the training there is an independent mental activity that can be organized during different types of training sessions. S.P. Velichko, D.V. Somenko, O.O. Somenko [3] believe that the methodology of organization of independent activity of students in physics should build in particular on the basis of wide application of information and communication technologies and use of various types of individual tasks (theoretical, experimental, research, teaching) purposeful learning activities of each student.

In the structure of independent activity traditionally isolated organizational and substantive, procedural and motivational components (fig. 1). The purpose of this article is to report the features of the structural components of independent educational activity of future teachers of physics in the context of their preparation for the implementation of innovative pedagogical practices (in particular, in the process of forming readiness for the organization of innovative activity of students in physics).

Presentation of the basic material of the study. The main task of independent educational activity of future teachers of physics in the context of their preparation for the imple-



mentation of innovative pedagogical practices should include the following:

- consolidation students with theoretical material on the basics of innovation and the development of the ability to carry out innovative activities;
- the formation of students independence in implementing their own innovative pedagogical search;
- experience of organization of innovative activity of students in physics.

The organizational-substantial component of independent learning activities. Due to the wide use of information and telecommunication technologies of learning, it becomes possible to expand traditional approaches to the organization of independent educational activity of future teachers of physics. First of all, this contributes to the implementation of distance learning technologies. Under these technologies, O.I. Ivanitskii understands a set of methods, forms and means of interaction in the process of independent but controlled development of students (pupils) a certain body of knowledge [4, p. 169]. The essential feature of distance learning, according to authors [5, p. 74], is the combination of information technology training with the communication (the latter include, along with traditional means of communication, computers, LAN and WAN, email, etc.). O.I. Ivanitskii considered three-component system network informa-

tion-communication complexes [4, p. 199], which make possible the creation of informational educational environment. This system provides: electronic bank of teaching and methodological documentation (e-Bank); use for educational purposes page of the teacher in social networks; the use of the Internet platform on the websites of the University.

The main disadvantage of e-Bank include the complexity of providing feedback between student and teacher, as well as inaccessibility of the Bank outside the University network. Therefore, without diminishing the value of this component in the creation of the educational environment, we believe that the most effective forms of implementation of organizational support for independent work of students in the process of preparation for innovative pedagogical activities appear: the use of virtual learning environment and the development of pages (websites) for teachers. Focus on them more.

The use of a virtual learning environment. Examples of non-commercial Internet platforms that are already being used for educational purposes is the virtual learning environment Moodle, open educational platform Lab the CMS and the Open edX Platform the like. Opportunities for distance learning, they allow to implement the functions of the first two components, while eliminating their shortcomings. Next, let's consider some features

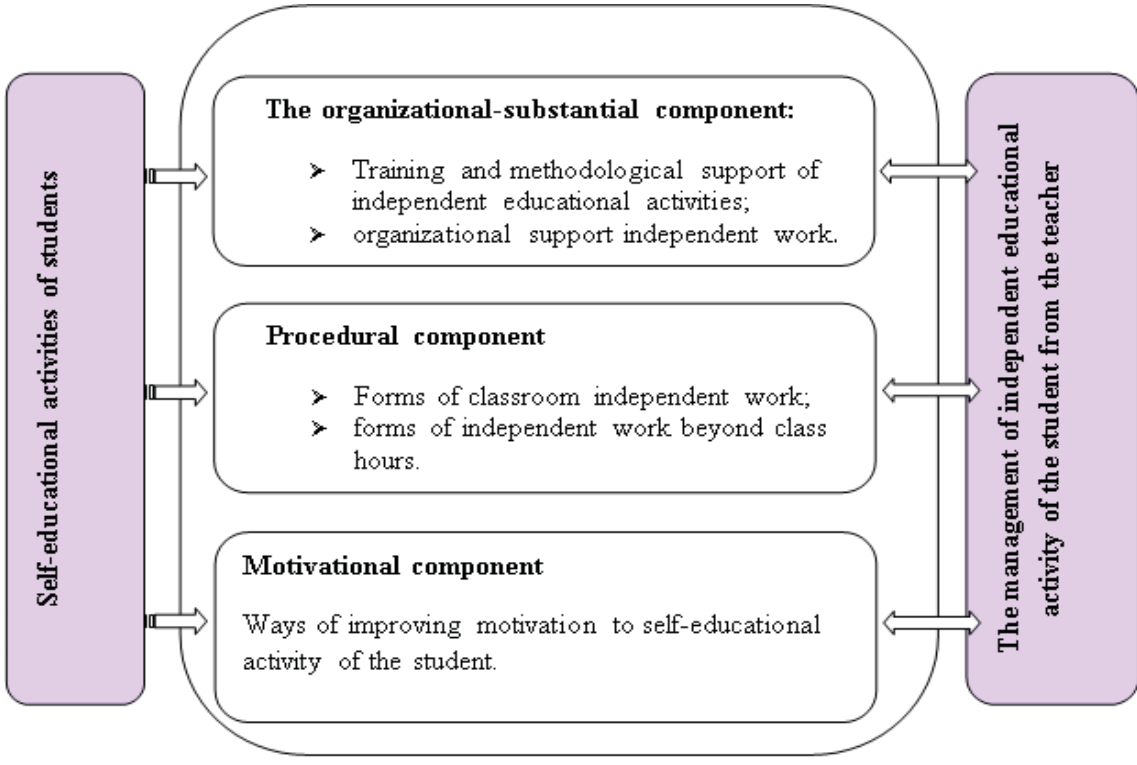


Fig. 1. The structure of the model of independent educational activity of students



of the Internet platform Moodle for distance learning of the future teachers of physics (in particular, in the context of their preparation for innovative pedagogical activity).

The software package Moodle refers to the content management systems of website (Content Management System – CMS) and is a virtual learning environment to ensure the learning process in a distance form. The system Moodle has a lot of flexibility regarding the presentation of educational material, testing students and tracking the success of their learning. The use of Moodle in the process of preparation of future teachers of physics to innovative pedagogical activity allows to:

- to provide students with methodological assistance in the course of their independent theoretical preparation for innovative activity and also to monitor the level of their educational achievements;
- organize a remote work with the students in their preparation for competitions and conferences;
- conduct collective training events for students (public lectures, workshops and the like);
- to carry out remote consultation of students with teachers in the course of studying a particular academic discipline;
- choose the student's own learning trajectory in the field of innovation in accordance with his abilities and inclinations;
- to monitor the level of students' knowledge in the field of innovation.

Training and methodological support disciplines, which is implemented through the Internet platform Moodle, can solve the following problem.

1. The organizational aspect. It is associated with the planning and organization of the discipline. Usually, this solves the problem of the working program, which shows the overall structure of the discipline, the topic of the lecture practical (lab) classes, defined subjects of independent work of students, lists of recommended literature. This block also includes instructional tips and tricks for learning, determines the types of control and informs about the way of accumulation of points by students which reflect their academic achievement.

2. The substantial aspect. It is associated with the statement (representation) of learning material to be absorbed. The essential feature is that the material is provided in a hypertext form. The student has the opportunity to see the structure of the whole discipline and its content is a separate topic.

3. The diagnostic aspect. This problem is solved by using control questions and exercises in separate topics, sections, and entire discipline. This unit allows students to check

the level of learning, and the teacher – to carry out systematic monitoring of their academic achievements. It is important that the Moodle system allows the construction of various form of tasks (e.g., tasks for finding the correct answer, job matching, etc.).

The use of pages (sites) of the teacher. As an additional organizational tool for the methodical providing of independent work of students may be the teacher, posted directly to the Internet or a social network (e.g. Facebook, YouTube, etc.). For today already there are examples of successful implementation of this approach in educational activities. One of them belongs to the famous non-profit educational organization Khan Academy (Khan Academy in English). It created a website that hosts a system of short lectures from various fields of knowledge (physics, mathematics, chemistry, biology, medicine and many others).

Created a teacher website (professional page), devoted to a certain discipline, can be used for methodological support of independent educational activity of students in their preparation for innovative pedagogical activity. For this author's page of the teacher should contain links that provide access to appropriate training and methodological content (short lectures, demonstrations, experiments and the like), which makes self-preparation of students. Using this approach identifies the following training opportunities:

1. The coverage of theoretical and practical material associated with novata and innovation, can be implemented by using videos. The main requirements appear: short-term (a few minutes) that is associated with retaining the attention from someone who is learning, and focus on coverage of specific substantive element of educational material. It is important that the presentation of educational material in video format can be brought closer to its coverage by the teacher during the live classes (the appropriate means will be discussed below).

2. Work independently with the learning content a student can exercise at a convenient time, giving the study a specific question as much time as he sees fit.

3. Development of educational material (particularly video) can be themselves to students as appropriate to individual job in the disciplines or in the course of term papers and qualification papers.

4. Using the author's page of the teacher to a certain extent solves the problem of lack of student in class, in particular, appears to be an effective learning tool for those students who for certain reasons are unable to systematically visit classrooms.



5. In contrast to material that is contained in a (and may have some errors and inaccuracies), the material displayed on the author page of the teacher is proven.

Consider the main features of the development of educational movies. For this purpose the graphic computer programs and software for video capture from the screen (this saves what is on the screen on the computer's hard drive). In fig. 2 shows a frame of the video clip we created using the graphic editor Microsoft Paint and software iSpring Free Cam (the program allows you to create video with audio and post them on YouTube). As additional equipment was used a graphics tablet (he played the role of a school Board) and the microphone.

In this video clip examines the essence of an innovative product «Demo capacitor», which was created by students in our experimental group. The basis for the development was given the task of reducing the number of capacitors (as compared to existing devices) to achieve a given range of possible values of capacitance. Explanation of the principle of operation of this device, implemented in a video format is to highlight the author of the semantic elements in the following sequence: the condenser and its capacity → parallel and series connection of capacitors → scheme designed store containers → the principle of the device and an example of its specific implementation. During movie playback the one who learns and creates the imagination that he is in the audience and met with the explanation of the teacher.

The procedural component of independent learning activities. The procedural component of independent educational activity of students – future teachers of physics in

the context of their preparation for innovative pedagogical activity is determined by the forms of independent work, which contribute to attracting students to innovative activities. Conditionally they can be divided into classroom and outside the classroom.

In the classroom, forms of independent work, which are important to prepare students to innovate in the first place, should include independent work during practical and laboratory classes. Among the forms of out of classroom learning activities, can provide an independent implementation of students innovation (including innovative pedagogical practices), an important place is occupied by the following:

- the implementation of the household (in particular individual) assignments in the disciplines;
- writing of term papers and qualification works;
- independent work undertaken by students during the practice;
- scientific-research work in problem groups and scientific circles, which are created on the basis of departments or teaching and research laboratories;
- student participation in departmental research projects;
- independent work of students in preparation for the research competitions and Olympiads of physics and technical direction;
- the management of students research work of students in the process of preparation for physical-technical competitions.

Among the research competitions to encourage students to innovate, it should be noted are: all-Ukrainian student competition of scientific works (in particular, physi-

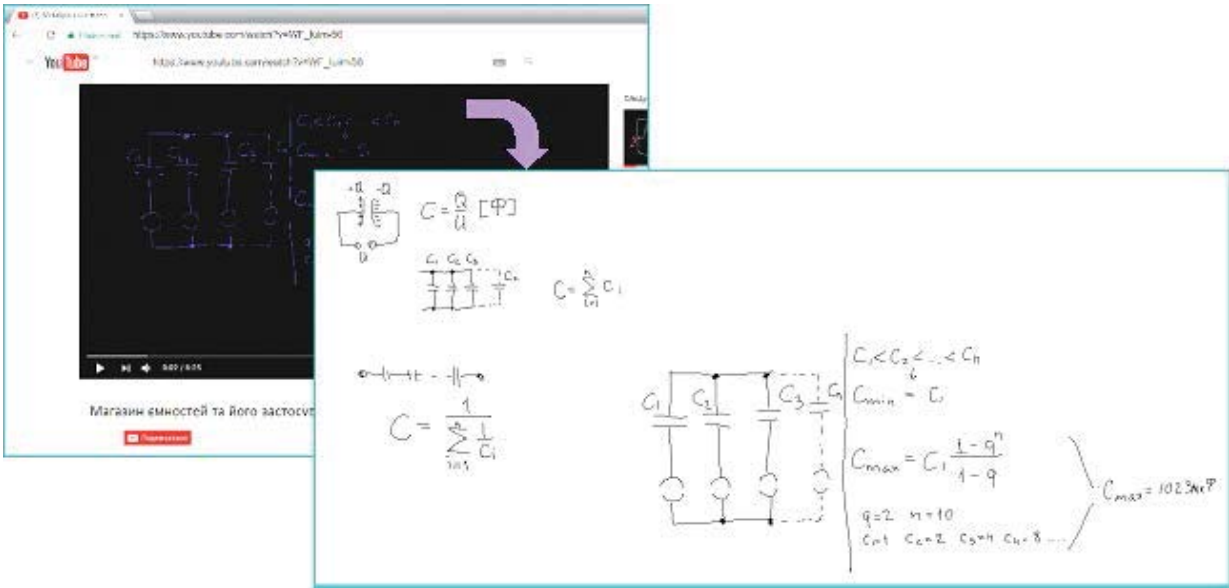


Fig. 2. A frame from a video that is dedicated to innovative product «Demo capacitor»



cal-technical and educational directions); all-Ukrainian contest of young innovators and inventors of “Nature – man – production – ecology”, which is part of the national week of “Ukraine – Europe – World”; all-Ukrainian student competition of scientific works “the way of the future”; all-Ukrainian youth competition “innovative intellect of Ukraine”; all-Ukrainian student Olympiad in physics and others. Students innovative activities also contribute to the scientific conferences of different levels. As an example we mention the reporting of scientific conference “Scientific potential of ZNU” and at the University scientific-practical conference of students, postgraduates and young scientists “Young science”, which is annually held in ZNU.

It should be noted that the current development of ICT allows you to expand the possible forms of independent work of students. Even for such organizational forms of education as a laboratory physical experiment is possible to use certain elements of distance learning. This possibility is particularly important for the organization of innovative activities of students and pupils. Indeed, the holding of a certain physical experiment (as relevant stage of the innovation activities in physics) may require a lot of time, and to provide for the use of specific hardware and software.

One of the possible options for remote conducting a physical experiment is associated with the use of programs to control a

remote computer over the Internet. Such programs, in particular, is AeroAdmin TeamViewer, Microsoft Remote Desktop. We give next the basic steps (algorithm) remote execution of the experiment that can be implemented using these programs.

1. The choice of the program to control a remote computer. Assume selected freeware AeroAdmin. The student must run this program on your own computer. It will provide remote access to a computer that is in an academic (scientific) laboratory. In addition, the student will need to own the computer ID (the physical address of its network card).

2. Connected to the lab computer. It needs to negotiate (call, send e-mail to contact in Skype, and the like) with the engineer who maintains the lab, remote execution of certain laboratory work, to find out ID computer laboratory; to conduct the procedure of connection on your computer (to fill the column “client ID/IP”, select the connection mode: “Full control”, click “Connect”); waiting for approval from the lab computer, log on his Desk.

3. Run the software for carrying out of physical experiment. Remote execution of the experiment may subject to automation. To implement the latter can, in particular, with the help of a computer program and a Soundcard Scope of hardware and software Arduino. Therefore, the student must run on the lab computer needs to perform the experiment software.

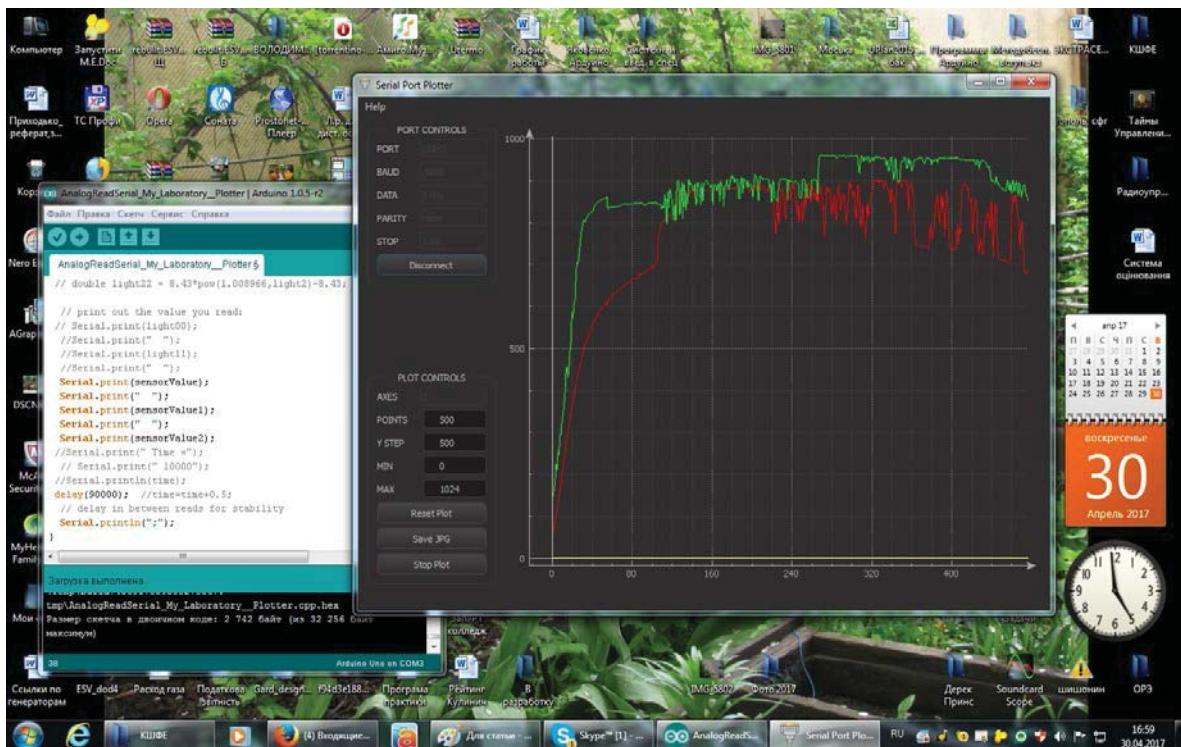


Fig. 3. Remote control of experiment by using hardware-software complex Arduino



4. The performance of the experiment. The use of such software as Soundcard Scope and the Arduino allows the student considerable control experiment (fig. 3). In particular, it allows to choose the parameters of the generator, the oscilloscope, create and configure the sketch for the Arduino hardware, choose and change the settings for graphical output of the experiment. To change the test object or move to a laboratory work (which is due to the change of equipment) the student must seek the assistance of the engineer of the laboratory.

Motivational component of self-learning activities. The effectiveness of self-activity (including one that has featured innovative) depends on the level of motivation of the students for this activity. In the absence of motives for the implementation of activities acquires a formal character, and therefore it does not play its educational value. Therefore it is necessary to provide ways to increase the motivation for independent learning activities of students. An important area is the identification of relevant requirements to objectives that are aimed at attracting students to independent innovation search. Consider the conditions, which enhance the motivation of students to independent activity.

The content of the jobs used to attract students (pupils) to independent and innovative research should take into account individual characteristics, interests and inclinations of the one who learns.

The complexity of the tasks should match the learning capabilities of the student. If the task is too easy, the student (disciple) will not feel the success of it. If the task is too difficult, the student (disciple) or not to decide or, having made several unsuccessful attempts, refuses further independent work.

It is desirable that the result obtained in the course of solving the problem, was not only educational, but also practical significance. However, we agree with the opinion of authors [5, p. 110] that it is important to guide students (students) not only on obtaining a certain result of solving the problem, but the interest in the activity. The development of cognitive motivation in the process of independent activity of students contribute to the task of representing the problem situation.

Tasks should include the ability to deploy long-term activity of students (which may also occur in the Department, scientific laboratories, and the like), followed by the presentation of the results obtained, for example, student conferences, research competitions.

As an example, consider a separate job for organization of independent educational activity of students according to the series of in-

dividual homework assignments that we offer within the discipline "the Organization of innovative activity of students in physics", under the curriculum of bachelor in Zaporizhzhya national University majoring in Secondary education (physics). The main purpose of such tasks is the simulation students the process of organization of innovative activity of students in physics and also to develop in students the author's system activities. In the structure of these tasks can be conventionally meaningful and the organizational part. A substantial part of the presented problem situation to be addressed. The organizational part is a guidance on the necessary components that need to be made in the course of solving the problem.

Tasks. «Demonstration instrument for measuring magnetic field induction». The problematic situation. The basics of physics of magnetic phenomena students are still in school. The list of standard school equipment for physics there are no devices that can visually demonstrate the process of measurement of the magnetic field. Therefore, it is important to create a device for measuring the magnetic induction at least in the simplest cases, for example, for the measurement of the magnetic field along the main axes of symmetry of the permanent magnets.

The organizational part of the job:

1. Invite the most important, in your opinion, the stages of the organization of student activities (student groups) for addressing this problem situation.

2. Describe ways to conduct a patent search aimed at studying existing devices of similar purpose.

3. Make a plan of action for the development of the design, theoretical and experimental studies of a new device.

4. Offer direction for the possible implementation of the device.

5. Invite the author's solution of a problem situation.

Note that the implementation of the above conditions that increase the motivation of students to independent learning activities were implemented in the proposed methodological approach for the development of creative tasks for laboratory work with physics that make possible the involvement of students (pupils) to independent innovative activities [6].

Conclusions. Effective implementation of the organizational-substantial component of independent work along with her traditional training and methodological support (the working program of the discipline; textbooks and manuals; guidelines and instructions for independent work of students) should include the use of virtual learning environment (implemented with the help of such open educa-



tional platforms like Moodle, Lab, CMS, Open edX Platform and others), and the use of pages (sites) of the teacher, posted directly to the Internet or social networks. The procedural component of independent work is determined by the classroom and outside the classroom forms of educational work, which play an important role in preparing students to carry out innovative activities and to acquire experience of involvement of students. A motivational component is associated with specific conditions that increase the motivation of students to carry out independent innovative research.

Further research we associate with the study of places and the methodological features of independent learning activities of students in the process of implementation of innovative activities in the educational process in physics.

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