ISSN: 2450-8160

Herald pedagogiki. Nauka i Praktyka

wydanie specjalne

Warszawa
2021

Editorial Team

(wydanie specjalne) Volume-2, № 3 May 2022

ARCHIVING

Sciendo archives the contents of this journal in ***ejournals.id*** *- digital long-term preservation service of scholarly books, journals and collections.*

PLAGIARISM POLICY

The editorial board is participating in a growing community of ***Similarity Check System's*** *users in order to ensure that the content published is original and trustworthy. Similarity Check is a medium that allows for comprehensive manuscripts screening, aimed to eliminate plagiarism and provide a high standard and quality peer-review process.*

About the Journal

Herald pedagogiki. Nauka i Praktyka (HP) publishes outstanding educational research from a wide range of conceptual, theoretical, and empirical traditions. Diverse perspectives, critiques, and theories related to pedagogy – broadly conceptualized as intentional and political teaching and learning across many spaces, disciplines, and discourses – are welcome, from authors seeking a critical, international audience for their work. All manuscripts of sufficient complexity and rigor will be given full review. In particular, HP seeks to publish scholarship that is critical of oppressive systems and the ways in which traditional and/or "commonsensical" pedagogical practices function to reproduce oppressive conditions and outcomes.Scholarship focused on macro, micro and meso level educational phenomena are welcome. JoP encourages authors to analyse and create alternative spaces within which such phenomena impact on and influence pedagogical practice in many different ways, from classrooms to forms of public pedagogy, and the myriad spaces in between. Manuscripts should be written for a broad, diverse, international audience of either researchers and/or practitioners. Accepted manuscripts will be available free to the public through HPs open-access policies, as well as we planed to index our journal in Elsevier's Scopus indexing service, ERIC, and others.

HP publishes two issues per year, including Themed Issues. To propose a Special Themed Issue, please contact the Lead Editor Dr. Gontarenko N **(info@ejournals.id)**. All submissions deemed of sufficient quality by the Executive Editors are reviewed using a double-blind peer-review process. Scholars interested in serving as reviewers are encouraged to contact the Executive Editors with a list of areas in which they are qualified to review manuscripts.

PSYCHOLOGICAL AND PEDAGOGICAL CONDITIONS FOR THE DEVELOPMENT OF CREATIVE ABILITIES IN STUDENTS OF A TECHNICAL UNIVERSITY (BY THE MATERIAL OF LABORATORY LESSONS IN PHYSICS)

Mansurova Mavjuda Yuldashevna
Candidate of Pedagogical Sciences, Associate Professor
Tashkent State Transport University, Department of Natural Sciences
mansurova19672203@gmail.com

Abstract:The article deals with the issues of using the problematic method of teaching in the classroom in the discipline "Physics" at the university for the development of creative thinking and independent search activity of students. Recommendations for the use of problem situations in various types of classes are given.

Keywords : creative thinking; creative thinking; laboratory lesson; contact phenomena; metal.

Introduction

Global changes in modern society, the complex and dynamic nature of the activities of workers in the field of transport services, the expansion of international relations pose the task of deep and lasting mastering the basics of physics for workers in the field of transport services to the population.

At the present stage of modernization of higher technical educational institutions, special attention is paid to improving the educational process, in which students are involved in active educational and cognitive activities that contribute to their personal development and self-education.

At present, technology is becoming much more complicated, vehicles are being modernized, which are mainly attached to environmentally friendly energy sources, the volume of techniques, actions and operations, the implementation of which the student must master perfectly, acting in the shortest possible time, is increasing. Creative abilities are manifested today most of all in moments of independent choice, discovery of something new, transfer of knowledge to other situations, in solving original and non-standard problematic tasks, which is especially important with an increase in the share of mental labor and creative solutions in all areas of transport activity. In this regard, the development of creative abilities among students of a technical university seems to be an important and relevant task.

An analysis of the quality of studying physics in technical universities shows that the teaching models implemented in most cases do not allow to fully reveal the creative abilities of students in the process of studying physics. This is due to the fact that the teaching methodology is focused on the development of skills in the subject area and does not take into account the possibility of developing the creative abilities of students.

In modern conditions, a creative person becomes in demand by society at all stages of its development. Changes in life that occur in a short period of time require qualities from a person that allow him to creatively approach any changes. In order to survive in constantly changing situations, in order to adequately respond to them, a person must activate his creative potential. Thus, a contradiction arises between the reproductive nature of the traditionally established system of education and the urgent need of society for a creative system of personal development.

During the reform of higher education with an increase in the share of independent learning activities of students within the framework of state educational standards, the pedagogical problem of developing creative abilities among students of a higher educational institution of a technical direction is especially acute today.

For the first time the term "creativity" appeared at the end of the 50s of the last century in Western psychology, it denoted the ability of an individual to create new concepts and form new skills.

Creativity is rather a collection of different abilities, each of which an individual can possess to a different degree. Creative abilities, according to English psychologists, are generalized intellectual abilities that can be developed through appropriate practice. This is "a combination of flexibility, originality, sensitivity to ideas that allow the thinker to break away from the usual stereotypes of thinking and use other productive ways of solving the set problems. Results that satisfy himself and possibly others" [1].

A significant contribution to the study of the creative (creative) activities of students in the 60-90s. XX century, the following researchers of the phenomenon of creativity were introduced: A.N. Voronin, T.V. Galkina, E.A. Grigorenko, V.N. Druzhinin, V.I. Zvyaginsky N.V. Kuzmina, Ya.A. Ponomarev , L.G. Khusnutdinova , A.I. Shcherbakov and others.

In psychology and pedagogy, creativity is usually considered as "creativity", the creative capabilities of a person, as some special property (stable feature) of a human individual, which determines the ability to display socially significant creative activity [7]. To separate the concepts of "creativity" and "creativity", modern researchers use two characteristics: procedural-productive (for creativity) and subjective-conditional (to designate creativity).

The development of creativity is influenced by the personal characteristics of the student , as well as emotional and motivational factors. At the same time, at present, there is no consensus in psychological and pedagogical science regarding the motivational characteristics of creativity . Some researchers believe that a creative individual is trying to realize himself in the best possible way, to match his capabilities to the maximum, to master new activities. Others believe that the motivation of students' creative abilities is based on the desire for risk, to test the limits of their capabilities.

The teacher's activity has a significant impact on the development of -students' creativity, since in the end, it is not knowledge and individual skills that provide a developing effect, but their embodiment in the development of personality abilities. Researcher E.

Torrance identifies several factors in the activities of a teacher that have a positive effect on the development of students' creative abilities. This is the recognition of the value of creative thinking, the development of students ' sensitivity to environmental stimuli , the free manipulation of objects and ideas, the ability to give constructive information about the creative process, develop constructive criticism, but not criticism, encourage self-respect, dispel fear of evaluation, etc. [3].

A creative student has intensive mental activity , and representatives of the heuristic and stimulus-productive levels of intellectual activity are characterized by extensive mental activity. A characteristic feature of each representative is his approach to the implementation of the task . Thus, a person with a stimulus-productive level increases the pace of work within the given and mechanically reproduces his activity on an expanded scale, a heurist applies more and more new ways to solve a problem, and a creative person explores the subject more and more deeply, finding theoretical explanations of the phenomenon.

To clarify the mechanism for the development of creative abilities, it should be noted that it is carried out in stages - five stages. At the first three stages, there is an acquaintance with various options (alternatives), their differentiation , enumeration (correlation) with one's own individual, psychological and professional abilities. Preference is given to motivations , inclinations, requests, personality traits, etc.

In the next two stages, the selected options are worked out and passed through students , their compliance in action is checked through the efforts of their own personality, introducing elements of novelty and originality .

It should be noted that creative abilities develop more successfully in the process of assimilating what has already been previously studied, and then changing, transforming the existing one is carried out. This is seen in students when performing problem tasks, as well as when using the project method.

Those articles _

An analysis of curricula and intrauniversity methodological developments in the discipline of physics shows that most often the teacher aims to ensure that students understand and assimilate the content of the educational material, acquire certain knowledge and learn how to apply it. Typical objectives of the lesson: the introduction and consolidation of theoretical material , the systematization of theoretical material, the preparation of reports on the topic studied. Such goal-setting does not contribute to the development of creative abilities, since many tasks are designed to develop convergent thinking. Divergent thinking, which is characterized by much greater freedom, inherent in a student with developed creative abilities, practically does not develop in such classes. And the individual has to solve problematic tasks that he encounters in real life, which, unlike educational tasks, do not have correct unambiguous solutions.

University practice shows that an important condition for the development of students' creative abilities is the creation of an atmosphere of creativity in learning, since only in this case does it become possible to manifest abilities in various types of educational activities. At the same time, it should be noted that the contribution of each individual to the common cause is important, it is necessary to encourage curiosity, develop interests, increase motivation, freedom of expression and action. This helps to reduce the level of fear to say or do something that goes beyond the limits set by the static, existing learning system. [8]

Along with the above, there are conditions that positively affect the development of students' creative abilities. These include recognizing the value of creative thinking, developing students' sensitivity to environmental stimuli, free manipulation of objects and ideas, the ability to give constructive information about the creative process, encouraging self -respect , dissipating fear of evaluation, etc.

In turn, it is necessary to highlight the conditions that impede the development of students' creative abilities in physics classes. These include: conformism, rigidity (the desire to use old knowledge), difficulty (up to complete inability) to change the planned program of activities in conditions that objectively require its reconfiguration, the desire for success at all costs, the desire to find an answer immediately , deference to authority. In such an atmosphere in the classroom, students may develop a fear of making a mistake and difficulty in overcoming these mistakes.

Much in the development of creative abilities in the classroom depends on the teacher, his personal and professional qualities, the teaching methods he chooses, and the learning materials that often have to be created by himself.

In physics classes, an important task of the teacher is the development of creative thinking, which is characterized by both reproductive (non-independent) and divergent types of thinking.

Among them, an important role is given to the creative abilities of the teacher. Only a creatively gifted mentor can educate students capable of non-standard thinking. Pedagogical activity is one of the most dynamic, every moment in the learning process is unique, unrepeatable, even if the content of learning remains unchanged. Therefore, the teacher needs the ability not only to adapt to changes, but also to actively introduce them into the creative learning process.

Consequently, there is a contradiction between the desire to consolidate effective techniques, methods, forms of education, a kind of teaching conservatism and the constant need to make changes that are required to develop students' creative abilities.

When organizing training, one can take as a basis the position of the American psychologist E.R. Torrance , that creativity can be developed and improved. In the process of specially organized training, such components as freedom, flexibility, originality, and complexity of thinking are formed. But for this it is advisable to create certain conditions conducive to the successful development of creative abilities [2].

The creative personality of a teacher can be characterized by such features as readiness for risk, independence of judgment, impulsiveness, cognitive "meticulousness", critical judgment, originality, boldness of imagination and thought, a sense of humor, a steady focus on creativity, motivational and creative activity, manifested in organic unity with a high level of creativity.

An analysis of the psychological and pedagogical literature carried out within the framework of the study shows that in the process of purposeful formation of students' creative abilities, one should rely on a system of requirements that allow creating a creative atmosphere in the educational process. This is , first of all, the search and research nature of educational activities, the encouragement of independence in solving practical problems, the widespread use of a problem-based approach to the organization of training.

Therefore, in teaching, the teacher can create problem situations , in the solution of which students activate their cognitive activity, as a result of which the creative mastery of professional knowledge, skills, abilities occurs, the development of mental, creative and cognitive abilities continues.

In technical universities, the disci pline "Physics" is given asmall number of teaching hours per year, and since students have different levels of training, it is important to pay sufficient attention to independent work so that they can eliminate gaps in knowledge. This is confirmed by the results of experimental work. So, for example, students with sufficient and high creative abilities (35.34%) easily assimilate educational material and complete tasks in an original , correct and fast way. It should be noted that the creation of a creative environment in solving problem situations and carrying out projects of varying complexity makes it possible to realize the creative abilities of students and thereby develop their creative abilities.

In the practice of studying physics at a technical university, a teacher can use various methods of organizing the educational and cognitive activities of students, which are aimed at developing their creative abilities. The level of educational knowledge, skills and habits of students in this subject, individual skills to work with information on different media are taken into account ; practical abilities and skills of students to correctly distribute the time of self-training, taking into account the value-motivational orientation and readiness of students to carry out professional activities, the teacher thereby successfully develops the creative abilities of the individual.

Thus, based on the results of the analysis of pedagogical research and experience in the learning process, we can conclude that the development of students' creative abilities in a technical university is a goal -oriented and student-oriented process of subject-subject interaction between a teacher and students, during which the teacher , using various types and forms of problematic assignments, as well as the method of projects, he achieves the achievement of their mastery of the educational material, subject to certain psychological and pedagogical conditions .

When developing a model for the development of creative abilities among students of a technical university, it is necessary to take into account the psychological and pedagogical conditions and factors of personal and professional development: increasing the prestige of a particular type of activity, increasing the social status and legal protection of the individual, developing personal and professional qualities, improving the style of activity

, the creation of individual and author's development programs (K.A. Abulkhanova-Slavskaya , V.I. Vinogradov, R.L. Kriche in- sky , E.A. Yablokov).

In turn, attention should be paid to the psychological factors that impede personal and professional development: restrictions caused by nature, "blurring", vagueness of goals and motives for achievements, negative moral and psychological climate in the team.

The disci pline "Physics" requires constant reflection, concentration of attention, and the frequent display of multimediacli ps, video cli ps leads to the scattering of students' attention and a significant decrease in their mental activity. Therefore, for laboratory and practical classes, such teaching aids as multimedia boards, projectors, etc., should be used very moderately, only for clarity of the process or phenomenon being studied.

To train technical specialists, the best way to conduct a laboratory session is to work with laboratory stands, installations and real measuring instruments. A joint discussion of the errors that arose as a result of the work, the reasons for the incorrect operation of the circuits, the lack of readings of measuring instruments and their self-correction by students accumulates the precious experience of a technical specialist, which turns out to be invaluable in the event of "abnormal" situations in professional activities. But at lectures, seminars, the use of various technical teaching aids is very useful. However, as experience shows, in lectures, the derivation of formulas and laws by the teacher on the blackboard has the greatest clarity, evidence and perceptibility of the studied material for students. Therefore, they should not be placed on presentation slides. An important aspect for improving the efficiency of the educational process when teaching the disci pline "Physics" is the constant retention of the attention of the audience. The teacher should be a subtle psychologist, catching any changes in mood, constantly monitoring the situation [11]. An experienced teacher skillfully uses various pedagogical techniques [7,5], improvising at every lesson. Despite the fact that the structure of the lesson, didactic materials, presentations are worked out in advance, the use of certain psychological and pedagogical methods and techniques [11,4,5] during the lesson is chosen by the teacher "on the go". This is due to several reasons: the level of the groups is different; the behavior of students depends, among other things, on what class the students came from (for example, after tests in physical training, after the final control in any disci pline, etc.); the time of the lesson (as you know, in the first lessons, students are more cheerful, work more actively, then fatigue gradually accumulates), etc. The most preferable, in our opinion, method of organizing alesson in the disci pline "Physics", which makes it possible to increase the effectiveness of teaching and overcome the problems described above difficulties in concentrating the attention of students, is problem-based learning [4], since it contributes to the mastery of creative activity, develops productive creative thinking, stimulates the activity and interest of students . Psychological science has established that thinking begins when a person encounters a problem, in a problem situation [4]. Therefore, the basis of learning, which ensures the creative assimilation of knowledge, is made up of problem situations, systematically and deliberately created by the teacher by posing problematic questions, tasks, tasks. A problem situation is a concept that characterizes the mental state of the interaction of an individual or group with a probabilistic subject and/or social environment. A person's assessment of the inconsistency of this environment causes the experience of intellectual difficulty, leads to the generation of cognitive motivation, mental interaction with the situation and the people included in it. As a result, the problem situation is transformed into a task or a problem [8]. The realization that previously acquired knowledge is not enough, which occurs when performing a practical or theoretical task, and the emergence of a subjective need for new knowledge generates purposeful cognitive activity. Depending on the nature of the contradiction between knowledge and ignorance, underlying the difficulty, there are types of problem situations:

1) in a known way,
2) by guesswork,
3) by logical analysis.

The problem situation gives impetus to the beginning of the thought process, and when setting and solving the problem, active mental activity takes place. The thought process from the emergence of a problem situation to the solution of a problem has several stages:

1) awareness of the problem situation (the essence of the difficulty) and the formulation of the problem;
2) finding a way to solve by guessing or making assumptions and substantiating the hypothesis;
3) proof of the hypothesis;
4) checking the correctness of the solution to the problem.

The cognitive activity of students can be considered independent only if, in a problem situation that has arisen, they independently go through all or the main stages of the thought process that require active mental search. Consider examples of the application of problem-based learning in the classroom in the disci pline "Physics". The teacher deliberately creates problem situations and organizes the search activities of students to independently formulate problems and solve them, or he himself poses problems and solves them, showing students the logic of the movement of thought in a search situation. The activity and interest of students in this case can be caused by elements of novelty and the emotionality of the presentation of the material by the teacher. When creating a problem situation, one must remember that the task must be feasible for students. It should make them think about the problem, task, draw analogies with the processes and phenomena already studied, recall the material they have studied. In a practical lesson, a problem can be made to choose a model that describes a phenomenon or process to solve the problem. When analyzing the conditions, students must determine what simplifications can be made, what effects on the physical system under consideration can be neglected (for example, neglect the influence of external bodies, consider system objects as material points, etc.), and which, on the contrary, must be taken into account. The result should be a reasonable choice of a model to which the previously studied or studied physical law is applicable.

This is the basic scheme of organizing the process of productive, creative assimilation of new knowledge and a new mode of action. The activity of thinking and the interest of students arise in a problem situation even if the teacher poses and solves the problem. But the highest level of activity of students is achieved when they themselves formulate the problem, put forward assumptions, substantiate the hypothesis, prove it and check the correctness of the solution.

The problematic situation created in laboratory classes in physics can be considered using the example of performing laboratory work on the topic "Calibration of a thermocouple ", since knowledge of the physical properties of metals is of great importance for a specialist graduating from a technical university.

To do this, first, students perform laboratory work according to aspecial descri ption offered to them for preparation for the next lesson, for this they carefully study the descri ption of the work, purpose, instruments and accessories, and must also master the order of doing the work.

Lab #12

Thermocouple graduation _

Instruments and accessories : thermocouple, constantan-copper, galvanometer with a sensitivity of 10 $^{-6}$ A / div, two vessels with water, two thermometers.

Brief theory and description of the installation

Electrons, having kinetic energy and freely moving to the crystal lattice of the metal, can escape from the metal to a distance of the order of atomic dimensions and be drawn back. As a result, a double electric layer is formed over the entire surface of the piece of metal (see Fig. 1). This double layer plays the role of a kind of capacitor, the field of which prevents new electrons from escaping. Let the potential difference on the plates of this capacitor φ . The work required to pull out a stationary electron (without kinetic energy) from a metal is equal to $e\varphi$. Consequently, by this value the potential energy of an electron that left the metal will exceed its potential energy inside the metal (see Fig. 1).

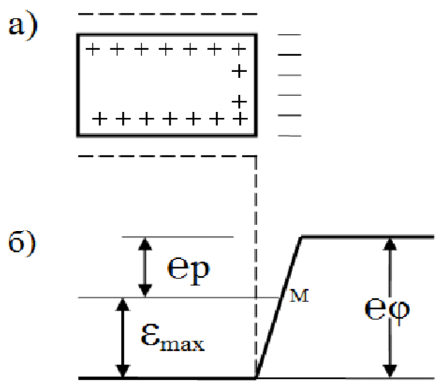

Рис. 12.1 а, б

There are no fixed electrons in a metal, and all electrons have one or another kinetic energy.

Let's denote by the highest kinetic energy of an electron in a metal and plot this value on the graph (Fig. 1 b.). Then, for the exit of an electron with such a kinetic energy, work must be done

$$A = e\varphi - \varepsilon_{,max} \qquad (12.\ 1)$$

Where A - the minimum work required to pull an electron out of a metal is called work function of the electron. Value A less than $e\varphi$, because the fastest electrons, due to their kinetic energy, can partially enter the double layer, and in order to leave the metal, only a part of the total potential difference, equal to ρ (Fig. 12.1b) from the point to the outer layer, must be overcome. The value of ρ is determined from the relation :

$A = e\rho$ or $\rho = \frac{A}{e}$ (12. 2)

and is called the contact potential of this material. Before their contact, the potential in the air between the metals will be the same.

When part of the electrons from the first metal passes into the second (because $e\rho_1 = e\rho_2$) , the metal - 1 will be positively charged, and the metal - 2, having acquired these electrons, will be negatively charged. The additional potential difference resulting from the contact is denoted by ρ_{12}, it's clear that:

$e\rho_1 + e\rho_{12} = e\rho_2$ or $\rho_{12} = e\rho_2 - e\rho_1$ (12. 3)

The potential difference that has arisen when two pieces of metal come into contact ρ_{12} is called the contact potential difference and will be equal to the contact potential difference of the contacting metals.

$\rho_{13} = \rho_{12} + \rho_{23} = \rho_2 - \rho_1 + \rho_3 - \rho_2 = \rho_3 - \rho_1$ (Fig. 12. 2), i.e. is equal to the difference in the contact potentials of the extreme metals and does not depend on the nature of the middle ones. This rule is called Volt's law .

A consequence of Volta's law: if you make up a closed circuit from several metals, all the contacts of which are at the same temperature, then the contact potential difference in such a

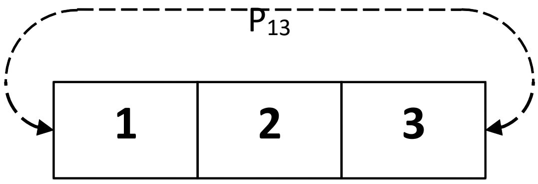

Рис. 2

circuit is zero (Fig. 12. 3), i.e. EMF does not arise and there is no current in the circuit . When considering the contact potential difference, one should also take into account the dissimilarity of the electron concentrations in the contacting metals.

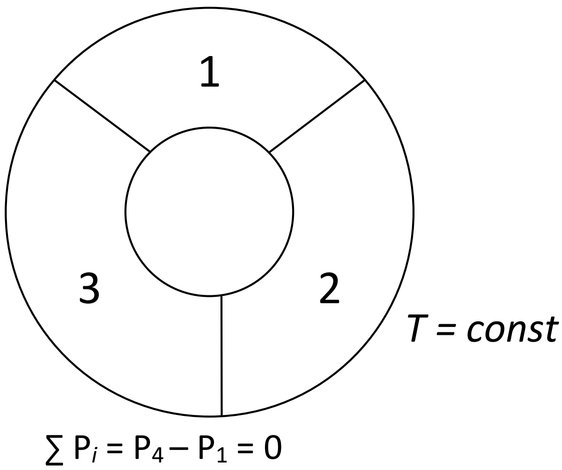

Рис. 3

Theoretical calculations give that :

$$p_{12} = \frac{kT}{e} ln \frac{n_{01}}{n_{02}}$$

where k - Boltzmann's constant: $K = 1{,}33{*}10^{-23}\ J / deg$. , e - electron charge, $e = 1{,}6{*}10^{-19}$ Coulon, n_{01} , n_{02} are the electron concentrations in metals 1 and 2.

Let us compose a closed circuit of two conductors of the first kind, and we will maintain contacts 1 and 2 at temperatures T_1 and T_2 , respectively. Now the contact potential difference at the junctions of the conductors will not be the same and will be determined by the equalities :

$$p_{12} = p_1 - p_2 + \frac{kT_1}{e} ln \frac{n_{01}}{n_{02}} \quad \text{and} \quad p_{12} = p_1 - p_2 + \frac{kT_2}{e} ln \frac{n_{01}}{n_{02}}$$

for the first and second contacts, respectively. In the presence of proportionality between the deviation of the galvanometer and the temperature difference, we have the experimental formula:

$$a_n = \gamma\ (t_n - t_0)$$

where γ - are determined from calibration data, α_n - galvanometer readings, t_n - thermometer readings.

The constancy of this value, which characterizes the slope of the graph curve for different α_n and t_n , is a criterion for the applicability of the formula

$$\varepsilon = C\ (T_1 - T_2)$$

Work order

1) Vessels *A* and *B* are filled with water. Thermocouple junctions are immersed in water. Thermometers are placed in the vessels to measure the water temperature (thermocouple junctions). With complete equality of temperatures, the galvanometer should not give any deviation. The water temperature then gives the value of the cold junction temperature t_0. Heat the water in vessel B with an electric coil until the galvanometer needle deviates by one division. Make a reading of the temperature of the hot junction t_n and note the readings of the galvanometer. Continue heating. After one division of the galvanometer, the temperature is again noted, etc. The water in the vessel must be stirred .

2) The results are shown on a graph, plotting the value along the abscissa and along the ordinate. If the obtained dependence turns out to be linear, then the coefficient of the experimental formula γ is determined by formula (4) .

Since the thermometer has inertia, in order to determine the true temperature of the junction, it is necessary to remove the dependence of the galvanometer readings on temperature during heating and cooling. If we assume that the rates of heating and cooling are the same, and the readings of the thermometer in the first case are lower, and in the second - higher than the true temperature, then we will obtain the true calibration dependence of the thermocouple by drawing a curve between the points obtained during cooling and during heating.

Test questions

1. What is called contact potential?
2. What is a contact potential difference?
3. Formulate the laws of Volta.
4. How does thermo -EMF arise?
5. What is a thermocouple constant?
6. Seebeck phenomenon ?

After completing laboratory work under the guidance of a teacher, students should consolidate their knowledge, that is, they should understand the physical nature of the metals used for measuring purposes, their "positive" and "negative" sides as an integral part of a thermocouple. For this purpose, they are invited to prepare, for example, a presentation on the topic “Contact Phenomena”, since due to the limited time in the lecture session, very little time is allocated to this topic.

For this, students can be divided into 3 groups, since there are three main points in this topic:

1. contact phenomena
2. Seebeck effect - the occurrence of thermo EMF
3. Peltier effect .

Next, the teacher gives a task to each group (optional, that is, each group chooses one of the subtopics).

Students of the first group must explain the experimental formula

$$\alpha_n = \gamma(t_n - t_0)$$

using the law of series contacts of Volta, using the example of a connection of various metals, moreover, they must be explained from a theoretical point of view.

Students of the second group must explain the experimental formula

$$\alpha_n = \gamma(t_n - t_0)$$

using the occurrence of thermoEMF from a theoretical point of view.

Students of the third group must explain the experimental formula

$$\alpha_n = \gamma(t_n - t_0)$$

Peltier effect from a theoretical point of view.

To do this, all students are offered a source of information, that is, a list of literature, which provides a detailed description of these topics. For this purpose, you can provide books in class or electronic sources, since nowadays almost all students have practical access to the Internet on mobile phones.

The students then work as follows:

1. Students analyze the available sources of information, compare them with their knowledge of contact phenomena.
2. Determine how to solve the problem.
3. Determine the degree of risk.
4. They draw up a plan for the implementation of the project, plan their work step by step.
5. Prepare a presentation of their work.

Since students on these topics should have had some fundamental body of knowledge on which they could rely, the working time of the classroom lesson within 30 minutes can be allotted for the implementation of this project.

At the end of the separated time, students in front of the whole group and the teacher show a presentation of the solution to the problem.

Evaluation of work can be organized in various forms, if such work is carried out for the first time, then the teacher can put the assessment himself, and at repeated similar classes, you can make up a group of experts from among students or assistants of the department.

The proof of the working formula can also be organized by solving problems on this topic. The selection of the task can also vary depending on the preparation of students.

Example 1. Determine the strength of the electric field that occurs in the gap between the plates of a flat capacitor, one of which is made of aluminum and the other is made of platinum. The plates are interconnected by a copper wire, the gap width is d = 5 mm. The work function of electrons from aluminum, copper and platinum is 4.25, respectively; 4.4 and 5.32 eV. How will the field strength change if aluminum and copper plates are connected by a platinum wire?

Example 2. Specific thermoelectric power of the contact of two conductors α= 10 μV/K. A current of force I = 1 A is passed through the contact. What should be the resistance R of the contact so that, as a result of the Peltier effect , cooling of the contact at room temperature T can be observed?

Example 3. In a germanium pn junction, the specific conductivity of the p-region γis p = 104 S/m, and the specific conductivity of the n-region γis n = 100 S/m. The mobility of electrons μn and holes μp in germanium is 0.39 and 0.19 m 2 /(V ·s), respectively. Obtain an expression relating the contact potential difference with the ratio of the concentrations of major and minor charge carriers in a semiconductor and find from it the contact potential difference in the junction at a temperature of T = 300 K. The intrinsic concentration of charge carriers at this temperature in germanium ni = 2.5 ·1019 m - 3.

Such tasks help to consolidate students' knowledge on the topic under study.

Conclusion

But it should be remembered that these measures will bring success if they are systematic and purposeful, and the purpose and objectives of the work must be clearly understood by all students and accepted by them unconditionally.

In this case, we suggest doing the following. First: we encourage students to actively use their own computer equipment during practical classes. Since not everyone has one, and the material possibilities of students are different, we suggest that they voluntarily make a choice - to work individually, in pairs or in a group, so that in the future there will be no misunderstandings, quarrels or insults. The student can also refuse this way of completing the task, this is his right, there is no need to create a problem here, let the student complete his individual task. The teacher, for his part, develops a system of such special tasks, taking into account the individual characteristics, interests and capabilities of students. The more interesting and useful the task, the more sources the student studies and analyzes during its execution, the higher the quality of physical education as a whole will be. The second way to solve the problem of unsatisfactory material and technical equi pment of the classroom in a practical lesson is a more active, original use of traditional teaching aids. The teacher should remember that traditional teaching aids - posters, books, tables, reference books, didactic handouts - have not been used in vain for many years in the educational process, and will be used for more than one decade, since they themselves are sources of creative ideas. And if you develop posters, supporting notes, cards, didactic material yourself, and at the same time apply modern technologies and innovative approaches, then such teaching aids will certainly increase the efficiency of assimilation and application of new knowledge.

Used literature.

1.Guilford J.P., Hoepfner R. The analysis of intelligence. N.Y., 1971.-228 p.

2.Torrance E.P. Scientific views of creativity and factors affecting its growth. Daedalus: Creativity and Learning. 1965. 663-679 p.

3.Torrance E. P. Teaching creative and gifted learners // Handbook of research on teaching // Wittrock M.C. (ed). N.Y., 1986. 124 p.

4.Брушлинский А.В. Психология мышления и проблемное обучение. - М.: Знание, 1983 - 98 с.

5.Вербицкий А.А. Активное обучение в высшей школе: комплексный подход: Методическое пособие. - М.: Высшая школа., 1991. - 207 с.

6.Вербицкий А.А., Ильязова М.Д. Инвариенты профессионализма: проблемы формирования: монография./ А.А.Вербицкий, М.Д.Ильязова. - М.: Логос, 2011, - 288с.

7.Гнатко Н.М. Проблема креативности и явление подражания. М.: ИП РАН, 1994, С.10-11.

8.Долматов А.В. Основы развивающего образования: теория, методы, технологии креативной педагогики. - СПб.: ВУС, 1998. - 198 с.

9.Железный С.В. Использование проблемного обучения на занятиях физики в вузе / С.В.Железный, Е.А.Москалева, И.В.Сычев. - Текст.: непосредственный / / Молодой ученый. - 2015. - № 22(102) - с.780-784.

10.Лернер И.Я. Дидактические основы методов обучения / И.Я.Лернер. - М.: Педагогика, 1981. - 186 с.

11.Самыгин С.И. Психология и педагогика: Учебное пособие / С.И.Самыгин, Л.Д.Столяренко. - М.: КноРус. 2012. - 480 с