

PEDAGOGY

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PREREQUISITES SUCCESSFUL PARTICIPATION OF STUDENTS IN INTERNATIONAL CONTESTS OF PHYSICS AND TECHNICAL CREATIVITY

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Abstract

In the article the problem of preparation of students to participate in international level competitions physico-technical direction. International contests of physics and technical direction is an important form of organization of cognitive activity of students in the field of energy saving in the system of extracurricular work in physics. The spectrum of such international events, in which can take part pupils of General education educational institutions is increasing. Active and successful performance teams in international stages physical-technical competitions is one of the criteria of the quality of education in the country. Abstract. In the article the problem of preparation of students to participate in international level competitions physico-technical direction. International contests of physics and technical direction is an important form of organization of cognitive activity of students in the field of energy saving in the system of extracurricular work in physics. The spectrum of such international events, in which can take part pupils of General education educational institutions is increasing. Active and successful performance teams in international stages physical-technical competitions is one of the criteria of the quality of education in the country. From my own experience of preparing

students for participation in these contests, the following components of successful performance of participants: the work must be brought to a beautiful and simple idea; work should represent a step in addressing the pressing problems of the world level; the results should be a significant personal contribution of the student; personal qualities of students, including presentation and communication skills, logical thinking, proficiency in English. The experience of the authors suggests that the preparation and participation of students in these contests is very motivational and training effect, which positively affects the study of physics as a whole. All this points to the need to promote the considered competitions and the creation of conditions for active participation of young people in them. Further research we associate with the study of the peculiarities of remote management of scientific-research activity of students in extracurricular work in physics.

Keywords: international student physics and technology competitions, components of successful performance in competitions, the natural counterparts of the devices, the project book.

Statement of the problem. International contests of physics and technical direction is an important form of organization of cognitive activity of students in the field of energy saving in the system of extracurricular work in physics. The spectrum of such international events, in which can take part pupils of General educational institutions of Ukraine is growing.

Active and successful performance of Ukrainian teams in international stages physical-technical competitions is one of the criteria of the quality of education in Ukraine. Consequently, an important problem is development of methodical recommendations on the preparation of students research works (projects) and their subsequent submission to the international stages of the competitions.

Analysis of recent research. Today there is a well-established system of training international students only in the stages of subject Olympiads. Thus, in analyzing the world experience of preparing students for participation in national and international intellectual competitions. G. Kramnick concluded [1] that the key to good results (first of all, we are talking about the international Olympiad) is to fulfill the four required conditions of preparation:

1) careful selection of gifted students, can be integrated: according to the results of participation in various intellectual competitions of a certain profile, or target, psychological testing, etc.;

2) a purposeful development of creative abilities of students, which is carried out on a scientific basis, not limited to specific academic subjects, learning profile or a separate branch of knowledge;

3) long-term (within two to three years) group of particular scientific system to prepare students for a particular subject (which is based on the cooperation of scientists, specialists in individual science and methodologists, teachers, owning methods of training);

4) psychological preparation of pupils for competitions.

Although these conditions were selected, primarily, in the aspect of training students in international Olympiads, it is impossible not to take into account in the preparation and in other international competitions, adding to the conditions, taking into account the specifics of conduct and specific objectives of the contest.

The purpose of the article. In this article, we aim, through our own experience of preparing students for participation in international physical-technical competitions, to highlight essential components of successful performances in these contests.

The main material of the article. Repeated and also quite productive participation of students in the experimental group phases in international competitions allows us to conclude that the necessary prerequisites to successful performance in them. To this end, we have analyzed some of the student projects in different years took part in international level competitions Intel ISEF, I – SWEEEP, “Energy and environment”, SJWP, etc. Revealed that special attention when evaluating student projects, the jury of these competitions pay on the following aspects:

– How creative the party came to solving problems? (It was found an original technical solution? Was carried out or created a new experiment? the like);

Available in scientific research methods? (Clearly defined the problem? Or used in scientific literature during the study? Or described the methodology of the experiment? Can we consider the results reasonable? Was determined sources of bias and whether they were appreciated at work? Defined the future direction of this project?);

– How diligent and detail the participant was doing his project? (Or have completed all the stages of the experiment? Or a design book and its accurate and detailed records?);

– How developed are the participant's research skills? (Where and how was the experiment? By using what equipment? Worked as a member in a specialized laboratory? Was the project done on your own? If the aid was, what was the personal contribution of the student?);

– How clear and understandable was presented with the draft?

– What is the public benefit of the implementation of the project results?

During the analysis we found was the relatively high rating received in the first place, those works which had the following characteristics.

In the study is based on a beautiful and simple idea. Quite often ideas developed by students device was taken from nature. Thus, in Fig. 1 shows a photo of three devices (current models) that were developed by our students. These models in different years were presented at the international competition Intel ISEF. Each of these devices has its natural analogue.

Thus, the analogue of a wind turbine blade (Fig. 1, a) is the wing of a bird. Plate the blades of the proposed wind turbine will work the same as the wing feathers: when moving up the wing its aerodynamic drag is less (as in this case, the air flows between the feathers) than during downward motion (when the feathers there are no gaps). Analogue speed sensor and wind direction of the anemometer (Fig. 1, b) is a plant that has the ability to deviate from the equilibrium position under the action of wind. Natural analogue screw energy Converter wave power plant (Fig. 1) is a fish tail or fin.

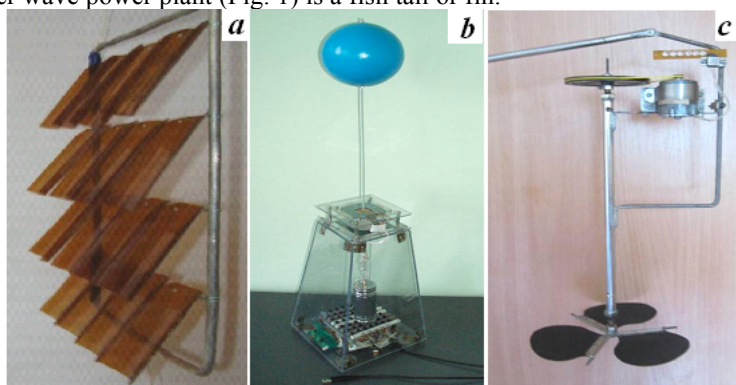


Fig. 1 – The device has substantial natural alternatives: a) the blade of a wind turbine; b) a speed sensor and wind direction of the anemometer; c) screw energy Converter wave power plant.

Work represents a step in addressing the pressing problems of the world level. Such problems include the problem of energy saving, environmental problem, problem of water quality. As an example, give some of those student works that were presented to our students on the international stages of the considered competitions:

1. “The wave power plant with helical energy Converter” (Intel ISEF).
2. “Device for measuring the speed and direction of the wind” (Intel ISEF).

3. Heat engine with external supply of heat to a water-jet vessels” (I – SWEEEP).

4. “The wave power plant to supply lighting navigation devices” (SJWP).

Experience shows that the choice of the topic of the future of the project and formulation of its task is quite a challenge, even for experienced teachers (more on this methodological issue was discussed in our article [2]). One method of solving this problem began, the organizers of the competition Intel-Techno Ukraine (national stage of the contest Intel ISEF). Its essence consists in the following [3].

Potential participants in advance to suggest topics of research projects with the formulation of the problem and a list of recommended literature (for a more detailed examination of the problem). The authors of these subjects are the teachers from the Institute of physics and technology, NTUU “KPI”, and also the staff of the Institutes of the National Academy of Sciences of Ukraine. In addition, they provide an opportunity for teachers of secondary schools and their students work together to implement these projects. Prepared work students can present not only at the competition Intel-Techno Ukraine and other Ukrainian and international competitions.

For example, consider a few such tasks that have been proposed for implementation of projects under the sections “Physics and astronomy” and “Energy” [3]. In their development of the direct participation of academician of NAS of Ukraine A. A. Khalatov and coordinator of the competition Intel-Techno Ukraine M. A. Dmitrenko (a former student of the author of the thesis).

Section “Physics and astronomy”.

1. Solar engine. Today there are a large number of devices using energy from the Sun. Thus, the use of solar energy is one of the priorities in the engineering industry (in particular, the creation of engines and propellers of motor vehicles). However, the main drawback of the existing devices, typically, there is a need for preliminary conversion of solar energy into electrical energy using photovoltaic converters. The application of these converters leads to a significant loss of energy. There are also devices for the direct conversion of solar energy, however they are ineffective.

Tasks. Provide a method or device – the engine or the propeller, which is powered by solar energy without using photovoltaic converters based on memory materials forms (alloys, polymers), which would be devoid of these shortcomings.

The Energy”.

2. The energy in the wind. The development of the automotive industry over the past 30 years and distribution of vehicles among the population is quite

significant. Only in Kiev there are about 1 million units. The vast majority of cars equipped with internal combustion engines, the efficiency of which is 20 – 30%. This means that 70 – 80% of the energy obtained from fuel combustion, emitted into the environment in the form of heat.

Tasks. Suggest possible methods of economic utilization of this heat (e.g. for air conditioning of the car).

3. Hydrogen energy. Water is an almost inexhaustible source of hydrogen and oxygen, which will play an important role in the energy mix of the future. Today, there are many ways of production of hydrogen from water. A common method is the electrolysis of water or its vapor. However, it is ineffective and needs significant improvement.

Tasks. To offer a more economical method of extraction of hydrogen from water.

4. Electricity from space. Among the many types of environmentally friendly renewable sources of energy traditionally isolated energy from the Sun. It is known that solar energy surface is dispersed, and its density does not exceed on the surface of the Earth 1 kW/m². Absorption and conversion of solar energy on the Earth's surface is not the most effective method.

The idea of accumulation and transmission of energy from space is not new, but it is only recently that mankind has developed the technology required for implementation of this approach on the basis of a number of satellites.

Tasks. To provide a method of accumulating and transferring solar energy to Earth from space.

The progress made in the work the results are pretty significant personal contribution of the student. In this work, which is part of the diploma and dissertation works of others are generally not allowed to participate in the international stage competitions. About the degree of autonomy of project implementation can testify, in particular, such materials are [4, p. 19, 33] (their students can use in communicating with the jury):

design book – a work book containing personal student notes, graphics, diagrams, sketches, rough designs, etc.;

– description of the study – the document stating the problem and objectives of research, research methods, obtained results and their analysis, conclusions, practical applications of research results, etc.).

The personal qualities of the participant. Important qualities that increase the chances of successful performance in the international finals is, first and foremost, a good enough command of the English language and the ability to clearly convey to the jury the essence of the project (presentation and communication skills, logical thinking, etc.).

It is clear that not all students can achieve high success in the international competitions. This may be due to different causes: a low level of educational achievements in physics, due to insufficient English proficiency, insufficient communication skills and the like. However, as our experience testifies, even the preparation for and participation in these contests is very motivational and training effect, which positively affects the study of physics as a whole. All this points to the need to promote the considered competitions and the creation of conditions for active participation of young people in them.

Conclusions. Important components of successful performance of students in international contests of physics and technical creativity are:

- the work must be brought to a beautiful and simple idea;
- the work must represent a step in addressing the pressing problems of the world level;
- the results should be a significant personal contribution of the student;
- personal qualities of students, including presentation and communication skills, logical thinking, proficiency in English.

Further research we associate with the study of the peculiarities of remote management of scientific-research activity of students in extracurricular work in physics.

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