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## GENERAL PRINCIPLES OF TRAINING PHYSICS OLYMPIC STUDENTS

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The article aims at the review of main principles of work with gifted students, particularly with students who are trained to participate in subject Olympiads. Subject Olympiads nowadays are given less importance than it was before. However, they play a great role in the achieving the state long and short-term goals for education and development of human capital, as they help develop students' system of values, 21<sup>st</sup> century skills and represent Kazakhstan at the world education arena. So, Olympic movement should be developed on the basis of research evidence, which will show the best ways of work with Olympic students. The authors consider the main factors leading to successful training and the main skills the students need to develop to have high achievements in the Olympiads on physics. Having considered the recommendations of local and foreign scholars on training Olympic students and analyzed more than 20-year experience of training students for different types of physics Olympiads at "Bilim-innovation" schools the authors suggest a methodology of training physics Olympic students, which proved to be effective for the educational environment they work in.

**Key words:** *physics subject Olympiads, teaching gifted students, training Olympic students, methods of work with gifted students, principles of Olympians training*

State Program of Education and Science Development for 2016 – 2019 points out that it is necessary to develop inclusive education, diverse programs for complementary courses and vocational training at the level of secondary education [1] as it is "important to reveal students abilities and orient them into professions which are of high demand at the job market" [2]. It is obvious that subject Olympiads is one of the tools that can help in achieving the aims of the Program and the aims stated by the President Nazarbayev in his last address to the citizens of Kazakhstan.

Inclusiveness as a new trend in education suggests work not only with those students who have special educational needs due to some physical or psychological problems, but also work with gifted students. Thus, subject Olympiads is an effective way of revealing gifted students and, at the same time, their interests and abilities, development of which will lead to their becoming highly professional specialists.

Subject Olympiads have been conducted in the republic of Kazakhstan since it gained independence, but tradition takes its roots in earlier years of the Soviet Union. For many years participation in subject Olympiads was prestigious as the winners at the republic level could enrol to universities without entrance exams and were allowed not to sit the National test. However, nowadays subject Olympiads are losing their prestige, as mostly only those students who win at international competitions are given scholarships by universities. As subject Olympiads develop a range of personal qualities and skills, such as leadership, creativity and collaboration, considered to be important in 21<sup>st</sup> century and therefore, enhance the development of human capital, the authors strongly believe that approaches to subject Olympiads should be reconsidered and more importance should be attached to the Olympiads. In the given article the authors aim at suggesting their own methodology of physics Olympic students' training.

Subject Olympiads or "Olympic movement"[3] are considered to be both a form of assessment of students' skills and abilities and a tool for developing creativity of students in the process of education

[4], [5]. According to the information on egov.kz site subject Olympiads held at the republic level in Kazakhstan have the following objectives:

- 1) developing students' creativity;
- 2) enhancing theoretical knowledge and developing practical problem-solving skills;
- 3) promoting personal development;
- 4) creating "conditions for identification of gifted students";
- 5) selecting and training gifted students for participation in international subject Olympiads;
- 6) increasing "the prestige of education in the Republic of Kazakhstan" [6].

However, the abovementioned list misses some other important objectives such as developing leadership skills and active citizenship position through teaching students to combine personal objectives with the objectives of their community (Olympiad team, school, district), leading to patriotism – the personal characteristics importance of which is stressed by the President N. Nazarbayev [2]. Furthermore, subject Olympiads help students choose their profession consciously in accordance with their interests and abilities.

It is important to notice that subject Olympiads are not only about students, but also about the teachers who work with gifted students and train them for the Olympiads. First of all the teachers should be enthusiastic and empathetic as they have the role of a tutor and supporter. The teachers should also follow updates in their subject and methods of its teaching and continuously develop professionally to be the model for their students. A teacher working with Olympic students should also know requirements and the system of Olympiads' organization at different levels and have a great number of Olympic questions and books in order to be able to facilitate different students' needs. If the teacher who works with Olympic students spends his / her personal time with them and supports students' autonomy by encouraging them to take responsibility for their learning and developing their higher order thinking skills, the students will do their best to meet the teacher's expectations.

As training students for participation in subject Olympiads is a multifaceted process involving students and their parents, teachers and community, it is obvious that the process should be organized in accordance with a logically developed effective framework. For this, main stakeholders and their roles in training successful physics Olympic students should be defined in the first place. Then, it is useful to work out the algorithm of selecting students and working with them taking into account development of a set of personal characteristics and skills, especially soft, an Olympic student should have. As it was mentioned above selection of relevant high quality materials also plays a great role in Olympic students training.

Considering the factors and stakeholders influencing students' choice to undertake subject Olympiad training it can be said that student's family has the most influence as parents want their children to effectively use their free time for personal development and have some achievements during school years, because they will help get a place at better universities and later get a better job or position as well as become the pride for the family. So, the family should be ready to support the student by sacrificing time and money and working together with the teachers and school. However, family is supposed not to put pressure on the student to succeed at any cost. Parents should also give the right to choose a particular subject to the student in accordance with his / her preferences and abilities and try not to make the student choose the subject they think is prestigious or more beneficial than others. For this reason parents should closely collaborate with homeroom and subject teachers. We can say that motivation from the family and student's interest are the first steps in the process of Olympiad students' training, which only partially depend on school and subject teacher who may influence students' desire to study the subject.

The next step for the school and subject teachers is to choose the students who will be able to represent the school at subject Olympiads. In this regard A. Veremeenko states that teachers may spot the students through observing them [7; 90]. However, at this stage we suggest that students should be given logic tests because "Bilim-innovation" schools, for instance, start training Olympic students as soon as they come to the school, that is in their year seven at school and at that moment students may not have all the subjects of the Olympic movement in their curriculum. Before tests assessing the students' logic they

are given a questionnaire where they rank the subjects they would like to study in order to participate in the Olympiad. After testing the students, the subject teachers and the school management discuss the results of logic tests and allocate the students according to their preferences to the subject teachers who would train the students for subject Olympiads. For physics Olympic students special attention is paid to the students' knowledge of English and Russian due to the fact that most Olympic problems books and materials are in these two languages. The students' behaviour is of high importance as well because talented but not disciplined students will disturb others in the team and not achieve much themselves.

The third step is to introduce the students to their Olympic team. Due to the fact that being a part of a team is a "basic human motivation" [8; 1], it is very important to build a team of Olympic students of different ages, in which the students will support each other and older ones will help the new team members with studies and be a role model for them showing the main principles and skills necessary to acquire the desirable results. Although the students who decided to participate in subject Olympiads already know some of the benefits they can bring, stories about real experience and personal achievements told by the older students motivate new Olympiad students even more as they see the real aims to be reached. Asking the older students to teach the younger ones will result in revising the topics by the former and gaining confidence by the later due to the feeling that the objectives set by the teacher are achievable. Furthermore, it will help to reduce the time the teacher spends on explaining the material. Role of the teacher in this process is not only to set the rules for collaboration, but also to organize teambuilding activities such as picnics, barbecues and football matches.

After being introduced to the team the students start their Olympic training. As the systematic studies [7] are one of the most important factors in training a successful Olympic student, one of the main duties of the teacher at this stage is to introduce students to an action plan and schedule the time for studies. The students are supposed to have extra Olympiad study hours every day six days a week, at least two hours after classes and four hours on Saturday. Due to the fact that in our settings the training of Olympic students starts when students are in their seventh year at school, students will not know any physics topics. Thus, the students start with the overview of all the main areas in physics, including mechanics, electricity, thermodynamics and optics. Usually the teacher does the overview himself / herself. After that students start studying mechanics in detail as it is one of the basic topics in physics and most Olympic problems are from this field of physics. Together with physics topics the students also start studying mathematics topics such as different types of equations, trigonometry, integers, derivatives, logarithms and vectors, necessary for solving physics problems. The teacher sets the goals the students have to achieve each week, month, term, for example study particular topic in mechanics and solve 15-20 problems on this topic in a week. The teacher as well as more experienced fellow students, the members of Olympic team, assist the 'newcomer' students in their studies and answer questions when necessary. In this regard, principles of flipped classroom, in our opinion, are the most suitable for training Olympic students as they take their own time to read and understand the theory, and discuss only particular aspects or problems they are not sure about with the teacher. At the further stages a guest lecturer or trainer might be invited to help the students with their studies. Usually the students study topics in the following order: mechanics, heat, electricity, geometric optics, electromagnetism, wave optics, nuclear physics, quantum physics in accordance with the tasks suggested at the different levels of republican Olympiads. It is necessary to agree with A. Popov and N. Puchkov who state that the Olympic problems suggested to students should be of two types:

1) Problems that require deep knowledge of the subject and ability to use the knowledge in non-standard situations to find the best solution. This type of problems should have different levels of difficulty – from moderate difficulty, when students need to use the knowledge of only one area in physics to high level of difficulty when students use knowledge of different areas in physics. The tasks of this type develop students' higher order thinking skills, like analysis and synthesis. The Russian journal "Kvant" suggests lots of physics problems of high-level difficulty requiring critical and creative thinking, thus developing students' ability to use heuristic methods of problem solving.

2) Problems requiring investigation of the processes in non-standard situations [3; 70-71]. In our context such kind of problems are usually experiments done with the use of laboratory equipment and

ordinary subjects such as eraser, play dough, ruler. Such kinds of tasks develop students' creativity and some of the students even try to invent gadgets or machines using the knowledge they acquired for solving engineering problems.

Analysis of previous Olympiad tasks is an effective way to understand the requirements, type of tasks and methods of Olympic problems' solution. That is why it is quite important to have collections of Olympic problems suggested at different levels (regional, republic, international and other countries' Olympiads, like federal level in Russia) and of different years. Solving of previous Olympic problems will help students get the feeling of achievement and, as a result, gain confidence, which is very important for keeping students motivated and managing stress in the course of different competitions.

Besides developing students' skills in solving Olympic problems it is important to pay attention to developing students' soft skills such as stress and time management, learner autonomy and critical thinking.

At the training and contest stages support from the teachers and school management is of high importance as it will foster the students' motivation to train for the Olympiad and achieve higher results due to the feeling that the student has to meet not only expectations of his / her family, physics teacher and team members, but the whole school.

As subject Olympiads are single events held only at particular time of the year, and students participating in physics Olympiad at the regional level should be in their ninth year at school, it is essential to keep students' interest in the Olympiad through the first two years when they officially can not participate in republic physics Olympiad. For this reason the teacher organizes small-scale contests among students in the Olympic team, the school organizes a mini Olympiad each term in collaboration with other schools of the same status (for example, for gifted students) and by the end of the year according to the results of the term Olympiads the best students from the schools for gifted students are invited for a republic contest. Along with the Olympiads at the level of aforementioned schools, students are invited to take part in Olympic students' camps, where they can meet their peers from different parts of Kazakhstan, share their ideas and experiences and study with different trainers.

So, to sum up the main stages and principles of work with Olympic students, comprising the methodology we suggest, we should say that there are three main stages:

- 1) Selecting the students to participate in the Physics Olympiad, which includes two main principles: selecting students with good logic and at least pre-intermediate knowledge of English and Russian;
- 2) Motivating the students to study and get achievements in the Olympiads of different levels, which is based on the teambuilding, planning (we suggest the modular system of studying the necessary topics together with scheduling fixed hours of work with the teacher, team members and autonomously) and constant involvement in different competitions and events connected to physics Olympiad;
- 3) Training process itself, which includes not only students' mechanic solving of different kinds of physics problems, but developing their problem solving and argumentation skills together with students' autonomy, persistence and time and stress management.

In conclusion it is necessary to notice that only collaboration of parents, school, subject teacher and Olympic student himself / herself can lead to success as lack of collaboration and support on behalf of one of the parties may cause stress and demotivation to the student. Most responsibility for Olympic students' achievements is placed on the subject teacher as he / she should be motivator, facilitator, tutor, assessor and planner at the same time. Although each student has particular learning style and habits and obviously should have personal training path, we think that the stages of Olympic students' selecting and training suggested above will help to train students in a more systematic and effective way.

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## ДАРЫНДЫ БАЛАЛАРДЫ ФИЗИКА ПӘНІ БОЙЫНША ПӘНДІК ОЛИМПИАДАҒА ДАЙЫНДАУДЫҢ НЕГІЗГІ ПРИНЦИПТЕРІ

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Бұл мақалада автор дарынды балалармен, атап айтқанда, пәндік олимпиадаларға қатысуға дайындалатын оқушылармен жұмыс істеудің негізгі принциптерін қарастырады. Қазіргі уақытта пәндік олимпиадаларға бұрынғыға қарағанда азырақ мән беріледі. Алайда, олар білім беру мен адами капиталды дамыту бойынша мемлекеттің ұзақ мерзімді және қысқа мерзімді мақсаттарына жетуде үлкен рөл атқарады, өйткені олар студенттердің құндылықтар жүйесін, ХХІ ғасыр дағдыларын дамытуға көмектеседі және элементтік білім беру аренасында Қазақстанды танытады. Сонымен, олимпиадалық қозғалысты олимпиадалық оқушылармен жұмыс жасаудың ең жақсы тәсілдерін көрсететін ғылыми-зерттеу дәлелдерінің негізінде дамыту керек. Физика олимпиадасына студенттерді табысты дайындауға ықпал ететін негізгі факторлар, дағдылар мен қабілеттер қарастырып, олимпиада оқушыларын даярлау жөніндегі отандық және шетелдік ғалымдардың ұсыныстарын ескеріп, «Білім-инновация» мектептеріндегі физика олимпиадаларына оқушыларды дайындаудың 20 жылдық тәжірибесін талдап, авторлар физика олимпиадасына оқушыларды дайындаудың өзіндік әдісін ұсынады. Осы әдіс авторларын жұмыс істейтін білім беру ортасы үшін тиімді болып дәлелденді.

*Түйін сөздер:* физика пәні олимпиадасы, дарынды балалармен жұмыс, оқушыларді олимпиадаға дайындау, олимпиадашыларды даярлау принциптері

## ОСНОВНЫЕ ПРИНЦИПЫ ПОДГОТОВКИ ОДАРЕННЫХ ДЕТЕЙ К УЧАСТИЮ В ПРЕДМЕТНОЙ ОЛИМПИАДЕ ПО ФИЗИКЕ

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В данной статье авторы рассматривают основные принципы работы с одаренными детьми, в частности, с теми, кто готовится к участию в предметных олимпиадах. К сожалению, на данный момент предметным олимпиадам в нашей стране уделяется все меньше внимания, однако, по нашему мнению, они играют важную роль в достижении как краткосрочных, так и долгосрочных целей в развитии человеческого капитала и сфере образования, так как они способствуют развитию моральных ценностей учащихся, навыков, необходимых в 21 веке, а также созданию положительного имиджа Казахстана в сфере образования на мировой арене. В связи с этим, олимпиадное движение должно развиваться на основе фактов, полученных в результате исследований и наблюдения работы с участниками предметных олимпиад. Рассмотрев основные факторы, навыки и умения, способствующие успешной подготовке учащихся к олимпиаде по физике, а также на основе анализа более чем двадцатилетнего опыта подготовки студентов к различным олимпиадам по физике на базе лицеев «Білім инновация», авторы предлагают свою методику подготовки учащихся к данной предметной олимпиаде, которая подтвердила свою эффективность в условиях образовательной среды, в которой работают авторы.

**Ключевые слова:** предметная олимпиада по физике, работа с одаренными детьми, подготовка учащихся к олимпиаде, принципы работы с олимпиадчиками

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