

# Informatics Olympiads in Kazakhstan: Team Selection and National Olympiads in Informatics

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**Abstract.** Improving education is one of the main reasons for modern society. Therefore, subject Olympiads make it possible to identify talented schoolchildren and students to improve the quality of education. The National Olympiads of schoolchildren in informatics, which are held annually, allowing gifted students to demonstrate a high level of training in subjects and contribute to the development of mental and creative abilities. The main goals and objectives of the Olympiad in Kazakhstan are the promotion of scientific knowledge and the development of students' interest in scientific activity, the creation of the necessary conditions for identifying gifted children, their further intellectual development, the selection and preparation of students to participate in international Olympiads, support with the choice of specialty when entering universities, increasing the prestige of education in the Republic of Kazakhstan. This article describes the current model of organizing Informatics Olympiads in Kazakhstan: steps, team selection (national and international olympiads), and evaluation. **This paper also includes the comparison with Informatics Olympiad organization procedure of Slovakia and Hungary.**

**Keywords:** IOI, olympiad in informatics, teaching programming.

## Introduction

Kazakhstan began active participation in the IOI in Portugal in 1998 with 4 participants. The Republican Scientific and Practical Center «Daryn» (Republican Scientific and Practical Center "Daryn") of the Ministry of Education and Science (Ministry of Education and Science of the Republic of Kazakhstan) is responsible for organizing and selecting National Computer Science Olympiads for secondary school students. The Republican Scientific and Practical Center "Daryn" (RNPC "Daryn") supports the organizational structure of the Olympiads in Kazakhstan not only in computer science, but also in other areas, such as biology, physics, chemistry, mathematics. The annual 27th International Olympiad in Informatics (IOI-2015) was held in Almaty on the basis

of Al Farabi Kazakh National University from July 26 to August 2, 2015. 324 people from 83 countries took part in the competition.

Kazakhstan is the second state among the CIS countries after Belarus, which has received the right to host the International Olympiad of Schoolchildren in Informatics.

In the following sections of this report, we will describe in detail the entire workflow of organizing for the Informatics Olympiads in Kazakhstan. We also provide statistics of medals for the last 23 years of the Kazakh IOI team.

## 1. Work Related

Nikhazy and Zsako (2020), in their paper, presented information about team selection, national informatics competitions, and training in Hungary. They also provided an overview of competitions in application development and usage, computational thinking and robotics.

Makieva *et al.* (2017) analyzed different problems and ways of improvement for Informatics activities in Kyrgyzstan. Researchers described The Contest Management System and suggested that it will improve the performance of students.

Forisek (2007) described olympiad preparation, team selection of Slovakian students and other important activities such as international cooperation.

In Gomel, students who prepared for the olympiad in Informatics practiced in courses such as “Programming-professionals (individual and collegiate),” “Preparing for IOI,” “Methods of algorithmization,” “Basic programming,” “Informatics” and learned different tasks based on various programming languages (Dolinsky, 2016, p. 241).

According to Iglikov *et al.* (2013) the important factor of Kazakhstani students’ success is the participation in various International competitions and camps, among them researchers emphasized the Summer school of computing for secondary school students (Summer School of Computing), Petrozavodsk training camps for high school students (Petrozavodsk Training Camps), and E. Pankratiev Open Team Programming Collegiate Cup (E. Pankratiev Open Team Programming Collegiate Cup), all these events in Russia.

Kiryukin and Tsvetkova (2011, p. 45) claim that participation in programming competitions is significant because it has many positive aspects such as persistence and the ability to sustain pressure. Olympiad preparation is an extracurricular activity, and this involvement of students relates positively to school engagement (Frederick and Eccles, 2005, p. 516). This activity is generally organized in groups and relates to the cooperative learning method, which positively influences students’ social skills (Lavasani *et al.*, 2011, p.1803). Amaroli *et al.* (2018, p.133) suggest fostering Computer science education through teams olympiads.

## 2. Educational Olympiads in Kazakhstan

Every year, the Olympiad is held throughout the academic year in four stages by the relevant educational authorities for each general education subject among students of grades 9–11 (Fig. 1):

- 1) The first (school) stage is held no later than November 30 of the current academic year in secondary education organizations according to the tasks prepared by the education authorities of the district (city).
- 2) The second (district/city) stage is carried out by the educational authorities of the district (city) at the district or city level.
- 3) The third (regional) stage is carried out by the education departments of the regions, the cities of Astana, Almaty and Shymkent, republican educational organizations, the autonomous educational organization “Nazarbayev Intellectual Schools” (hereinafter – AOO NIS) and the Non-profit joint-stock Company “Physics-Mathematics State School” (hereinafter – NAO “PMSS”).
- 4) The fourth (republican) stage is held with the division of subjects of natural-mathematical and social-humanitarian directions in different regions of the republic.

The works of the participants at all stages of the Olympiad are provided to the jury in advance in encrypted and scanned form. The evaluation of the works by the jury members is provided in accordance with the evaluation criteria developed by the organizing committees. The results of the evaluation of works at the end of each stage are transmitted by the organizing committee.

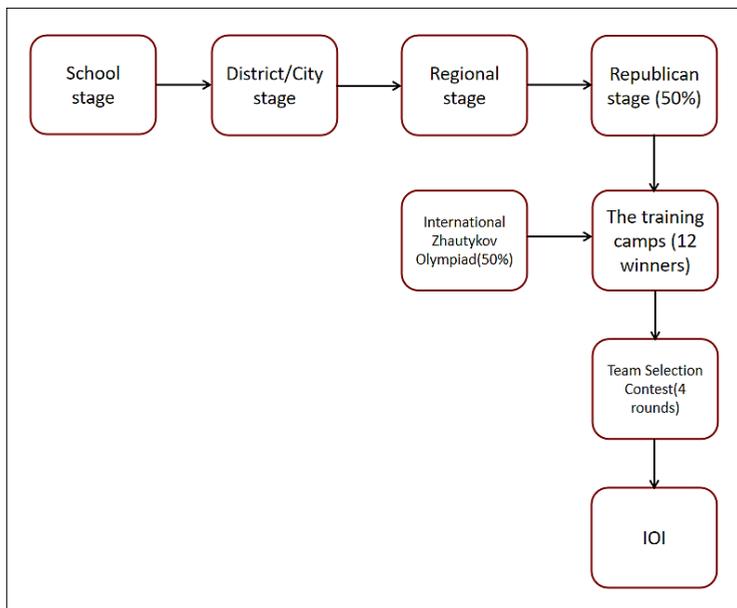


Fig. 1. Stages of Republican Olympiad in Informatics.

### 2.1. *International Zhautykov Olympiad*

The International Zhautyk Olympiad in Mathematics, Physics and Computer Science for students of specialized schools (hereinafter referred to as the Olympiad) is held annually in the second decade of January on the basis of the Non-profit Joint Stock Company “Physics-Mathematics State School” (hereinafter referred to as “PMSS”) in Almaty, Republic of Kazakhstan. The goals and objectives of the Olympiad are: creation of optimal conditions for identifying gifted schoolchildren, their further intellectual development and professional orientation, dissemination and popularization of physical, mathematical and IT knowledge among schoolchildren, development of international cooperation with physical and mathematical schools of various countries.

#### *Participants of the Olympiad*

Teams of schools of Kazakhstan and foreign countries from specialized physics and mathematics lyceums and gymnasiums and other schools are invited to the Olympiad. Several schools from the same country can participate in the Olympiad.

Each team should consist of 7 participants: 3 participants in mathematics, 2 in physics and 2 participants in computer science and 1 or 2 supervisors (physicist, mathematician, computer scientist) who speak one of the three official languages of the Olympiad: Kazakh, Russian or English. The participation of school teams in incomplete composition is allowed.

According to the results of the Republican Olympiad of schoolchildren in the subjects of the natural and mathematical direction, twenty-one teams of the Republic of Kazakhstan are determined to participate in the Olympiad. The list of teams is approved by the organizing committee of the Olympiad in coordination with the The Republican Scientific and Practical Center «Daryn».

## **3. International Olympiads**

International Olympiads of schoolchildren in Informatics are intellectual competitions for high school students (9th–11th grade) from different regions of the world. Each country is represented by a team of 4–6 people – winners of national Olympiads. When drawing up assignments, the diversity of world educational standards is taken into account. For a successful performance, in addition to knowledge, non-standard thinking and a creative approach to solving problems are required. Each Olympiad is a separate competition, with its own organizers, rules of conduct and an award system. International Olympiads in which Kazakhstan participates:

- International Olympiad in Informatics (IOI).
- International O. Zhautykov Olympiad in Mathematics, Physics and Informatics for students of specialized schools.
- International Junior Science Olympiad (IJSO).

- International Olympiad for schoolchildren “Tuymaada” in mathematics, physics, chemistry, informatics.
- Central European Olympiad in Informatics (CEOI).
- European Junior Olympiad in Informatics (EJOI).
- Eurasian Olympiad in Informatics (for the SCO countries).

#### 4. Team Selection for IOI Participation

*Criteria for the selection of applicants for participation in training camps for participation in the international Olympiad in the subject of informatics.*

Formation of the composition of the participants in the training camps of the Olympic reserve: Based on the results of the participation of schoolchildren in the final stage of the Republican Olympiad for schoolchildren, the composition of the training camps is formed. The training camp includes 12 winners and prize-winners of the Republican Olympiad (awarded with diplomas of the first, second and third degrees) students of grades 9–10–11 (12) (Olympiad tasks are the same), who scored the most points. Applicants are selected by the sum of points for the Republican Olympiad and the International Zhautykov Olympiad (Table 1). The number can be increased if several participants scored the same number of points.

Selection to the national team for participation in the IOI: for the qualitative selection of the national team for the IOI, 4–5 intermediate olympiads will be held at the qualifying training camps (Table 2). The level of complexity of the Olympiads at the training camps is identical to the level of the IOI tasks, and the quality of the tasks is superior to the International Zhautykov Olympiad and the Republican Olympiad. Each olympiad will consist of 3 tasks.

Table 1  
Formation of the composition of the participants in the training camps of the Olympic reserve

№	Full name of the participant	Grade	Results		Total
			The Republican Olympiad of schoolchildren	The International Zhautykov Olympiad	
			50%	50%	100%

Table 2  
Selection to the national team for participation in the IOI

№	Full name of the participant	Grade	Results				Total
			1 round	2 round	3 round	4 round	
			25%	25%	25%	25%	

## 5. Review of Informatics Olympiad Organization Procedure in Slovakia and Hungary

Olympiad organization procedure and team selection of Kazakhstan and Slovakia is slightly similar, but different from Hungary.

### *Slovakia.*

According to The Ministry of Education of the Slovak Republic, the Olympiad in Informatics at the national level is provided by a national commission called the Slovak Olympiad in Informatics (SK OI). The Slovak national Olympiad in Informatics (OI) has two categories: A and B. Only those students who do not graduate from high school this or the next school year may join Category B. All students (primary and secondary) can take part in category A. Category B has two rounds: domestic and regional. Category A consists of three rounds:

- (1) **Home round** – organized by local teachers in schools. For each task of the home round, you can get from 0 to 10 points.
- (2) **Regional round** – Slovakia has 8 regions for this round. Each region has chairmen of regional commissions. After the solution is corrected, the coordination of scoring scales will take place, the result sheets will be merged into one nationwide, and according to her, approximately the top 30 solvers are invited to the national round.
- (3) **National round** – the final round which consists of two days. Participants solve theoretical problems on the first day and practical problems on the second day.

Top 10 winners will be invited to the weekly qualifying camps. And based on their results, SK OI will select teams to participate in the International Olympiad in Informatics (IOI) and the Central European Olympiad in Informatics (CEOI).

From 1993 till now, in IOI, the Slovak team has 102 medals: 25 gold, 43 silver, 34 bronze.

### *Hungary.*

Hungary is one of the first countries to participate in the IOI since 1989. According to John von Neumann Computer Society (NJSZT), the Hungarian national team for IOI-CEOI is selected after the conduction of 6 stages. The following competitions can participate in the qualifying competition of the International Student Olympiad in Computer Science (IOI):

- (1) National High School Education Competition in Informatics (OKTV) – first 15–20 places.
- (2) International programming competition Noble Tihamér – first 3–7 places in 10th grade.
- (3) Olympic qualifying competition (previous academic year) – 4–6 participants.
- (4) Izsák Imre Gyula Competition – winner, winner in the field of information technology.
- (5) Dusza Árpád Memorial Programming Contest – members of the winning team.

A member of the IOI Olympic team automatically becomes a participant who won a gold medal at the Olympic Games last year (CEOI, IOI). A member of the CEOI Olympic team automatically becomes a participant who won a gold medal at the previous year's Olympic Games (CEOI) if he or she is a student up to the 11th grade. Qualification Competition for selecting Hungarian team for the International Informatics Olympiad is intensive and consists of 6 rounds where students have to solve 18 problems in 3 days (Nikhazy and Zsako, 2020).

Stages of the qualifying competition for IOI-CEOI:

Stage 1 of the competition – with the participation of 30–40 competitors.

Stage 2 of the competition – with the participation of 30–40 competitors.

Stage 3 of the competition – with the participation of 20–25 competitors.

Stage 4 of the competition – with 15–20 competitors.

Selection of 6–6 Olympic team candidate candidates.

Stage 5 of the competition – with 6–12 competitors.

Stage 6 of the competition – with 6–12 competitors.

Selection of 4–4 Olympic team members.

Before the third day of the competition, participants will take part in online training. The official result is determined by the Competition Commission before the start of the current round.

As a result, for all the years of participation since 1989, participants from Hungary have won 13 gold, 36 silver, 46 bronze medals.

## Conclusion

Kazakhstan has been participating in the IOI since 1998 and has good achievements. At the moment, Kazakh IOI teams have won a total of 61 medals (gold 3, silver 21, and bronze 37). The stages of team selection (republican and international Olympiads) are described and compared with Hungary and Slovakia. However, some issues with the Informatics Olympiads promotion exist and actions should be taken to spread essential knowledge of Informatics by involving more students and schools.

Table 3  
Performance in IOI

Year	IOI Host	Medals			Total
		Gold	Silver	Bronze	
1998	Portugal				
1999	Turkey			1	1
2000	China				
2001	Finland			2	2
2002	South Korea				

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Year	IOI Host	Medals			
		Gold	Silver	Bronze	Total
2003	USA			1	1
2004	Greece		1	2	3
2005	Poland			3	3
2006	Mexico		1	3	4
2007	Croatia	2	1	1	4
2008	Egypt		2		2
2009	Bulgaria			2	2
2010	Canada			3	3
2011	Thailand		1	3	4
2012	Italy		3		3
2013	Australia			1	1
2014	Taiwan		2	1	3
2015	Kazakhstan		3	1	4
2016	Russia		3	1	4
2017	Iran		1	3	4
2018	Japan		1	3	4
2019	Azerbaijan	1	1	2	4
2020	Singapore		1		1
2021	Singapore			4	4
<b>Total</b>		<b>3</b>	<b>21</b>	<b>37</b>	<b>61</b>

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